

# **Getting Started with Synergy/DE**

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# Preface

## About this manual

*Getting Started with Synergy/DE* provides a technical overview of all components of Synergy/DE®, as well as a task-oriented “cookbook” for using Synergy/DE. It walks you through the steps required to develop a basic Synergy™ application—and tells you what else you can do and where to get more information if you want to go beyond the basics.

Because we assume that you are familiar with programming in some language, this guide does not cover basic principles of programming. Instead, it includes language features specific or integral to developing in Synergy/DE.

## Manual conventions

Throughout this manual, we use the following conventions:

- ▶ In code syntax, text that you type is in `Courier` typeface. Variables that either represent or should be replaced with specific data are in *italic* type.
- ▶ Optional arguments are enclosed in *[italic square brackets]*. If an argument is omitted and the comma is outside the brackets, a comma must be used as a placeholder, unless the omitted argument is the last argument in a subroutine. If the comma is inside the brackets and an argument is omitted, the comma may also be omitted.
- ▶ Arguments that can be repeated one or more times are followed by an ellipsis...
- ▶ A vertical bar (|) in syntax means to choose between the arguments on each side of the bar.
- ▶ Data types are **boldface**. The data type in parentheses at the end of an argument description (for example, (n)) documents how the argument will be treated within the routine. An **a** represents alpha, a **d** represents decimal or implied-decimal, an **i** represents integer, and an **n** represents numeric (which means the type can be **d** or **i**).

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### WIN

- ▶ Items or discussions that pertain only to a specific operating system or environment are called out with the name of the operating system.
-

### Other resources

- ▶ *Repository User's Guide*
- ▶ *Synergy DBL Language Reference Manual*
- ▶ *Synergy Tools*
- ▶ *Environment Variables & System Options*
- ▶ *UI Toolkit Reference Manual*
- ▶ *Installation Configuration Guide*
- ▶ *xfNetLink & xfServerPlus User's Guide*
- ▶ Professional Series Workbench online Help system
- ▶ S/DE Composer online Help system

### Product support information

If you cannot find the information you need in this manual or in the publications listed above, you can reach the Synergy/DE™ Developer Support department at the following numbers:

800.366.3472 (in the U.S. and Canada)

916.635.7300 (in all other locations)

To learn about your Developer Support options, contact your Synergy/DE account manager at one of the above phone numbers.

Before you contact us, make sure you have the following information:

- ▶ The version of the Synergy/DE product(s) you are running
- ▶ The name and version of the operating system you are running
- ▶ The hardware platform you are using
- ▶ The error mnemonic and any associated error text (if you need help with a Synergy/DE error)
- ▶ The statement at which the error occurred
- ▶ The exact steps that preceded the problem
- ▶ What changed (for example, code, data, hardware) before this problem occurred
- ▶ Whether the problem happens every time and whether it is reproducible in a small test program
- ▶ Whether your program terminates with a traceback, or whether you are trapping and interpreting the error

## Reporting Synergy .NET issues

If you are having any of the following problems, please send us the complete set of source files to re-create the issue, and send us the information in the **BuildVersion.txt** files in the \MSBuild\Synergex\dbl and \Synergex\SynergyDE\dbl directories in “Program Files” or “Program Files (x86)”.

- ▶ Visual Studio lock up or crash
- ▶ Compiler crash
- ▶ Unusual MSIL Assembler (**ilasm.exe**) issues
- ▶ “Invalid program” errors
- ▶ “JIT Compiler has encountered an internal limitation” error at runtime

For Visual Studio issues, zip the entire project.

Note that for untrapped errors, you won’t get a traceback, as you would with traditional Synergy. Instead, you’ll get the Windows Dr. Watson box. And if you click Debug, you’ll go into the debugger. If the program was not built with debug information, and you instead click Cancel, you’ll get a traceback.

## Synergex Professional Services Group

If you would like assistance implementing new technology or would like to bring in additional experienced resources to complete a project or customize a solution, Synergex® Professional Services Group (PSG) can help. PSG provides comprehensive technical training and consulting services to help you take advantage of Synergex’s current and emerging technologies. For information and pricing, contact your Synergy/DE account manager at 800.366.3472 (in the U.S. and Canada) or 916.635.7300.

## Comments and suggestions

We welcome your comments and suggestions for improving this manual. Send your comments, suggestions, and queries, as well as any errors or omissions you’ve discovered, to [doc@synergex.com](mailto:doc@synergex.com).



# 1

## What Is Synergy/DE?

Welcome to Synergy/DE version 10, the next generation of Synergy tools designed with programmer productivity and flexibility in mind.

### **What Is Synergy/DE? 1-2**

Defines the underlying philosophy and advantages of developing in Synergy/DE.

### **Elements of Synergy/DE 1-4**

Briefly describes each component of Synergy/DE.

### **Developing an Application 1-7**

Illustrates the products and steps you can use to create a Synergy application.

### **Using the Documentation 1-9**

Describes the reference manuals, user's guides, and online Help that are included with the Synergy/DE products.

# What Is Synergy/DE?

Synergy/DE is a full suite of development tools that provides everything you need to create powerful, event-driven business applications. It includes tools to write and process your applications, design and support your user interface, manage your data from one central location, and create comprehensive reports.

## An underlying philosophy

If you were building a house, you would need many tools, ranging from the very powerful to the very basic. Having these tools readily available would reduce the time and maximize the efficiency with which you could complete the job. This same principle applies to developing a business application: Well-chosen, accessible tools make the job a lot easier. Using the right tool for the right job is the fundamental philosophy of Synergy/DE.

Using Synergy/DE, you can focus most of your resources on your vertical or custom application, because Synergy/DE takes care of your systems-level development.

## Advantages of Synergy/DE

Synergy/DE enables you to

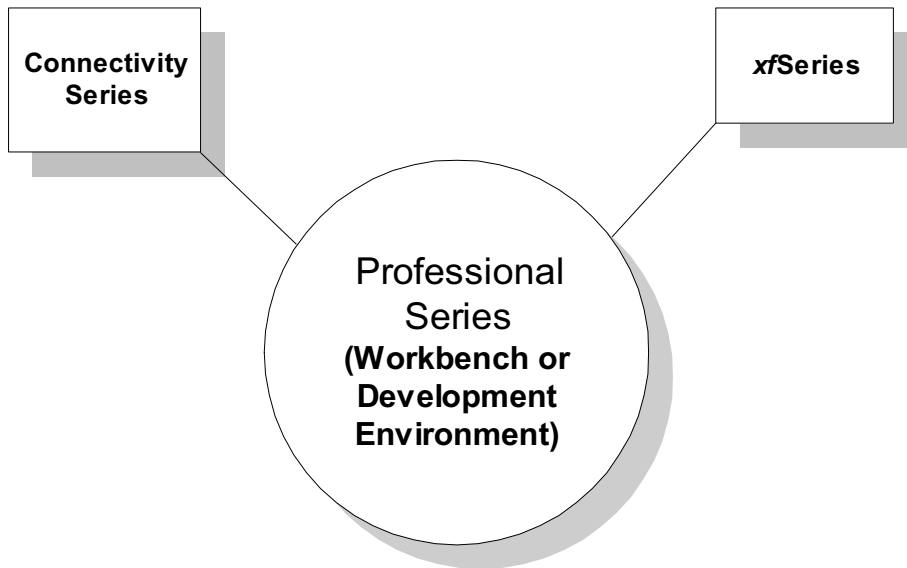
- ▶ take advantage of one of the most highly scalable distributed technologies. Unique Synergy multi-tier technology enables you to scale your application from one stand-alone machine to an enterprise-wide system hosting thousands of users.
- ▶ open your Synergy business logic and data to a variety of thin client technologies. Using Synergy/DE xfNetLink and xfServerPlus, you can build distributed solutions that enable web browsers, Visual Basic .NET front-end applications, ASP.NET, Java, or Synergy thin clients to access Synergy routines and database files.
- ▶ maintain database independence. Third-party applications can access your Synergy data, and your Synergy application can access popular, third-party SQL databases.
- ▶ easily create and maintain your application. “Draw” and maintain user interface elements in a visual environment. Easily add new features to accommodate your customers’ changing needs. Quickly customize and localize your user interface.
- ▶ keep your applications portable. Develop your applications in any environment—Windows, virtually all UNIX platforms, OpenVMS—and in most cases deploy in other environments by simply relinking.
- ▶ save time. Save development and maintenance time by creating and reusing object and executable libraries. Call routines or share information with applications written in other languages.
- ▶ use functional depth. Develop complete applications by working only at the high level, such as in Composer or by calling environment-supplied subroutines, or drop down to the core level where you have complete flexibility to customize all aspects of your application.



- ▶ manage the development process. Eliminate duplication of work by reusing supplied and custom libraries and centralizing all data definitions where the entire development team can access them and ensure consistency between efforts.
- ▶ reduce maintenance. Centralizing data definitions and libraries means that changes can be made in one central location rather than throughout thousands of lines of codes.

# Elements of Synergy/DE

The following Synergy products comprise Synergy/DE:



*Figure 1-1. The components of Synergy/DE.*

## Professional Series

Both Professional Series Workbench and Professional Series Development Environment include the components listed below. In addition, Professional Series Workbench provides an interface that not only launches all of these components but features a Synergy DBL–sensitive visual editor as well as project management tools. (Professional Series Workbench is only available on Windows.)

### UI Toolkit

UI Toolkit gives you all you need to create your application's user interface, including an extensive set of subroutines to handle your environment maintenance and menu, input, text, selection, and list processing.

## Composer (Windows only)

Composer is an interactive user-interface design tool. You “draw” windows and input windows just the way you like, graphically assigning properties that are immediately reflected on your screen, and Composer generates the appropriate script commands to define your objects. Composer also accepts predefined input windows and fields from Repository, so you can view and modify them graphically.

## Repository

Repository is the tool you use to define and maintain the data that will be used in your application or in reports that can be created with Synergy/DE ReportWriter or xfODBC. It provides a method of managing data structures and fields in one centralized location, so that you can modify a field throughout your application simply by changing one definition in your repository.

## Synergy DBL

Synergy DBL is a high-level business programming language that encourages structured, system-independent, modular code. Beyond the basic statements that specify processing to be performed, Synergy DBL includes a large number of prewritten external subroutines and functions, a source-level debugger, graphical user interface support, and a fast and efficient system-independent file structure.

## Synergy DBMS

The Synergy DBMS system includes everything needed to create and manage high-speed, keyed access and ordered sequential access databases.

## ReportWriter

ReportWriter is an end-user application that retrieves, integrates, and consolidates data into columnar, ad hoc reports. You can customize and include ReportWriter as part of your application, either predefining reports for your customers to run or enabling them to design their own reports.

## Synergy Runtime

Synergy Runtime supports the actions requested by your Synergy/DE applications during execution.

## Connectivity Series

### SQL Connection and Synergy database drivers

SQL Connection is Synergy/DE's SQL API that works in conjunction with the appropriate database driver to enable a Synergy application to access SQL data sources (typically RDBMSs).

Synergy/DE provides database drivers that enable SQL Connection access to popular databases such as Oracle and SQL Server.

### SQL OpenNet

SQL OpenNet provides the middleware needed if your Synergy SQL application will be accessing remote RDBMSs (residing on a remote computer on your network).

### xfODBC

xfODBC opens Synergy DBMS data to any third-party, 32-bit ODBC application. It supports version 2.5 of the ODBC API (level 1) and uses SQL OpenNet for remote data access.

## xfSeries

### xfServer

xfServer processes network client requests for Synergy DBMS data. Residing on the same computer as the Synergy databases, the server can serve data to any Synergy application running with a Synergy runtime (version 6.1 and higher).

### xfServerPlus

xfServerPlus handles the remote execution of Synergy routines. in conjunction with xfNetLink.

### xfNetLink

xfNetLink provides three methods for accessing Synergy logic:

- ▶ xfNetLink Synergy Edition, which is a set of routines that work in conjunction with xfServerPlus to execute Synergy routines stored on a remote machine
- ▶ xfNetLink Java Edition, which works in conjunction with the Java™ programming language
- ▶ xfNetLink .NET Edition, which works in conjunction with Microsoft's .NET Framework

## Developing an Application

Figure 1-2 illustrates how you can use Professional Series to develop your application.

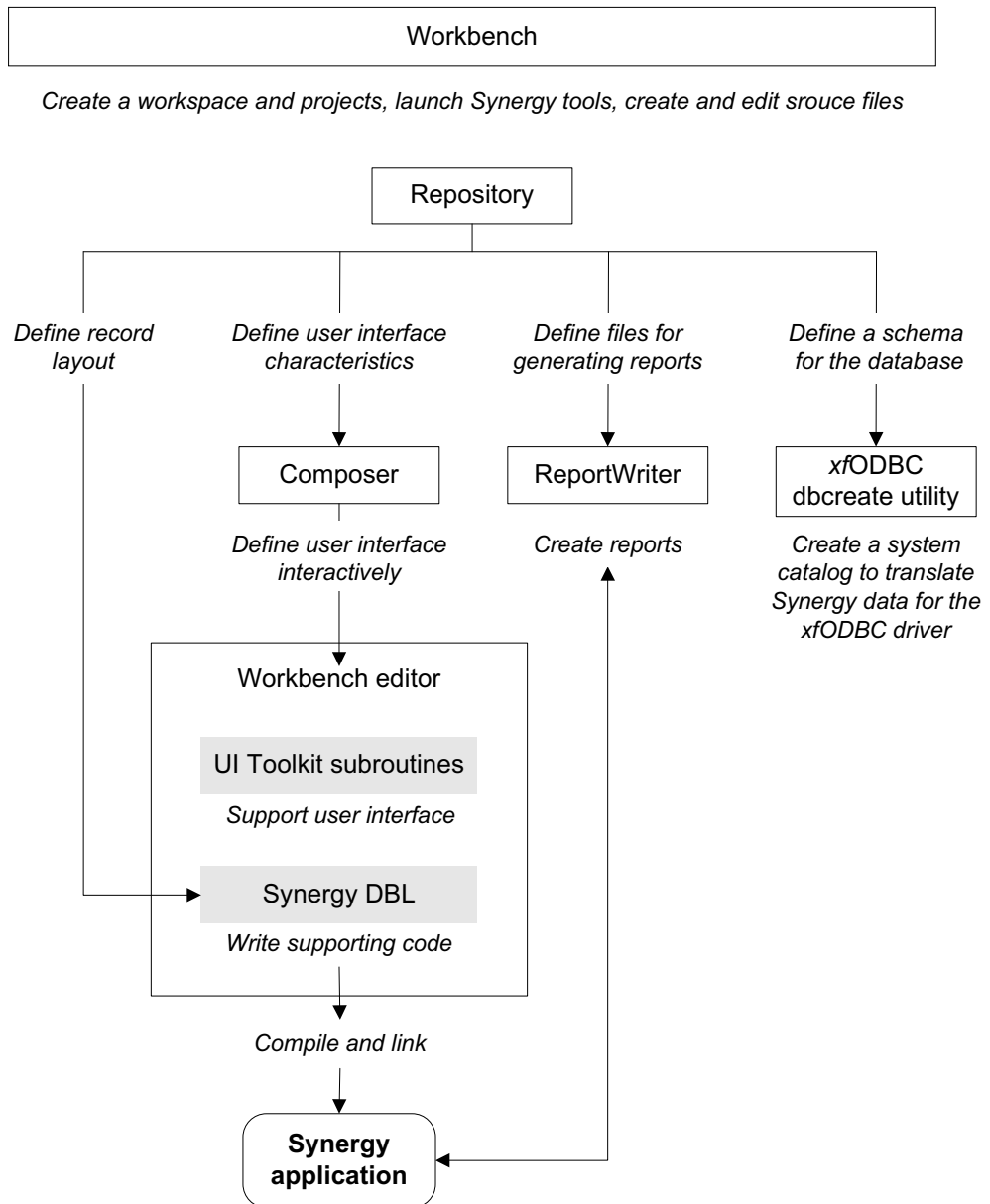


Figure 1-2. Developing an application with Synergy/DE.

### Developing a distributed application

Synergy/DE also provides the capability to design and deploy your Synergy application in two-tier or multi-tier systems. See [chapter 9, “Accessing Logic Remotely with xfServerPlus.”](#) The *xfNetLink & xfServerPlus User’s Guide* provides additional information about building a distributed computing system.

# Using the Documentation

## Getting Started with Synergy/DE

This manual is primarily intended for experienced developers who are new users of Synergy/DE tools. It provides a technical overview of all components of Synergy/DE, as well as a task-oriented “cookbook” for developing with Professional Series. Like a tutorial, this guide walks you through the basic tasks (illustrated in [figure 1-2](#)) that you will perform as you develop your Synergy application. It also discusses client/server, web, and .NET development.

## Online Help

Composer has a complete online Help system, including context-sensitive help. The Composer Help system provides online instructions for performing any task in Composer. You can search for information about any topic and then display that information, with hypertext links to additional, related information, on the screen. The context-sensitive help informs you to how to proceed from the current point or defines your current options. Workbench also has an online Help system, as do many of the Synergy/DE utilities.

## Synergy/DE reference manuals and user’s guides

Here’s a list of other manuals that will assist you in using Synergy products:

- ▶ *Synergy DBL Language Reference Manual*  
Describes the syntax of all statements, functions, subroutines, compiler directives, utilities, and environment variables included in Synergy DBL. Also documents other DBL features, such as program organization, expressions, indexed sequential access method (ISAM), system options, compiler and runtime errors, the message controller, and the debugger.
- ▶ *Synergy Tools*  
Describes the programming tools that are used with Synergy DBL: the compiler, linker, librarian, and runtime; the debugger; the Synergy DBMS file management system; and general utilities. Also documents the Synergy DBL error messages.
- ▶ *Environment Variables & System Options*  
Lists and discusses all of the environment variables and system options available in Synergy/DE.
- ▶ *UI Toolkit Reference Manual*  
Describes the syntax of all Toolkit subroutines and utility programs, which are used to create and maintain state-of-the-art user interfaces.

## What Is Synergy/DE?

Using the Documentation

- ▶ *Repository User's Guide*

Explains how to define data in Repository and describes its utility functions. Also describes the syntax of Synergy Data Language statements and Repository information-retrieval subroutines.

- ▶ *ReportWriter User's Guide*

Explains how to use ReportWriter to access and organize your data into useful reports. Includes a tutorial and describes the ReportWriter utility functions.

- ▶ *SQL Connection Reference Manual*

Describes how to access SQL databases from Synergy applications.

- ▶ *Professional Series Portability Guide*

Discusses the functions, requirements, and processes that are unique to each of the platforms on which Synergy/DE runs, so that you can design your application to be as portable as possible.

- ▶ *xfODBC User's Guide*

Describes how to access Synergy databases from ODBC applications.

- ▶ *Installation Configuration Guide*

Provides information about using License Manager to license your Synergy products, configuring a client/server system with xfServer, and installing and configuring Connectivity Series products. Also includes general information on Synergy/DE installation and operating system requirements.

- ▶ *xfNetLink & xfServerPlus User's Guide*

Describes how to build a distributed Synergy application with a Synergy, Java, or .NET front-end that enables you to access Synergy routines and data remotely.

- ▶ *Synergy/DE Quick Migration Guide*

Describes the changes you need to make to your code when upgrading to the latest version of Synergy/DE.



# 2

## Developing Your Application in Workbench

This chapter introduces you to the Professional Series Workbench, a visual development environment that includes the Professional Series Development Environment toolset, an integrated launch pad that brings these tools together, Synergy DBL–sensitive code editing capabilities, and project management tools. Professional Series Workbench is only available on Windows.

### **What Is Professional Series Workbench? 2-3**

Defines Professional Series Workbench.

### **Where Do You Begin? 2-4**

Describes how to set up the startup environment and how to run Workbench.

### **Accessing Synergy/DE Tools 2-8**

Explains how to launch Synergy/DE tools from Workbench.

### **Setting Up Your Development Environment 2-9**

Describes the benefits of using workspaces and projects and explains how to create them.

### **Editing Synergy Code with the Workbench Editor 2-16**

Explains how to edit a file, automate code formatting and completion based on your own company style, display popup help for routine syntax, and work with documentation comments and tag files.

### **Generating Synergy Code Segments 2-27**

Describes how to use aliases and code templates to quickly generate Synergy DBL/UI Toolkit code for some of the more common code structures, including your own method routines.

### **Analyzing Your Code 2-33**

Describes the analysis tools that can help you identify which routines are called by a specified routine and which routines call a specified routine.

### **Compiling, Building, Running, and Debugging 2-36**

Describes how to compile, build, and run your project from Workbench, as well as how to customize compile, build, debug, and execute commands for individual projects.

### **Customizing Your Development Environment 2-38**

Discusses how to customize the way a project is opened, define script extensions other than **.wsc**, add your own commands to the Workbench menu, add or remove buttons from the Workbench toolbar, change the tagging delay or turn tagging off completely, access the version control tool of your choice, and copy or save your customization settings.

### **Using Workbench for Non-Windows Development 2-46**

Describes how you can use NFS-based mapped drives or FTP to make Workbench your primary editor on non-Windows systems.

## What Is Professional Series Workbench?

Professional Series Workbench is an enhanced version of the Professional Series Development Environment (PSDE). Workbench makes moving between Repository, Composer, and other Synergy/DE components easier as you develop your applications. Workbench's smart, fully customizable language-sensitive editor provides color coding, automatic indenting, standardized code templates, project tag capability for recognizing and accessing routine code, and many other code-automating features. It enables you to take advantage of automated script compiling and many other features that can streamline your development efforts.

In short, Workbench can help you spend less time writing and debugging, ensure standard coding practices, and speed your applications to market.



The Workbench editor is based on SlickEdit® technology from SlickEdit, Inc.

---

# Where Do You Begin?

## Starting Workbench

Depending on what version of Windows you're running, do one of the following:

- ▶ **On versions prior to Windows 8**, select Start > All Programs > SynergyDE > Workbench.
- ▶ **On Windows 8**, go to the Start screen and select the Workbench tile.
- ▶ **On Windows 8.1**, go to the Apps screen and select SynergyDE > Workbench.
- ▶ **On Windows 10**, from the Start menu, select All apps > SynergyDE > Workbench.

The Workbench desktop looks like this:

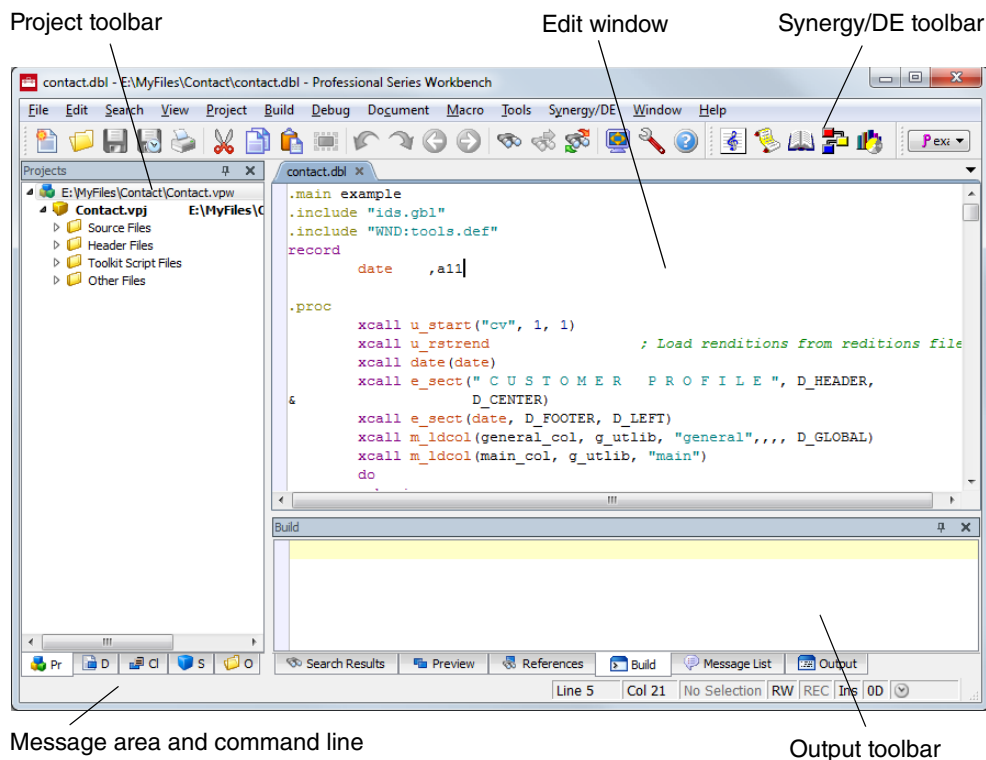


Figure 2-1. The Workbench desktop.

Running Workbench for the first time after installation runs the **update\_synergy** command, which initializes Workbench and creates the SlickEdit configuration directory, `C:\Documents and Settings\user\My Documents\My SlickEdit Config\version`, where *user* is the user name of the user who is currently logged in and *version* is the current version of SlickEdit in the format *x.x.x* (for example, 10.0.2).

## Defining the startup environment

Setting environment variables and initialization settings enables you to control program functionality externally without modifying your code. For a more complete discussion of the advantages of environment variables, refer to [“Referencing data indirectly” on page 5-18](#). For a list of all environment variables and initialization settings available to Synergy/DE and instructions on how to set them, refer to the [“Environment Variables”](#) chapter of *Environment Variables & System Options*.

You can define environment variables and initialization settings either in the environment, in the **synergy.ini** file, or in the Open tab of Workbench’s Project Properties dialog box. **Synergy.ini** is an initialization file that contains variables that affect the Synergy runtime and Synergy/DE development tools on Windows.

Variables are set in the following order:

- ▶ Globally, by selecting Start > Settings > Control Panel > System > Advanced > Environment Variables
- ▶ At a DOS prompt
- ▶ In the **synergy.ini** file (which is read when the project is opened)
- ▶ In the Open tab of the Project Properties dialog box (see [“Customizing the way a project is opened” on page 2-38](#)) or using **syn\_set** or **syn\_set\_global** on the Workbench command line (see [“Setting environment variables in Workbench” on page 2-6](#))

Environment variables set in the environment are available to Workbench when it is started. All appropriate initialization settings from the [synergy] section of **synergy.ini** are set in the order in which they are specified in **synergy.ini**. Settings in **synergy.ini** override any duplicate variables set at the environment level. We set the variables from the active **synergy.ini** when Workbench is started and again whenever a Synergy/DE project is opened. We restore the settings from the **synergy.ini** that was active when Workbench was started whenever a project is closed. Settings in a project’s Open tab are specific to that project.

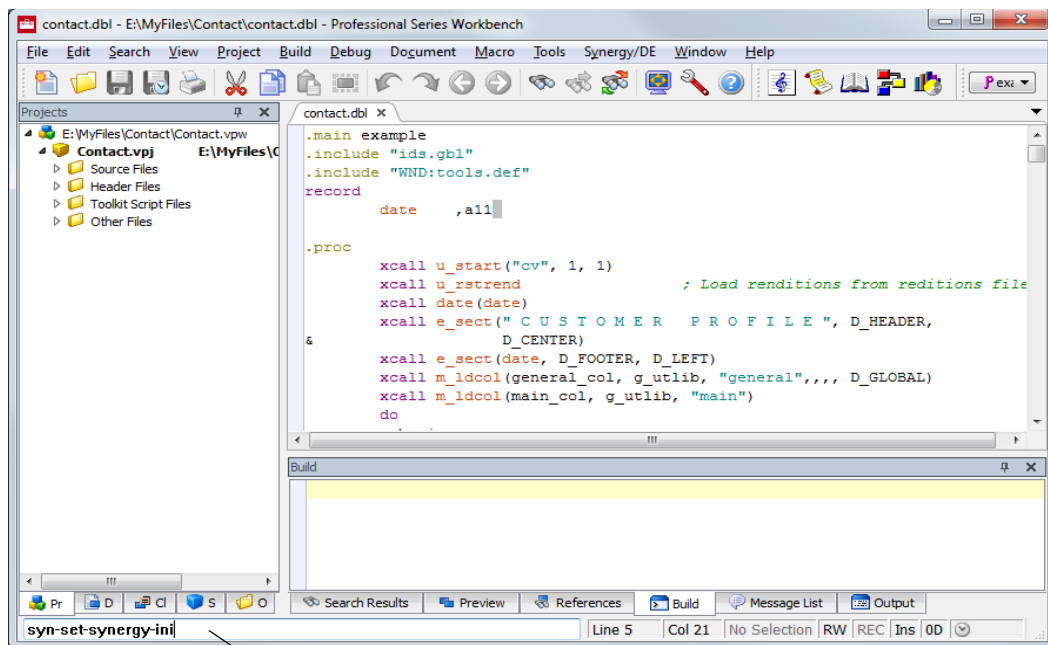
## Accessing the Workbench command line

Besides enabling you to set environment variables, the Workbench command line can be used to execute Workbench or operating system commands and to run other programs. You can display and move the cursor to the Workbench command line in one of two ways:

- ▶ With your cursor in the edit window, press ESC.
- ▶ Click in the message area at the bottom of the Workbench window. (See [figure 2-2.](#))

## Developing Your Application in Workbench

### Where Do You Begin?



Workbench command line

Figure 2-2. Typing at the Workbench command line.

## Setting environment variables in Workbench

To set an environment variable when a Synergy project is open,

- At the Workbench command line or in the Open tab of the Project Properties dialog box, enter the following command:

```
syn_set var=value
```

where *var* is the environment variable you want to set and *value* is the value you want to set it to. This command overrides any variable set globally, at a DOS prompt, or in **synergy.ini** while the current project is active. If *value* is empty, Workbench unsets *var* from the environment while the project is open. When the project is no longer active, the variable is unset (or reset to its original value if it was already set when Workbench was invoked).

To make Workbench load the environment variables from the [synergy] section of **synergy.ini** and then **synuser.ini**,

- ▶ At the Workbench command line or in the Open tab of the Project Properties dialog box, enter the following command:

```
syn_set_synergy_ini [path]
```

where *path* is the directory path to which the SFWINIPATH environment variable will be set. The environment variables will be loaded from the [synergy] section of the **synergy.ini** and **synuser.ini** files in that path. If *path* is not specified, Workbench uses the default path for **synergy.ini** and **synuser.ini** as defined in “[Setting Environment Variables and Initialization Settings](#)” in the “Environment Variables” chapter of *Environment Variables & System Options*. If **syn\_set\_synergy\_ini** is not called in the project’s Open tab, it will be called after all project open commands.



Environment variables set with **syn\_set** after **syn\_set\_synergy\_ini** is called are available in the environment for any command that Workbench spawns. Be aware, however, that the Synergy tools (**dbl**, **dblink**, etc.) may read the [synergy] section of **synergy.ini**, which will override settings made in the spawned environment when these tools are launched from Workbench. We recommend that you use **syn\_set** to add environment variables based on values in **synergy.ini**, instead of trying to override variables that are set in **synergy.ini**.



We do not recommend using the SlickEdit **set** command to change the value of an environment variable.

To reset your environment variables back to what they were when you opened the project,

- ▶ At the Workbench command line, enter the following command:

```
syn_init_proj filename
```

where *filename* is the name of a file that will list the environment variables and initialization settings after they are reset. See “[Accessing the Workbench command line](#)” on page 2-5 if you need help displaying the Workbench command line.

## Running Workbench on a Terminal Services machine or in a shared configuration

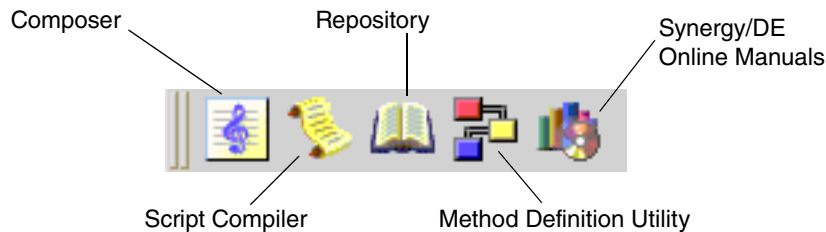
On a Terminal Services machine or in a shared configuration, the **update\_synergy** command only creates the SlickEdit configuration directory for the user who is currently logged in. For clients of a shared installation, it creates this directory on the client machine. For Terminal Services users, it creates this directory on the Terminal Services machine.

# Accessing Synergy/DE Tools

You can start the following tools from the Synergy/DE menu and/or toolbar:

- ▶ Composer
- ▶ Script
- ▶ Repository
- ▶ Method Definition Utility
- ▶ Synergy/DE Online Manuals

You can launch one of these applications (or to bring it to the forefront) by clicking the relevant toolbar button, as shown in [figure 2-3](#), or selecting it from the Synergy/DE menu.



*Figure 2-3. The Synergy/DE toolbar.*

When Composer is selected, if a Synergy/DE project is open and a script file is active, Composer is launched with that script file. If no script file is active, or no script files exist in the project, the Launch Composer dialog is displayed, where you can select an existing script or create a new script to edit in Composer.

The following utilities are available from the Utilities submenu:

- ▶ ActiveX Diagnostic utility
- ▶ Script-to-Repository Conversion utility
- ▶ File Extensions
- ▶ Synergy UI Toolkit Control Panel
- ▶ Method Definition Utility
- ▶ Synergy Type Library Configuration utility
- ▶ xfNetLink .NET Configuration utility
- ▶ SMC/ELB Comparison utility
- ▶ Variable Usage utility
- ▶ Synergy Prototype utility

Depending on what project type is open, additional utilities may be available from the Build menu.



# Setting Up Your Development Environment

## Understanding workspaces, projects, and configurations

A workspace is the top level structure in Workbench. It enables you to group related projects together and also to save the settings from your editing session. Context Tagging at the workspace level provides contextual help for routines and classes across projects. The data for each workspace is stored in a text file that has the extension **.vpw**.

Projects enable you to specify collections of files and build parameters that operate on those files. They facilitate tagging files, restoring edit sessions, compiling from Workbench, customizing builds, loading files, and managing version control, and they enable you to define environment variables specific to a project. We strongly recommend that you create a project if you want to use one or more of these features.

A configuration is contained within the project file. A project can have multiple configurations, each with different values for various project settings, to cause different tools and options to act upon the same set of working files depending on where or how those files are going to be used. The most common use of project configurations is to enable you to have debug and release versions of your project without defining two different projects. You might also require 32- and 64-bit configurations if your end user has concurrent 32- and 64-bit installations. All of these are included as part of your Workbench distribution, but you will need to customize the settings as described in [“Customizing a configuration” on page 2-14](#) if you want to use them effectively.

## Creating a workspace

Workspaces are usually created when you create a new project. At that time you have the option to create a new workspace for the project or add it to the current workspace, if one exists. See [“Creating a project” on page 2-10](#). The Create new workspace radio button in the Project tab of the New dialog must be selected, as shown in [figure 2-4 on page 2-11](#).

You can also create a workspace outside of a project, for example, if you intend to import existing projects or if you want a workspace to edit files that aren’t part of a project, but this isn’t very common.

## Opening a workspace

From the Project menu, select a recent workspace from the bottom section of the menu. If the workspace you’re looking for is not listed, select All Workspaces and then locate your workspace in the displayed submenu.

Creating a project



Projects created prior to 9.3.1 may not have access to all of the features mentioned in this chapter.

You can create several types of Synergy/DE projects in Workbench:

If you want the end result to be	Select this as the project type
One or more DBRs (multiple source files targeting one or more <b>.dbr</b> files)	Synergy/DE
A DBR (multiple source files and one or more ELBs and OLBs, built into a single <b>.dbr</b> file)	Synergy/DE Application
An ELB (multiple source files built in one executable library)	Synergy/DE Executable Library (ELB)
An OLB (multiple source files built in one object library)	Synergy/DE Object Library (OLB)
A COM type library	Synergy/DE COM Component
A Java JAR file	Synergy/DE Java Component
A .NET assembly	Synergy/DE .NET Component

For instructions on creating a Java or .NET component project, see the relevant section of the *xfNetLink & xfServerPlus User’s Guide*:

- ▶ [“Creating a Synergy/DE Java Component Project”](#) in the “Creating Java Class Wrappers” chapter
- ▶ [“Creating a Synergy/DE .NET Component Project”](#) in the “Creating Synergy .NET Assemblies” chapter



When developing for .NET, you’ll probably want to create one project for creating an assembly and one for creating an executable.

To create a regular Synergy/DE project, a Synergy/DE application project, or an executable or object library,

1. From the Project menu, select New. The Project tab of the New dialog box is displayed. (See [figure 2-4](#).)
2. Enter the desired information in each field and then click OK.



You cannot change the project type after the project has been created, so select your project type carefully.

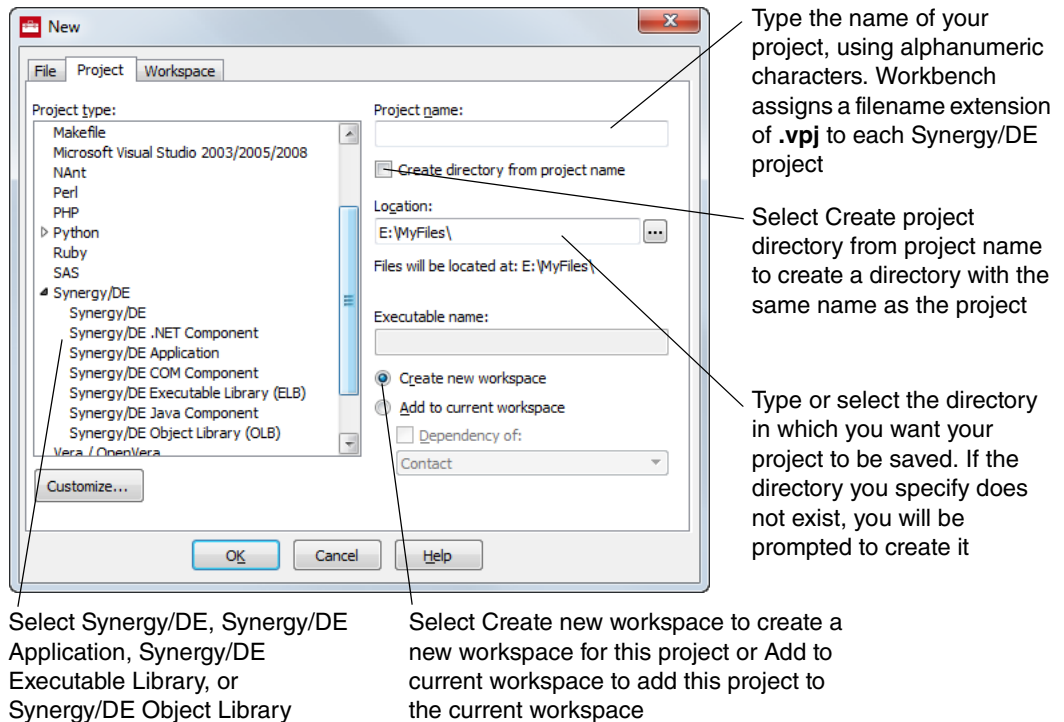
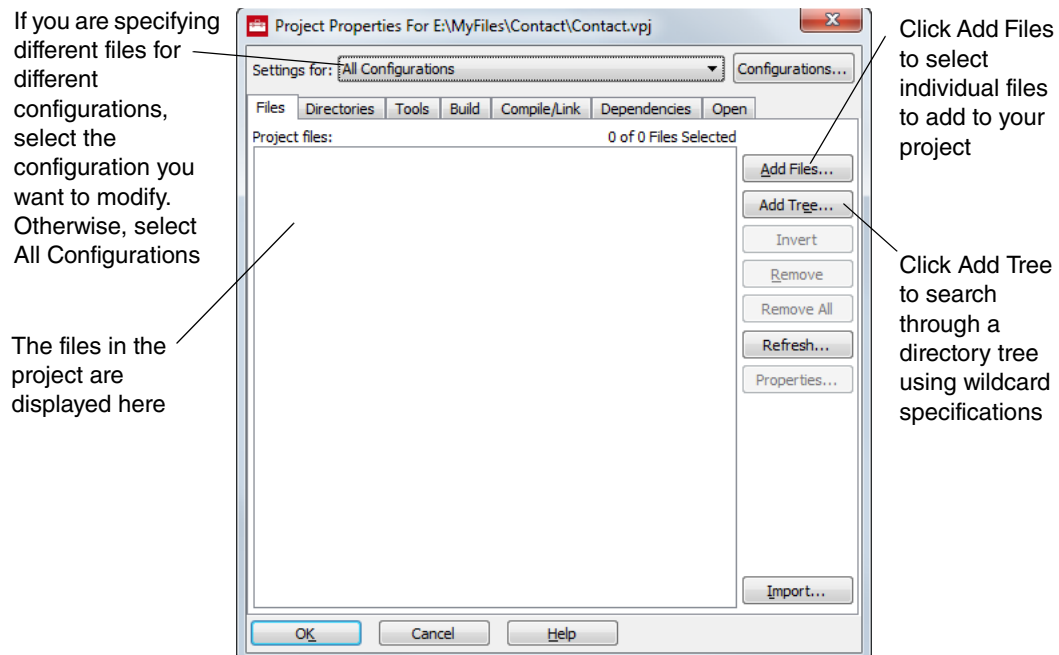


Figure 2-4. Creating a Synergy project.

## Developing Your Application in Workbench

### Setting Up Your Development Environment

The Project Properties dialog box is displayed. (See [figure 2-5](#).) From here you can add files to a project and define other project settings.



*Figure 2-5. Adding files to a project.*

3. From the Files tab of the Project Properties window, click Add Files to add files to your project. The Add Source Files dialog box is displayed. (See [figure 2-6](#).) (You can also add files by clicking Add Tree.)
4. Select the files you want to add and click Open. The Project Properties dialog box is redisplayed with the files you selected listed in the Project files field.
5. Exit the dialog box when you're done, unless you want to define other project properties.

To add additional files (including ActiveX controls) later, right-click on the project in the Projects tab of the project toolbar and select Add Files. The dialog box in [figure 2-5](#) is redisplayed.

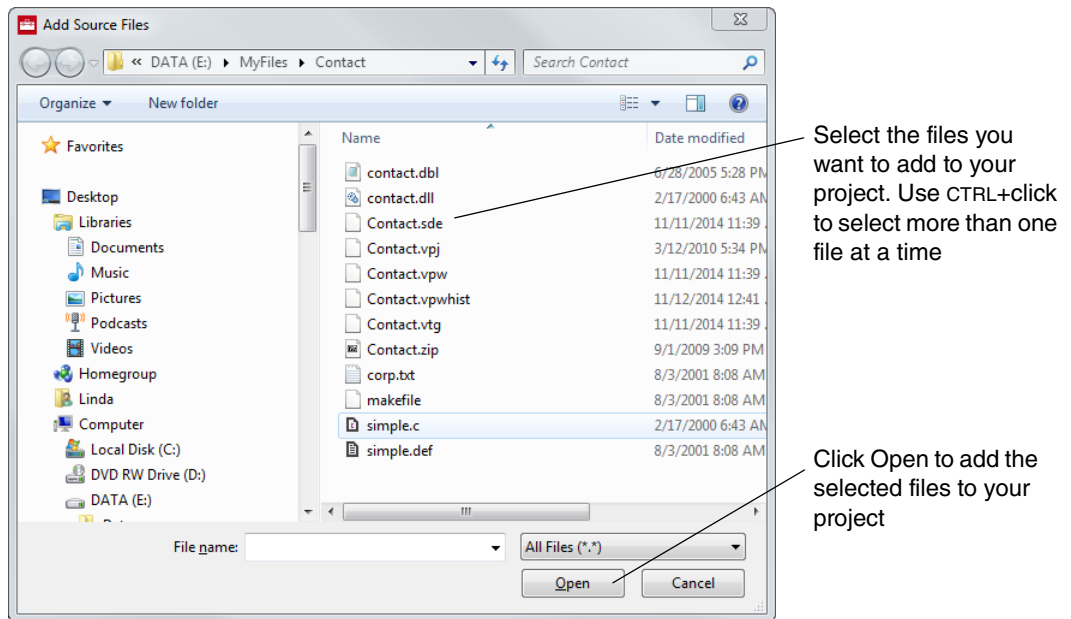


Figure 2-6. Adding files to a project.

## Using multiple configurations of a project

Workbench is distributed with the following configurations so you can set up different tools and options for the 32- and 64-bit release and debug versions of your application (if you need them):

- ▶ Release32
- ▶ Release64
- ▶ Debug32
- ▶ Debug64
- ▶ All Configurations

Debug32 is the default project configuration. You will need to customize any of these configurations that you want to use by changing their settings in the Synergy/DE Options dialog box. For example, you can configure your build commands to place the object code in different directories or perform a rebuild after switching configurations.

Note that you can define additional configurations if you need them by clicking the Configurations button in the Project Properties dialog.

### Customizing a configuration

The following instructions apply to the Synergy/DE, Synergy/DE Application, Synergy/DE Executable Library, and Synergy/DE Object Library project types. To change the prototype, compiler, linker, or runtime settings for any of these projects,

1. From the Build menu select Synergy/DE Options. The Synergy/DE Options dialog box is displayed. (See [figure 2-7](#).) (You can also get to this dialog from the Tools tab of the Project Properties dialog by selecting Synergy/DE Options in the Tool name field and clicking the Options button.)

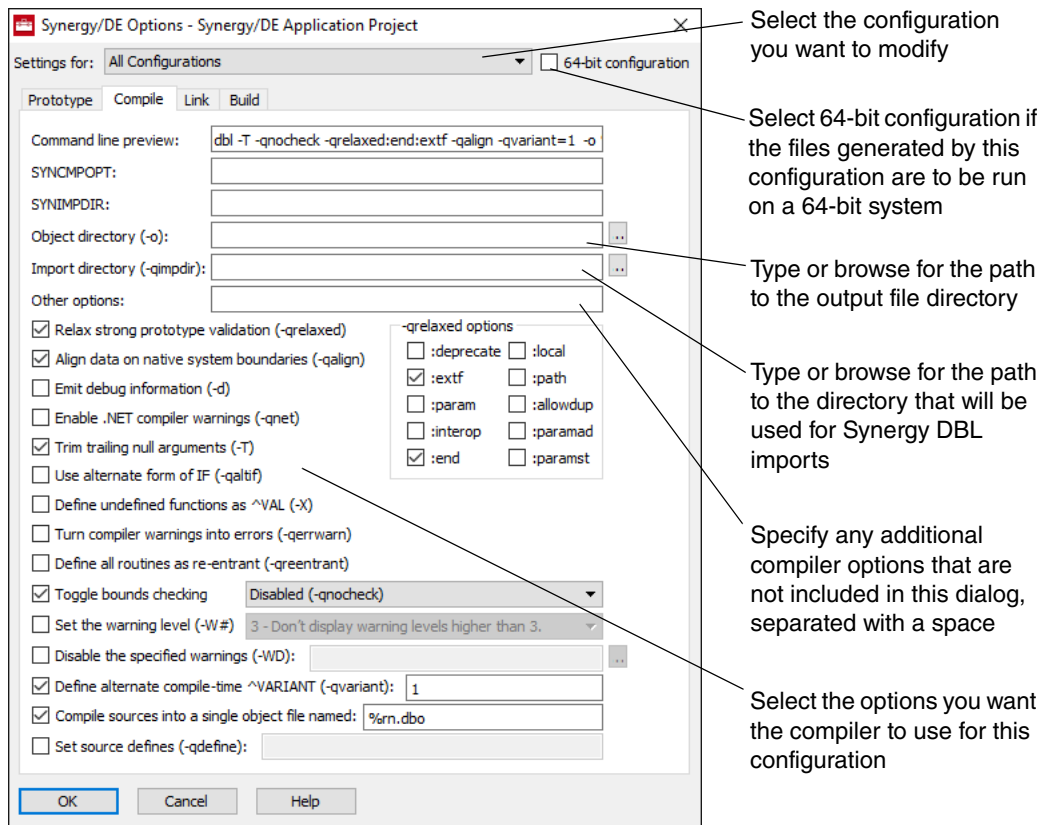


Figure 2-7. Customizing compiler settings.

2. In the Settings for field, select the configuration you want to modify. If you are making changes that should be applied across all configurations in the project, select All Configurations.
3. If the files generated by this configuration are to be used on a 64-bit system (even if Workbench is currently running on a 32-bit system), check the 64-bit configuration box. This tells Workbench to use the 64-bit tool set.

4. Enter the desired information in each field on each tab and then click OK. Note that this dialog only contains the most commonly used options; you can use the Other options field to specify additional options.

The build commands for the debug version need to specify any debug options, and if you're referencing ELBs or OLBs, you'll need to select the libraries on the Link tab.



If you select "Generate batch file on build" on the Build tab, your source files must be on the same drive as the project file in order for the project to benefit from this feature.

---

### Switching between configurations

To change the active configuration, from the Build menu, select Set Active Configuration and then select the desired configuration from the submenu.

## Adding a project to a workspace

You can add a project to a workspace either when you create that project or later. When you are creating a new project, select the Add to current workspace radio button on the Project tab of the New dialog box. (See [figure 2-4](#).)

To add a project to a workspace after the project has been created,

1. From the Project menu, select Insert Project into Workspace. The Add Project to Workspace dialog box is displayed.
2. Type or select the name of the project file you want to add to the current workspace.



Sharing workspace and project files can cause project corruption or abnormal side effects. We strongly recommend that workspace and project files reside on your local hard drive.

---

# Editing Synergy Code with the Workbench Editor

Professional Series Workbench includes a language-sensitive visual editor that provides

- ▶ automatic code indentation.
- ▶ Synergy DBL recognition.
- ▶ Synergy DBL compiler integration.
- ▶ Context Tagging.
- ▶ repository awareness.
- ▶ context-sensitive routine help.



We suggest adding the Synergy DBL entry in the Options dialog to the Options Favorites menu tree. Select Tools > Options > Languages > Application Languages > Synergy DBL and click the Add Synergy DBL to Favorites button. Then click Show Favorites and click the plus sign before Synergy DBL to expand the listing.

## Setting up automatic code formatting

To set up or customize automatic code indentation,

1. From the Tools menu, select Options > Languages > Application Languages > Synergy DBL > General. The Synergy DBL > General pane is displayed. (See [figure 2-8](#).)

Select Use SmartPaste® to automatically indent pasted code

Select Syntax indent to indent code automatically

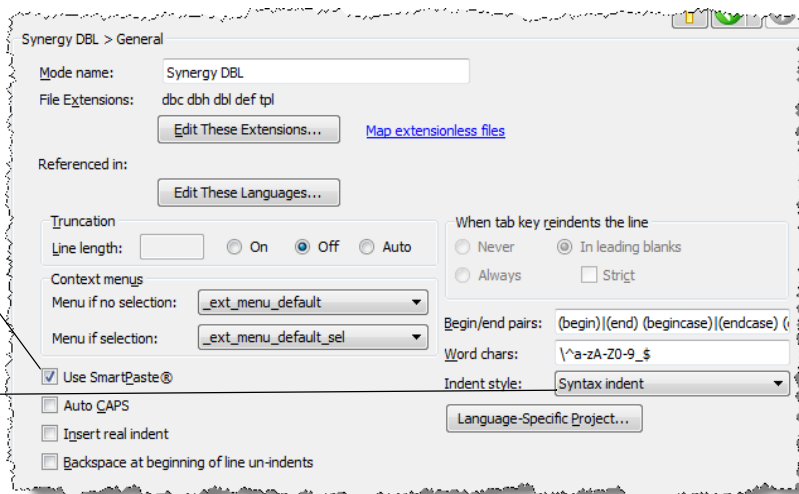


Figure 2-8. Setting up automatic code formatting and completion.

2. To make the editor automatically indent a statement correctly when you copy and paste it to nest it within another statement, select Use SmartPaste®.



3. In the Indent style field, select “Syntax indent.”
4. Select Formatting under Synergy DBL in the tree on the left. The Synergy DBL > Formatting pane is displayed. (See [figure 2-9](#).)

Select Indent with tabs to indent with tabs rather than spaces

Enter how many letters each line of code should be indented

Type the tabbing increment

Select the BEGIN-END formatting you prefer

Select the default case in which keywords will be entered

Type the number of indents to which the cursor will automatically be indented after a PROC statement or subroutine label

The screenshot shows the 'Synergy DBL > Formatting' dialog box. It has several sections: 'Indent' with a checked 'Indent with tabs' option and fields for 'Syntax indent' (4) and 'Tabs' (+8); 'Begin-End Style' with four radio button options (Style 1, Style 2, Style 3, Style 4) and corresponding code snippets; 'Keyword Case' with radio button options (Same case as first character, Lowercase, Uppercase, Initial capital); and 'Number of Indents to First Level of Code' (2) and 'Default Comment Column' (49). There is also an unchecked 'Extended Syntax Expansion' checkbox. Annotations with arrows point to various fields and options, explaining their function.

Select Extended Syntax Expansion to generate extended block endings, such as ENDRECORD, ENDCOMMON, and so on

Type the number of the column at which comments will start by default

Figure 2-9. Setting code formatting options.

5. In the Syntax indent field, type the number of characters that each level should be indented when Enter is pressed. The default is 4.

If Indent with tabs is checked, pressing Tab or Enter will indent with tabs rather than spaces. The value in the Tabs field sets the tabbing increment or individual tab stops.



We recommend that the Tabs value be either the same as or a multiple of the value of Syntax indent. If these values do not match, tabs will only be inserted when the cursor is indented past a tab location. We do not recommend specifying individual tab stops in the Tabs field.

The Workbench editor offers four styles of automatic code indentation to choose from for conditional statements (IF, CASE, USING), looping statements (WHILE, REPEAT, FOR), and BEGIN-END blocks. When you type such statements, they are automatically indented based on the style you have selected. For example, as you type BEGIN beneath an IF statement, both the BEGIN and the END statement (which you can specify should be added automatically when BEGIN is typed) are formatted and indented according to your chosen style. To set this up,

6. Enter the desired information in the remaining input fields and then click OK.

All of the above settings are global, rather than project-specific, settings.

## Editing a file

You can either create a new file or edit an existing one.

1. Do one of the following:

To	Do this
Create a new file	Select File > New. In the New dialog box, select <b>Synergy DBL</b> from the list of file types. You can also specify a filename, location, and whether to place the file in the current project.
Edit an existing file	Select File > Open. In the Open dialog box, type or select the name of the file you want to edit.

The file opens in the edit window. (See [figure 2-1](#).)

2. If the file is untitled or if it does not have a **.dbl** extension, save your file as a **.dbl** file using the Save or Save As command.
3. Type or edit your code, taking advantage of keyword completion and syntax expansion (if desired) as explained in the sections below.
4. When you're done making edits, save your file again.

## Taking advantage of keyword completion

After you type a Synergy DBL keyword, the color of the text changes to indicate that the editor recognizes a keyword. If the Enable auto-completion and Keywords check boxes in the Synergy DBL > Auto-Complete pane of the Options dialog are selected, a drop-down list of possible keywords is displayed when you type a partial keyword. Use the up and down arrow keys to highlight the desired keyword or alias, and select it by pressing Enter or the spacebar. For instance, if you type "exit", the keywords EXITLOOP and EXITTRY are displayed in a drop-down list.



Compiler directives, although recognized as keywords, are not automatically completed in this way. If you want to customize the color of your keywords and compiler directives, see “Customizing keyword color coding” on page 2-42.

To turn on keyword completion and set the minimum number of characters at which the editor will complete the keyword for you,

1. Select Tools > Options > Languages > Application Languages > Synergy DBL > Auto-Complete. The Synergy DBL > Auto-Complete pane of the Options dialog box is displayed. (See figure 2-10.)

Select Enable auto-completion to see suggested keyword and syntax completions as words are typed

Select Syntax expansion to add block-ending keywords to the corresponding block-beginning keywords

Select Keywords to show keyword choices for the prefix under the cursor

Type the minimum number of characters to type before the keyword list is displayed

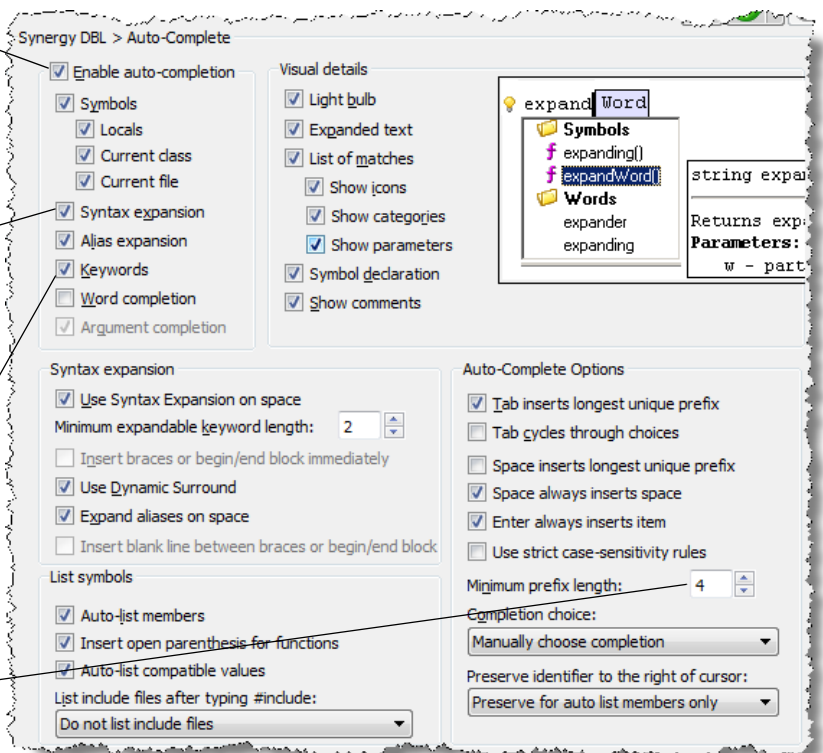


Figure 2-10. Setting up syntax expansion.

2. Select the Enable auto-completion check box.
3. Select the Keywords check box.
4. In the Minimum prefix length field, type the minimum number of characters to type before the drop-down keyword list is displayed.
5. Click OK to exit the Options dialog box if you are done modifying options.

### Taking advantage of syntax expansion

When syntax expansion is enabled, Workbench inserts the corresponding block-ending keyword(s) whenever you type a block-beginning keyword followed by space at the end of a line. Examples of block-beginning keywords are CLASS (ENDCLASS), FOR (FROM...THRU), and SUBROUTINE (PROC).

To enable alias expansion and to make Workbench automatically insert block-ending keyword(s) for the corresponding block-beginning keywords,

1. Select Tools > Options > Languages > Application Languages > Synergy DBL > Auto-Complete. The Synergy DBL > Auto-Complete pane of the Options dialog box is displayed. (See [figure 2-10 on page 2-19](#).)
2. Select the Syntax expansion check box.

You can also generate extended block endings (for example, PROC...ENDSUBROUTINE for the SUBROUTINE keyword) by doing the following:

3. Select Synergy DBL > Formatting from the tree view on the left. (See [figure 2-9 on page 2-17](#).)
4. Select the Extended Syntax Expansion check box.
5. Click OK to exit the Options dialog box if you are done modifying options.

### Getting help with routine syntax

As you type text in the Workbench editor, you can display help for the current situation.

#### Displaying context-sensitive routine help

To display a list of arguments for a subroutine, function, or method,

- Type the routine name, followed by an open parenthesis.

If the routine has more than one definition (for example, a routine with multiple subfunctions), the displayed syntax will say “1 of  $n$ ,” where  $n$  is the total number of definitions. You can cycle through the definitions by pressing ALT+comma (ALT+,) or clicking on the gray and black arrow buttons in the displayed routine help. (You can also press ALT+comma with the cursor anywhere in the routine name or syntax to display routine help in the first place.)

As you type each argument in the editor, it is boldfaced in the argument list so you can easily keep your place. Optional arguments are displayed in square brackets. (See [figure 2-11](#).)

This procedure works not only for Synergy DBL and UI Toolkit routines but also for your own routines. Depending on how your project is set up, you may first need to set up a .dbf-specific tag file that references those routines. Refer to “[Setting up a .dbf-specific tag file](#)” on page 2-24 for more information.

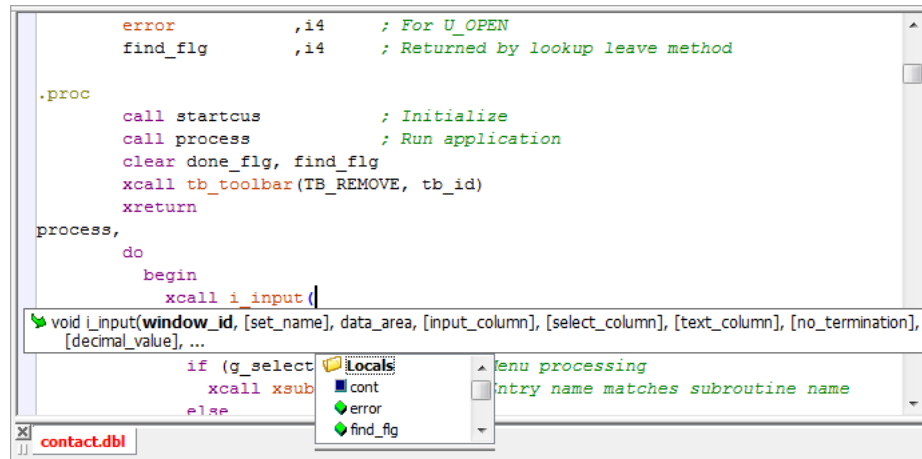


Figure 2-11. Displaying context-sensitive help.

## Displaying a list of valid operations for the current location

To list the valid variables, functions, macros, and so forth that can be used at a specific location, press ALT+period (ALT+.) at that location. If there is text before the cursor, the displayed list narrows down your options. For example, pressing ALT+period after “u\_” provides a list of items that begin with “u\_”.

If you’re specifying a record or group, when you press period (.) after the record or group, a list of all members in that record or group automatically appears. If your cursor is at a field name or class variable followed by a period (optionally followed by more text or, for a class variable, by the method name) and a right parenthesis, the Workbench editor displays the list of subfields for the field in question, matching text as described above. You can do this with repository structures as well, as long as you have .INCLUDEd the repository in your source code. (See “[Including from a repository](#)” in the Discussion for .INCLUDE in your *Synergy DBL Language Reference Manual* for more information.)

## Creating and using documentation comments

Documentation comments are special comments containing XML tags that can be extracted and processed into a file, thereby making it easier to document routines. If documentation comments have been written for a routine, calling the routine or performing a mouseover of the routine name in Workbench will show a parsed view of the comments.

In Synergy, documentation comments are indicated by three semicolons (;;; ) as the first text on the line. When you type “;;;” on the line before a routine, Workbench automatically generates a default documentation comment containing summary and returns sections, as well as a section for each parameter that exists.

Text similar to the following is added to your code (unless you've edited the expansion text), where *param\_name1*, *param\_name2*, etc., are your actual parameter names:

```
;;; <summary>
;;;
;;; </summary>
;;; <param name="param_name1"></param>
;;; <param name="param_name2"></param>
;;; ...
;;; <returns></returns>
```

If you want to change the automatic expansion of documentation comments,

1. Select Tools > Options > Languages > Application Languages > Synergy DBL > Comments.
2. Click the Edit Expansion button to edit the documentation comment text that Workbench inserts automatically, or change the check box settings in the Doc comments section as desired.

For general information about documentation comments, refer to SlickEdit's online help file.

## Moving between routines in a single source file

Each named main routine, named function, named subroutine, macro, and .INCLUDE is represented on the project toolbar's Defs tab in a tree view. (See [figure 2-12](#).)

To jump to a particular main routine, function, or subroutine in the source file, double-click on the routine name in the project toolbar.

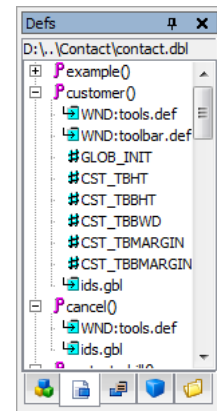


Figure 2-12. The Defs tab.

## Setting up and using collapsible regions of code

A collapsible region is a block of code that you can hide or make visible depending on whether the region is collapsed or expanded.

1. To define a collapsible region, add the .REGION compiler directive at the beginning of the code block and the .ENDREGION directive at the end of the code block.
2. Collapse or expand a collapsible block by double-clicking on the - or + in the left margin of your Edit window.

To collapse all code regions in the file, select View > Hide #region Blocks from the menu.

## Working with tag files

If you have multiple source files, you'll probably want to use the editor's tag file feature. A tag file lets you move between files using CTRL commands or get context-sensitive help for routines located outside the current file. A tag file is automatically created for each new project with the name of the project and the extension **.vtg**. You can add files to this file or create additional tag files if you desire. Once a tag file is created, it automatically updates in the background when you make edits.



We recommend that custom tag files be placed in directories outside the Synergy/DE directory tree. Any custom tag files should reside on your local hard drive.

The Symbol tab of the output toolbar displays tags for the word under the cursor. If only one tag is found, the source file containing the tag is displayed, and you can double-click on it to edit the file. Otherwise, the tag symbols are listed, and you can double-click on a tag symbol to go to that tag.



If the source file contains a **.INCLUDE** as the first line in the file, the Symbol tab does not display the definition of tag symbols in the file.

## Adding files to the workspace's tag database

1. From the Tools menu, select Tag Files (or click the Tag Files button on the Symbol tab). The Context Tagging - Tag Files dialog box is displayed. (See [figure 2-13](#).)

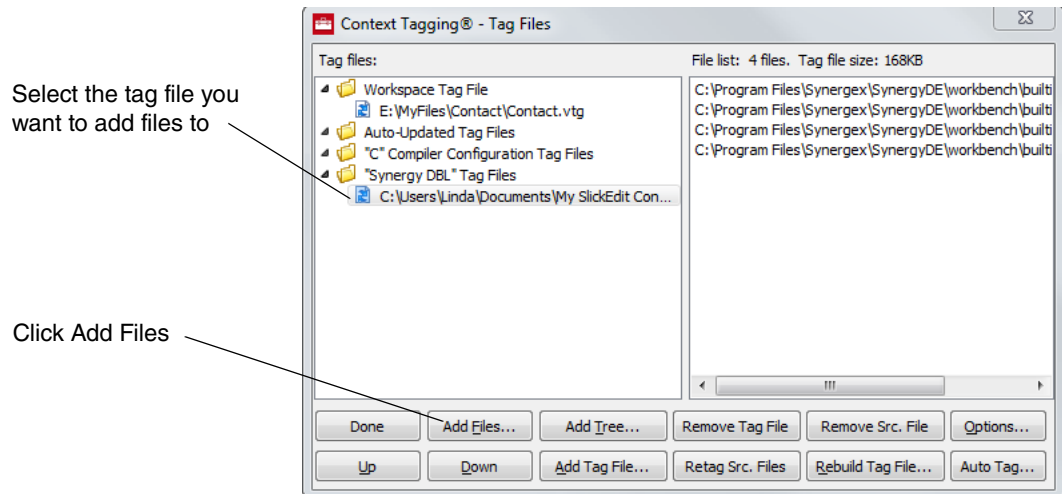


Figure 2-13. Adding files to a tag file.

2. Select the tag file you want to add files to and click the Add Files button. The Add Source Files dialog box is displayed.

3. In the File name field, type or browse for the name of a file you want to add and click the Open button. The file you select will be added to the list of files in your tag file.
4. Repeat steps 2 and 3 for as many files as you want to add.

### Setting up a .dbl-specific tag file

You might want to set up a separate, extension-specific tag file for files that, for one reason or another, you don't want to include in your project. For example, if you have a set of `.INCLUDE` or source files that you don't modify very often or that are used by other developers (such as your core routines), you probably want to maintain them outside of your project. Setting up separate tag files for such files lets you use the editor's tagging features for *all* symbols—not just the symbols in your project—including being able to view popup help for routines that aren't part of the current project.

To set up a **.dbl**-specific tag file,

1. From the Tools menu, select Tag Files (or click the Tag Files button on the Symbol tab).
2. In the Context Tagging - Tag Files dialog box, click the Add Tag File button.
3. In the Add Tag File dialog box, select **Synergy DBL** from the list and then click OK.
4. In the Add Tags Database dialog box, enter a name for the new tag file and click Open. The default filename is **tags.vtg**.
5. The Synergy/DE file extensions are listed in the File types field of the Add Tree dialog box. In the directory tree below the File types field, select a directory in which to save the tag file (or leave the Path blank to select the default location), and then click OK.
6. In the Context Tagging - Tag Files dialog box, click Done when you are finished.

### Tagging imported classes

To tag imported classes efficiently, we recommend creating a separate tag file for a specific class, namespace, or series of classes and then including that tag file whenever the tags for those classes are needed. This feature is especially useful if you use the Synergy .NET assembly API and have a large number of imported classes created by the **gennet40** utility, because you don't need to include the source files for all of those classes in your project.

1. Follow steps 1 through 3 of "Setting up a .dbl-specific tag file" above.
2. In the Add Tags Database dialog box, choose a descriptive name and an appropriate location for the import tag file and click Open.



3. In the “Add Tree” dialog, do one of the following:

To select	Do this
An entire directory	Select the directory you want to tag and click OK.
Individual file(s)	<ol style="list-style-type: none"> <li>1. Click Cancel.</li> <li>2. Select the new tag file in the list and click the “Add Files” button.</li> <li>3. Locate and select the individual source files to be tagged. Click OK.</li> </ol>

### If the files in your tag file change...

Files in a tag file are not automatically retagged when they change. To retag the contents of a tag file,

1. From the Tools menu, select Tag Files (or click the Tag Files button on the Symbol tab).
2. In the Context Tagging - Tag Files dialog box, select the tag file that needs to be retagged.
3. Click the “Rebuild Tag File” button.
4. In the Rebuild Tag File dialog box, select the desired options and then click OK. (Select “Retag modified files only” if you only want to retag files that have been modified since the last time they were tagged.)

### Including a tags database from another project

To include a tags database from another project (for example, your common library routines),

1. From the Tools menu, select Tag Files (or click the Tag Files button on the Symbol tab).
2. Click the “Add Tag File” button.
3. In the Add Tag File dialog box, select **Synergy DBL** from the list and click OK.
4. In the Add Tags Database dialog box, select the project tag file that you want to add and click Open.

Moving between files in your project

To jump to the definition of a routine or label in the source file (or vice versa),

- 1. Place the cursor on the invocation of the routine or label or on its definition.
- 2. Do one of the following:

To move from	Press
The invocation of the routine or label to the definition	CTRL+period (CTRL+.)
The definition of the routine or label back to the invocation	CTRL+comma (CTRL+,)

For example, placing the cursor over “sub1” in “xcall sub1” and pressing CTRL+period takes you to the definition of the subroutine **sub1**. Pressing CTRL+comma returns to the “xcall sub1” invocation.

Displaying online Help

- Do one of the following:

To find information about	Do this
The editor using a table of contents	Select Help > Contents
The editor using an index or full-text search	Select Help > Search
The editor using a list of frequently asked user questions and their answers	Select Help > Frequently Asked Questions
Other Synergy-specific aspects of Workbench	Select Synergy/DE > Workbench Help Topics
A specific dialog box or error message	Click the Help button in the dialog or message box

# Generating Synergy Code Segments

Aliases and code templates are time-saving features of Workbench that generate common UI Toolkit code segments and method routines directly into your program.

## Using aliases

Workbench provides two types of aliases: directory (stored in the **alias.slk** file) and extension-specific (stored in the **dbl.als** file). Both are distributed in the workbench directory. When they are modified for the first time, they are copied to the SlickEdit configuration directory, and the modifications are made to that version of the file.

Using directory aliases means you don't have to type in long path names when prompted for a filename or directory. For more information about directory aliases, refer to the online Help. (See [“Displaying online Help” on page 2-26.](#))

Extension-specific aliases are used for syntax and code expansion, enabling you to generate entire sections of code automatically. The remainder of this section describes how to use extension-specific aliases.

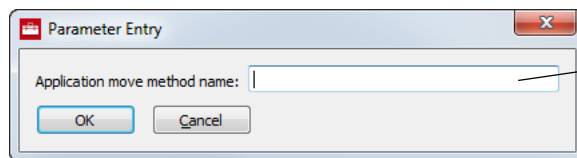
Before you begin using aliases in Workbench, follow the instructions in [“Taking advantage of syntax expansion” on page 2-20](#) to turn on alias expansion.

## Invoking an alias

If the file you're editing has an extension associated with Synergy/DE, you can expand an alias as follows:

- ▶ Type the alias into the Workbench editor and press the spacebar or Enter.

Each alias displays a Parameter Entry dialog box that prompts you for such information as routine name, variable names, and so forth (see [figure 2-14](#) for an example). After you enter the requested information, Workbench inserts the alias code into the current source code window, substituting the names you specified in the appropriate places.



Type the requested names or IDs for the alias code segment you want to add to your program

*Figure 2-14. Entering alias parameters.*

## Developing Your Application in Workbench

### Generating Synergy Code Segments

Workbench is distributed with aliases for the following code segments:

Code segment	Alias
Application move event	synmeappmove
Application resize event	synmeappsize
Application state changed	synmeappstate
Application century method	synmecentury
User defined data - check field method	synmechkfld
Application close event	synmeclose
User defined data - display field method	synmedspfld
User defined data - edit display field method	synmeedtdsp
Application input override method	synmeentrst
User function key override method	synmefkey
User help method	synmehelp
User utilities method	synmeutils
Input field arrive method	synmiarrive
Input field change method	synmichange
Input field display method	synmidisplay
Input field drill method	synmidrill
Input field edit format method	synmieditfmt
Input field hyperlink method	synmihyper
Input field leave method	synmileave
List arrive method	synmlarrive
List double click method	synmldblclk
List leave method	synmlleave
List load method	synmlload
Tabset method	synmtab

Code segment	Alias
Window button method	synmwbutton
Window click event method	synmwclick
Window close event method	synmwclose
Window generic event method	synmwevent
Window maximize event method	synmwmax
Window minimize event method	synmwmin
Window move event method	synmwmove
Window restore event method	synmwrest
Window scroll event method	synmwscroll
Window resize event method	synmwsize
Synergy function	synfunc
Synergy subroutine	synsub
Input processing loop	syninp
List processing loop	synlist
Tabset processing loop	syntab

### Customizing an alias

To modify either the code that is generated when you expand an alias or the parameters you are prompted for,

1. From the Tools menu, select Options > Languages > Application Languages > Synergy DBL > Aliases. (See [figure 2-15](#).)

(You can also view which aliases are available from this pane in the Options dialog box.)

2. Edit as many aliases as you want to and then exit the Options dialog box.

### Creating your own alias

1. From the Tools menu, select Options > Languages > Application Languages > Synergy DBL > Aliases. (See [figure 2-15](#).)
2. Click the + button in the Alias file section. The Enter New Alias Name dialog box is displayed.
3. Enter the name of the alias you want to create and then exit the Enter New Alias Name dialog box.

## Developing Your Application in Workbench

### Generating Synergy Code Segments

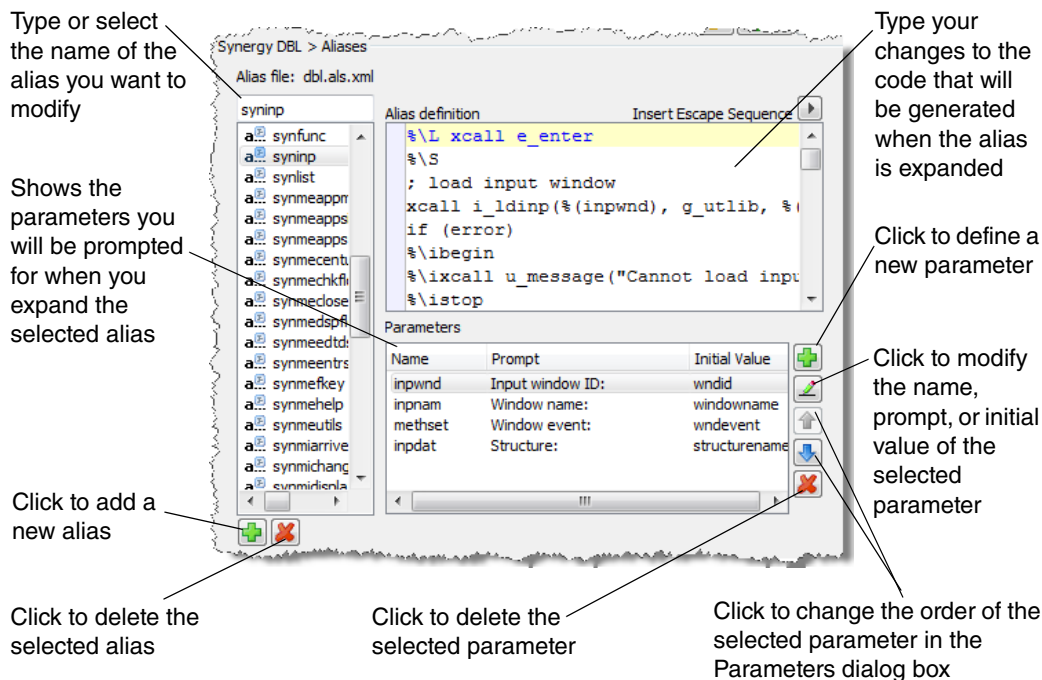


Figure 2-15. Editing an alias.

4. In the edit window of the Synergy DBL > Aliases pane, type the code that will be generated when this alias is expanded.
5. Click the + button in the Parameters section. The Enter Alias Parameter dialog box is displayed.
6. Enter the desired information in each input field, as shown in [figure 2-16](#), and then exit the Enter Alias Parameter dialog box.

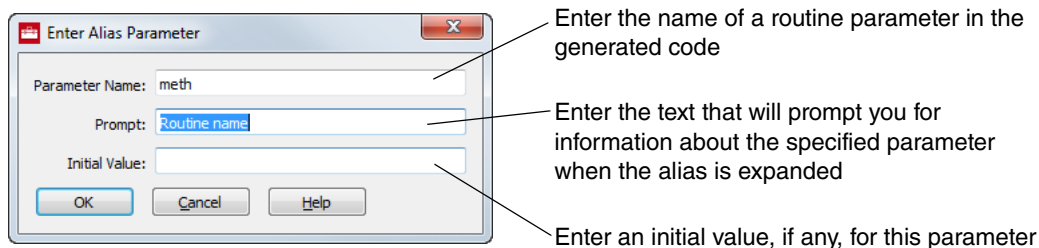


Figure 2-16. Defining alias parameters.

7. Create as many aliases as you want and then exit the Options dialog box or select a different option to modify.

## Using code templates

Template files enable you to create generic versions of your Toolkit method routines. When the drilldown button for a method property of an input field or button is clicked in Composer or Repository, Workbench generates the appropriate method routine into the editor. You can then customize the routine as desired.

Template files have the extension **.tpl**.

To expand a template file,

1. In the Application window in Composer, select the input field or button object for which you want to generate a method routine.
2. In the Properties window, click the drilldown button for the desired method property. The Choose Method File dialog box is displayed in Workbench.
3. Type or browse for the name of the source file that contains or will contain the code for the method you selected in Composer. If the file does not exist, it will be created for you.

## Customizing template files

You can customize the template files that are distributed with Workbench. The **\*.tpl** files are distributed to the `workbench\wbsamples` directory and then copied to the `workbench` directory if they don't already exist. If you are in a Terminal Services or shared configuration and you want all users to have a version that is different from the distributed version, edit the template files in the `workbench` directory. If only some of the users want to use a modified version, they can copy the desired **\*.tpl** files to their SlickEdit configuration directory and then edit those files instead.

## Using tokens in template files

In the templates, you can use tokens to represent specific names. For example, structure and field tokens enable you to replace generic references to structures and input fields with references to actual structure and field names when generating methods for input windows. When Workbench inserts the template file's contents into the specified file, it replaces all instances of the tokens with the appropriate structure or field name.

Workbench is distributed with the following tokens:

This token	Is replaced with	For this method
#STRUCTURE#	Structure name	Input field
#FIELD#	Input field name	Input field
#CURSOR#	The flashing cursor (so you can begin typing)	All
#ROUTINE#	Routine name	All

## Developing Your Application in Workbench

### Generating Synergy Code Segments

If the field is a repository field, the #STRUCTURE# token is replaced with the repository structure name. If the field is not a repository field, the #STRUCTURE# token is replaced with the name of the structure the field belongs to in the input window.



To avoid potential conflict with the names of tokens we may add in the future, we recommend that if you create your own tokens, you either use a character other than the pound sign as the delimiter (for example, *@token@*), or you use a unique prefix (for example, your initials, as in *#AK\_token#*).

---



# Analyzing Your Code

When you must restructure or otherwise modify a routine, it's important to be aware of possible ramifications to other pieces of code. Workbench provides some analysis tools to help you identify which routines are called by a specified routine and which routines call a specified routine.

## Viewing a call tree of external routines

The call tree utility lists all routines (across multiple source files) called by the chosen routine. You can also expand any routine in the call tree to see what routines are called, in turn, by that routine.

The primary objective of this utility is to provide insight into the logical structure of an unfamiliar software system. The generated list of called routines can be especially useful when you are converting legacy systems into components. Or if you want to expose a method in a component, generating a call tree of that method enables you to view all the methods called from that method, which can help you determine the scope of work needed to expose the method.

## Launching the call tree

A call tree can only be generated when a workspace is loaded.

1. From the Symbols tab of the project toolbar, right click on the routine for which you want to generate a call tree. (To locate the routine you want, expand the Workspace folder and then the Global Functions or Global Procedures subfolder, depending on whether you're looking for a function or a subroutine, respectively.)
2. Select Calls or uses from the context menu.

A call tree is displayed for all methods under the selected method. (See [figure 2-17](#).) The call tree continues searching through submethods until either there are no more submethods, the submethods loop back recursively to an existing method, or the call tree reaches a method that is defined outside of the project.

To place your cursor at the beginning of a call in the Workbench editor, double-click on that call in the Symbol Uses/Calling Tree window.

## Determining what appears in the call tree

To toggle which items are included in the call tree,

1. Right-click in the Symbol Uses/Calling Tree window to display the context menu.
2. Highlight Quick filters in the context menu and then select the items you want to display.

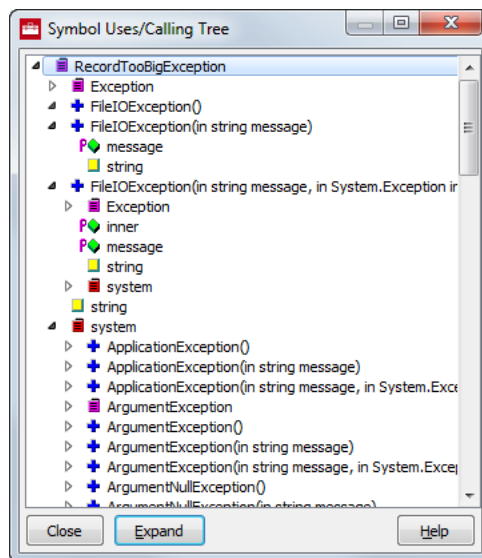


Figure 2-17. Viewing a call tree.

## Viewing where a method is called

When restructuring code for a component, you may want to know where a particular method is called, to help you identify which areas of code will be affected by changes to that routine.

### Launching the reference utility

References can only be generated when a workspace is loaded.

1. From the Symbols tab of the project toolbar, right click on the routine, class, class member, or local field for which you want to generate references. (To locate the item you want, expand the Workspace folder and then the appropriate subfolder, depending on what type of item you are looking for.)
2. Select References from the context menu.

Workbench searches all files in all projects in the current workspace to create a list of calls to the selected routine or references to the selected class, class member, or local field. The call list is displayed in the References tab of the output toolbar. (See [figure 2-18](#).)

To locate a reference in the Workbench editor, double-click on the occurrence in the results window, or select the results window and press CTRL+G to move your cursor through the results window one line at a time. The appropriate file will be opened in the editor if it is not already open. The source line containing the reference is displayed in the preview window in the References tab if you highlight the occurrence in the results window.

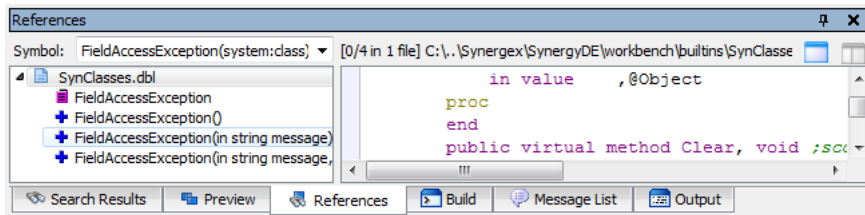


Figure 2-18. Viewing routine references.

### Another way to find references

1. From the Search menu, select Find.
2. Enter the name of the method or other item you want to search for and click the Files >> button.
3. In the Look in field, enter the files or group of files to be searched. If you click the drop-down button, you can select <Buffers> to search all open files, <Workspace> to search all files in the workspace, <Project> to search all files in the project, or the specified directory to search that directory. (Refer to the SlickEdit help for additional information about the Find dialog box or appending multiple search targets.)
4. Click OK to search for all places where this method or other name appears in the selected files.

### Browsing an ActiveX control

To view all methods and fields within an ActiveX control,

1. Add the ActiveX control to a project if it's not associated with one already.
2. Select the Symbols tab on the project toolbar to display the Workbench class browser.
3. Locate the ActiveX control by expanding the Workspace folder and then the Packages/Namespaces subfolder.
4. Expand the ActiveX control or right-click on it to select an option from the context menu.

You should be able to view all classes in the control, all methods in each class (including the parameters for each method), and all properties in each class.

# Compiling, Building, Running, and Debugging

After you've typed and edited your code, you can compile, build (or link), and run your project directly from Workbench by selecting the desired command from the Build menu or clicking the appropriate toolbar button. (See [“Customizing and adding commands”](#) on page 2-39 for instructions on changing your default commands.)

## Checking compilation errors

If Workbench encounters any compilation errors, it displays them in the Build tab of the output toolbar, which is below the edit window. You can move between compilation errors in the build window as follows:

To move to	Do this
The next error	Press CTRL+SHIFT+DOWN ARROW
The previous error	Press CTRL+SHIFT+UP ARROW
A specific error	Click on that error

As you select each error, that line of code is highlighted in the Workbench editor.

## Debugging a project

To compile and build in debug mode, make sure Emit debug information (**-d**) is selected in the Compile and Build tabs of the Synergy/DE Options dialog box (Build > Synergy/DE Options). When you run the compiler and linker, the object and **.dbr** files will be created with debugging information.

You can also execute a user-defined (or default) debug command by selecting Debug from the Build menu.

## Saving the current debugger state

The Synergy debugger enables you to save the current debugger state to a file. The debugger state includes break points, watch points, and option settings. By specifying the name of this debugger state file as the initialization file for the debugger, you can associate a set of debugger commands with a project and invoke those commands every time you restart the debugging session.

Use the debugger SAVE command to save the debugger settings to a file. (See the [“Debugging Synergy Programs”](#) chapter of *Synergy Tools* for details.)

To restore the saved debugger commands,

1. From the Project menu, select Project Properties and then click the Open tab.
2. In the editing area of the dialog, set the DBG\_INIT environment variable to the name of the file that contains the saved debugger state.

When you invoke the Synergy debugger, it will use the specified file to initialize itself.

# Customizing Your Development Environment

## Customizing the way a project is opened

To specify commands that will get executed when the project is opened,

1. From the Project menu, select Project Properties and then click the Open tab.
2. Enter the desired commands in the field shown in [figure 2-19](#) and then exit the dialog box. (You do not need to close and reopen the project to make these changes take effect.)

Select the configuration you want to modify. Select All Configurations to change the settings for all of your configurations

Type any macro commands (one command per line) that you want executed when the project is opened

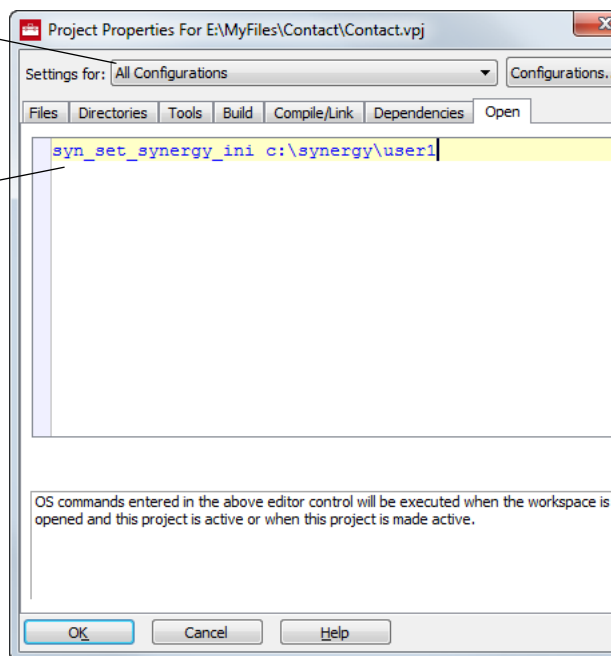


Figure 2-19. Specifying project open commands.

The commands that you specify in this dialog box are executed before any initialization settings in the [synergy] section of **synergy.ini** are loaded and set.

For details about specific commands, select Search from the Help menu and search for those commands.



To save effort, we recommend setting SFWINIPATH instead of individual settings. (Refer to [SFWINIPATH](#) in the "Environment Variables" chapter of *Environment Variables & System Options* for details.)

## Customizing and adding commands

You can customize the commands for compiling, building, debugging, and executing for a project, for a project type, or for a file with an extension associated with Synergy/DE when no project is opened. For example, if you have a version control system, you can specify that the Build command on the Build menu is “build” or “make” or any other command you want it to be. Alternatively, you can specify a batch file that designates which files to build.

Workbench also enables you to create any number of tools to perform any desired commands. Two customizable tools (User 1 and User 2) are provided for you, or you can create a brand new tool. Note that any customized tool you create can only be activated from the menu and cannot be bound to a toolbar button or key press.

### Customizing commands for a specific project

You can modify the command lines for existing tools or add new tools that can be used by an entire project.

1. Open the project if it is not already open.
2. From the Project menu, select Project Properties.
3. In the Project Properties dialog box, select the Tools tab if it’s not already displayed.
4. Enter the desired information in each input field and then exit the dialog box.

Once your project is set up, you can simply select Compile, Build, Debug, or Execute from the menu.

### Customizing commands for a project type

You can modify the command lines for existing tools (Compile, Build, Debug, and so forth) or add new tools that Workbench will use when creating a Synergy/DE project.

1. Close any open workspaces and files.
2. From the Project menu, select New.
3. Click the Customize button.
4. In the Customize Project Types dialog box, select the configuration you want to change the template for (for example, Synergy/DE > Synergy/DE) and click the Edit button.



Because Synergex reserves the right to override user settings in future versions of Workbench, we recommend you do not change the project packages for “Synergy/DE Java Component” or “Synergy/DE .NET Component.”

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5. In the Project Package for *project* dialog box, select the Tools tab if it’s not already displayed.
6. In the Tool name field, select Synergy/DE Options and then click the Options button.

## Developing Your Application in Workbench

### Customizing Your Development Environment

Select the configuration you want to modify

Select the options you want the compiler to use for this configuration

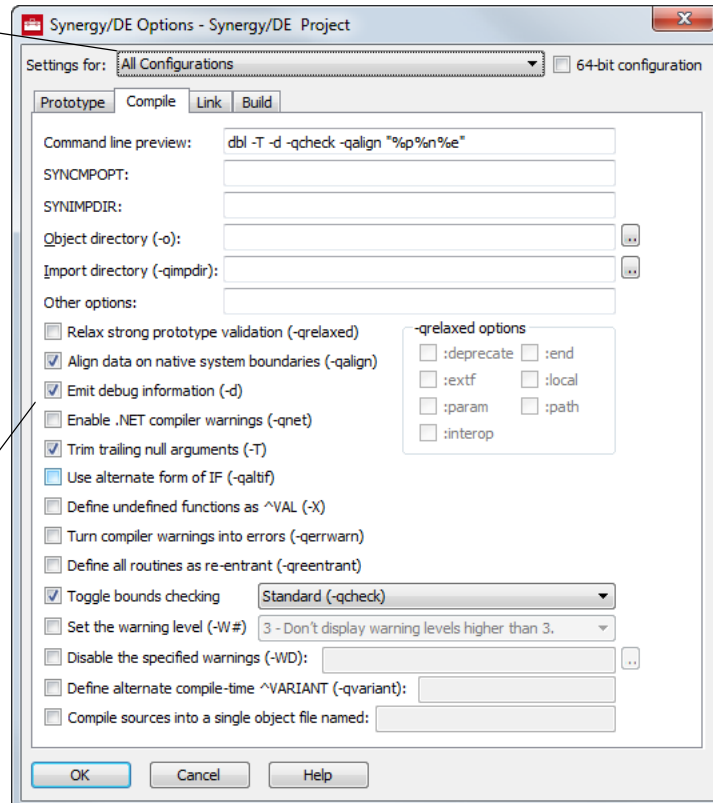


Figure 2-20. Customizing compiler commands.

7. Enter the desired information in each input field, as shown in [figure 2-20](#). Then exit the dialog box.

All new projects of this type and configuration will inherit these tools when the project is created. If a project type has more than one configuration, you will need to customize each configuration individually.

### Customizing commands for a file being edited outside a Synergy/DE project

You can customize the commands for compiling, building, debugging, and executing on a global level when a **.dbl** file is opened with no open project or workspace.

1. Close any open workspaces and files.
2. From the Tools menu, select Options > Languages > Application Languages > Synergy DBL > General.
3. Click the Language Specific Project button.



4. In the Project Properties dialog box, select the Tools tab if it's not already displayed.
  5. Enter the desired information in each input field (see [figure 2-20](#)), and then exit the dialog box.
- You can add your own commands using the New button, although they will not appear in the menu.

## Adding file extensions to Workbench

Workbench enables you to specify your own file extensions for source files, include files, and UI Toolkit script files in Synergy/DE projects. For example, unless you specify additional script extensions, only scripts with the extension `.wsc` will be recognized in Composer and Workbench. The extensions you specify will be added to the appropriate dialog boxes in Workbench.

To specify a new filename extension for a Synergy/DE project,

1. From the Synergy/DE menu, select Utilities > File Extensions.
2. Enter the desired information in each input field (see [figure 2-21](#)), and then exit the dialog box.

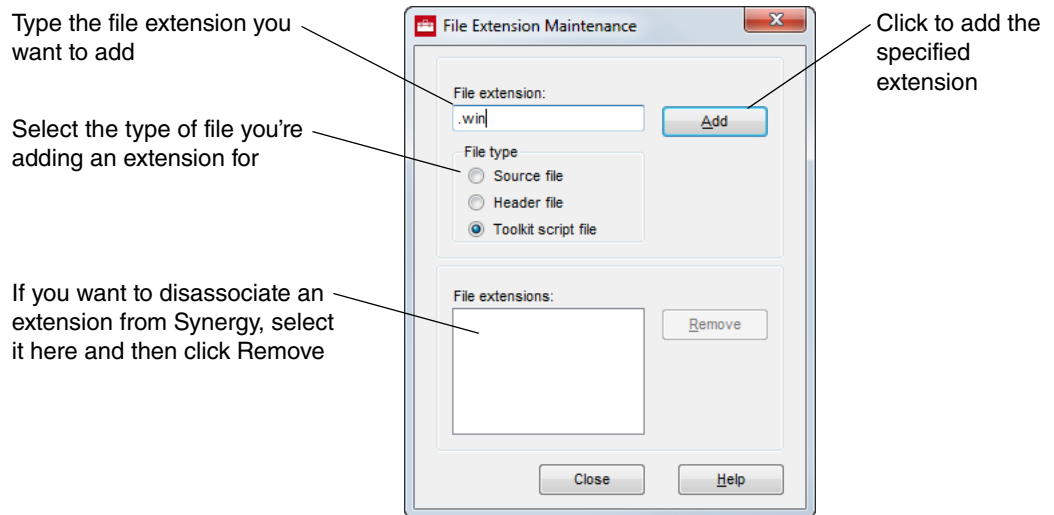


Figure 2-21. Specifying different script extensions.

3. If you've added a UI Toolkit script file extension and you want the default for a script file to be something other than `.wsc`, change the default extension in Composer by doing the following:
  - ▶ Run Composer.
  - ▶ From the Options menu, select Composer.
  - ▶ Click the File tab, and in the Default Extensions section, change the Script file value. Exit the dialog box.

## Customizing keyword color coding

Synergy keywords, compiler directives, and operators are automatically displayed in a different color from the rest of your code. To change the colors that are displayed,

1. From the Tools menu, select Options > Languages > Application Languages > Synergy DBL > Color Coding.
2. In the Lexer name field, make sure **db1** is selected.
3. Select the Keywords radio button to change the default keyword color, the Preprocessor radio button to change the default compiler directive color, or the Operators radio button to change the default operator color.
4. Click the Colors button.
5. In the Foreground color (or Background color or Embedded code) field, click the Click to change color button. In the Select a color dialog box, click the desired text color or change the Red, Green, and Blue values as desired, and then click OK.
6. Change the color of any other screen element by selecting the one you want to change in the list at the left side of the Colors pane and performing step 5.
7. Exit the Options dialog box or select a different option to modify when you're finished customizing colors.

## Changing the tagging delay

You can customize how often tagging takes place by changing the number of seconds of idle time before tagging begins on a changed buffer. The default value is 3, which means open files are retagged immediately after you stop typing or using the mouse. Most people find this value too low. To change the tagging delay value,

1. From the Tools menu, select Options > Editing > Context Tagging.
2. Change the value in the Start after seconds idle field.

You can experiment with this value to find the one that works best for you. Depending on how fast you type, you may want to set this value to a number like 15 or 30. (In general, faster typists will probably prefer a higher value than slower typists.)

3. Exit the dialog box when you're finished.

## Turning tagging off

To turn off automatic tagging,

1. From the Tools menu, select Options > Editing > Context Tagging.
2. Set Tag file on save and Background tagging of open files to False.

When Background tagging of open files is not checked, Workbench only generates tags upon request.



Deselecting either of these options may cause all tagging to occur the moment you request it, which might cause Workbench to appear to hang.

3. Exit the dialog box when you're finished.

## Interfacing with version control tools

Workbench provides support for several popular version control systems. To access these tools directly from Workbench,

1. From the Tools menu, select Version Control > Setup.
2. In the Version Control Setup dialog box, select the version control system of your choice (or create a new one using the Add button).
3. Click Setup and make any necessary changes to the version control commands, depending on your preferences or procedures.
4. Click OK.

The Get and Put toolbar buttons are now enabled.

For additional information, refer to the online Help system (see [“Displaying online Help”](#) on [page 2-26](#)) and select “Version Control” from the index.

## Changing the environment for .NET Component projects

By default, Workbench uses the batch file `%VSnnCOMNTOOLS%vsvars32.bat` (where *nn* is the highest version of Visual Studio that is installed on the system) to set the environment variables used by .NET. (See [“System Requirements”](#) in the “Creating Synergy .NET Assemblies” chapter of the *xfNetLink & xfServerPlus User's Guide* for complete details.) You can specify a different environment set-up file. To change the batch file,

1. Open the project.
2. From the Build menu, select Component Information and click the .NET Environment button.
3. In the .NET Environment Configuration dialog, enter the path for a different batch file in the .NET environment batch file field or click the browse button and select the desired file.
4. Click OK.

## Copying customization settings

To copy certain Workbench customization settings to another machine or to another user in a Terminal Services or shared configuration,

1. From the Tools menu, select Options > Export/Import Options.
2. To export all options, click the Export All Options button. To export a specific set of options, click the Setup Export Groups button. To import options that have already been exported, click the Import Options button.
3. For additional information and instructions, click the Help button in the Export/Import Options pane of the Options dialog.

To copy any of the customizations listed in the table below,

1. If the target machine has a brand new Workbench installation, enter the command **update\_synergy** at the Workbench command line before beginning this procedure. Restart Workbench and change your editor configuration to match the machine whose configuration you are copying.
2. Copy the desired files below from the source SlickEdit configuration directory to the target SlickEdit configuration directory:

File	Description
diffmap.ini	Diff dialog settings
oem.vlx	Color
project.vpe	File extension command settings
ubox.ini	Comments
uformat.ini	Code formatting
usrprjtemplates.vpt <sup>a</sup>	Project templates
vsrobjs.e	User-defined dialog boxes and menus
wbcfg.e	Workbench configuration file
wbkeys.e	Workbench keymapping file

a. The **usrprjtemplates.vpt** file is version specific and should therefore only be copied to a SlickEdit configuration directory of the same Synergy/DE version.

3. If any of your template files have been customized, see [“Customizing template files” on page 2-31](#).
4. Run Workbench on the target machine.

5. Change the emulator configuration on the target machine to match the emulator settings on the machine from which you are copying.
6. Press ESC to go to the Workbench command line, and enter the command  
`load_conf`
7. Exit Workbench.

## Using Workbench for Non-Windows Development

Even though Workbench is only available on Windows, you can use it as your primary editor for all Synergy/DE-supported platforms via distributed computing. There are two options for accessing source files:

Option	Pros	Cons
NFS (Network File System) based mapped drives	<ul style="list-style-type: none"><li>▶ An NFS-based mapped drive is virtually identical to mapping a drive to a Windows server.</li><li>▶ Projects can be used.</li><li>▶ Composer can be used.</li></ul>	<ul style="list-style-type: none"><li>▶ This option can be slower than FTP, although NFS can be optimized for better performance.</li><li>▶ NFS is not a very high-performance file server when used on OpenVMS.</li></ul>
FTP	<ul style="list-style-type: none"><li>▶ This option is potentially faster, because you only transfer a file once and you edit it locally.</li></ul>	<ul style="list-style-type: none"><li>▶ FTP is not suitable for systems using version control.</li><li>▶ If you have multiple developers, the potential exists for overwriting each other's changes.</li><li>▶ Projects cannot be used.</li><li>▶ Composer cannot be used.</li></ul>

You will need to use xfServer to access your repository.

## Using NFS-based mapped drives

If you have problems with file loss or corruption, before using an NFS-mapped drive, we strongly recommend that you add “-s3” to the end of the command shortcut that runs Workbench. For example:

```
c:\synergyde\workbench\bin\vs.exe -s3
```

Using the NFS protocol to map a drive enables desktop users on a network to access remote source files and window scripts from UNIX and OpenVMS. If this option is too slow, you'll probably want to tweak the performance of your file server. Your NFS software can help you optimize performance.

We also recommend that you turn off automatic tagging in Workbench. (See [“Turning tagging off” on page 2-42.](#))

## Using FTP

Workbench's built-in FTP functionality provides the ability to import source code directly into the editor from any other system on your network. Once you've set up the session protocols, Workbench's FTP tools enable you to edit remote code and compile it with the Windows compiler to check for errors. If you've set up your code to build on Windows, you can link it and perform test runs in the Workbench editor. You can then upload the modified source code to the original directory on the original platform simply by saving your work.

To set up FTP links between Windows and remote platforms, you must do the following:

1. Define your connection if it is not defined already.
2. Start a connection.
3. Open the file you want to edit and make your changes.
4. Transfer the file between your local machine and an FTP host.
5. Close the connection.

Basic instructions follow in the sections below. For additional information, refer to the *SlickEdit User's Manual*.

### Defining a connection

1. From the File menu, select FTP > Profile Manager. The FTP Profile Manager dialog box is displayed.
2. If you want to set up any firewall/proxy settings, log file options, or any other default settings, see ["Customizing your FTP sessions" on page 2-49](#).
3. Click Add. The Add FTP Profile dialog box is displayed. (See [figure 2-22](#) and [figure 2-23](#).)
4. Enter the desired information in each field and click OK when you're finished.

You can define as many sessions with full specifications as required. You can also create more than one session to the same host with each accessing a different remote directory with source files. In addition, you can specify the full path to the local work directory into which you want to download the code for each session.

### Starting a connection

1. In the FTP Profile Manager dialog box, select the connection you want to establish.
2. Click Connect.

## Developing Your Application in Workbench

### Using Workbench for Non-Windows Development

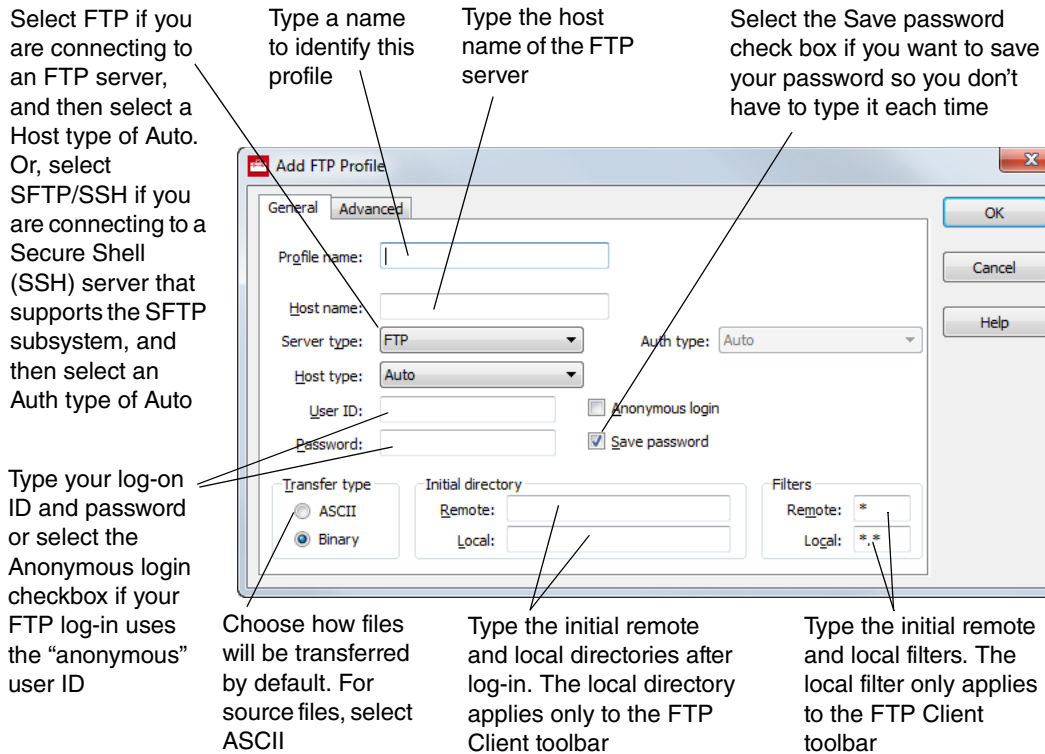


Figure 2-22. Adding an FTP profile.

### Opening a file for editing

1. After you have started a connection, click the Open tab on the Project toolbar. A listing of FTP files is displayed.
2. Double-click on a file to open it.
3. Edit the file as usual in the edit window.

### Transferring files between your local machine and an FTP host

The FTP Client dialog box enables you to open several FTP sessions at one time and then jump from session to session as desired.

1. From the File menu, select FTP > Client to display the FTP Client toolbar.
2. Right-click on the local or remote file listing to display a menu of operations from which to choose.



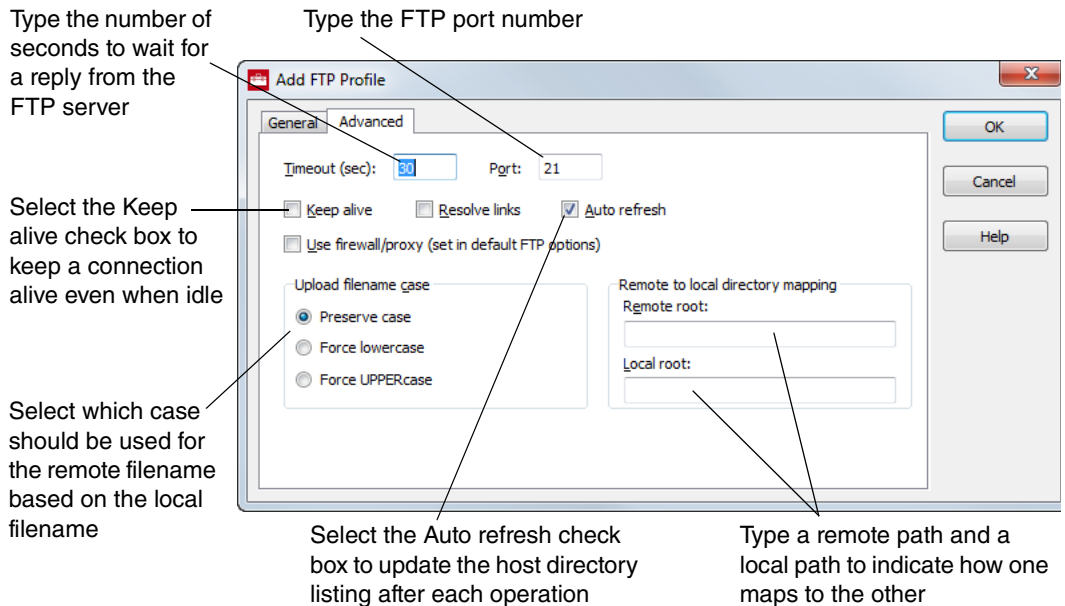


Figure 2-23. Adding an FTP profile (advanced settings).

### Closing a connection

1. Open the FTP Profile Manager dialog box (File > FTP > Profile Manager) if it's not open already.
2. Select the connection you want to close in the Profiles field.
3. Click Close.

### Customizing your FTP sessions

You can optimize each session's protocols for the connecting remote host by customizing your FTP sessions in the FTP Options dialog box. From this dialog you can do the following:

- ▶ Specify a default password for anonymous log-ins
- ▶ Set default case sensitivity for the filenames you bring into Workbench from a UNIX system, so you can later upload those filenames back to the original system
- ▶ Specify whether you'll be prompted to upload each time code is saved in the Workbench editor (or that code should not be uploaded at all when it is saved)
- ▶ Specify how long Workbench will wait for a reply from the FTP server
- ▶ Set up firewall and proxy specifications if you are creating FTP sessions on secured networks
- ▶ Set up a session log to be created for all FTP sessions

## Developing Your Application in Workbench

### Using Workbench for Non-Windows Development

To customize your FTP sessions,

1. If you're in the FTP Profile Manager dialog box, click Default Options. Otherwise, from the File menu select FTP > Default Options. The FTP Options dialog box is displayed.
2. Enter the desired information in each field of the appropriate tabs and click OK when you're finished.

# 3

## Setting Up Your Repository

This chapter introduces you to S/DE Repository and walks you through defining your data for several different uses. We've set up a small example for you to practice with, because we believe you will learn more quickly by actually performing the steps rather than just reading them.

For each of the instructional sections of this chapter, you will need to define a structure and its fields; we strongly recommend that you begin by following the instructions in the sections [“Defining a structure” on page 3-3](#) and [“Defining fields” on page 3-4](#), even if you don't need to define a record layout for use in an application.

### **What Is Repository? 3-2**

Describes what Repository is, how to run it, and how to access context-sensitive help.

### **Defining a Record Layout for Use in an Application 3-3**

Explains how to define the type and size characteristics of your data in Repository so it can be used by the Synergy compiler.

### **Defining User Interface Characteristics 3-7**

Explains how to define the visual and behavioral characteristics of your data in Repository so it can be used by S/DE UI Toolkit (including Composer).

### **Defining Files for ReportWriter 3-14**

Explains how to define additional visual and relational characteristics in Repository so your data can be used by Synergy/DE ReportWriter.

### **Defining a Database Schema for xfODBC 3-20**

Tells where to find instructions for using Repository with xfODBC.

# What Is Repository?

Repository enables you to define the structure of your data in a centralized location, without redundancy. Repository can then supply this information to the Synergy compiler for processing application files, to Composer for building a user interface, and to ReportWriter for creating reports.

Because data is only defined once, changes need only be made once. For example, if you want to expand a field that appears throughout your application, one simple change to your repository does the trick.

## Starting Repository

To start Repository, do one of the following:

- ▶ From the Workbench toolbar, select Repository.
- ▶ At a command prompt, type

```
dbr RPS:rps
```

(If you are not in the directory that contains **dbr.exe**, DBLDIR\bin must be in your path.)

## Getting help

From any field in any input window in Repository, you can access context-sensitive help for that field. If you're not sure what information to enter in a field,

1. Place your cursor in the field.
2. Press F1 or click the Help button.

## Displaying a list of valid data for a field

Many fields in Repository also enable you to display a list of available selections. To display such a list,

- ▶ With your cursor in the field, select List Selections from the menu.

## See also

Your *Repository User's Guide*. This includes instructions for using all features of Repository, as well as information about Repository utilities, the Synergy Data Language (which describes the contents of a repository), and the subroutines that enable you to access repository data from within an application.

## Defining a Record Layout for Use in an Application

The most efficient way to define data fields is in one central location—a data repository—rather than in each of the programs that make up your application. The same definitions can then be accessed by multiple applications across multiple systems.

You will first need to define a structure and then define the data fields required by your application, including the data type and size of each field.

As an example for this chapter and the ones that follow, we've designed a simple application that maintains business contact information. It requires the following data fields:

company	,a45
address	,a45
city	,a25
state	,a2
zip	,d5
salutation	,a4
lname	,a16
fname	,a16
contact	,a32
phone	,d10
fax	,d10
modem	,d10
email	,a47
notes	,a47
type	,a10
status	,a10
sl	,d1
tk	,d1
rps	,d1
pvc	,d1
odbc	,d1
dte	,d1

### Defining a structure

The first step in defining a record layout is to create a new structure. In Repository, the term *structure* refers to the entire record definition, or the combination of field and key characteristics.

To define a structure,

1. From the Modify menu, select Structures.
2. From the Structure Functions menu, select Add Structure.

The Structure Definition input window is displayed. (See [figure 3-1](#).)

3. Enter the desired information in each input field and then exit the input window.

## Setting Up Your Repository

### Defining a Record Layout for Use in an Application

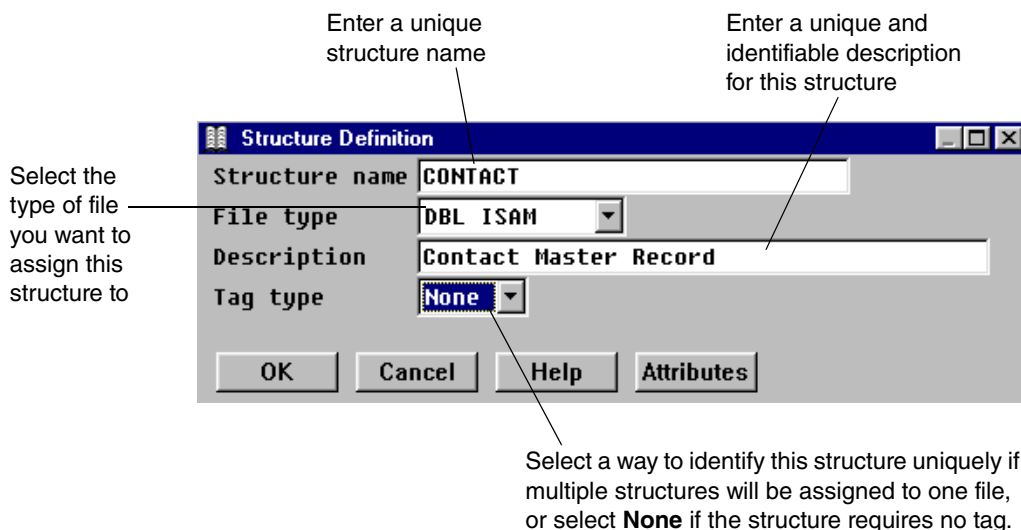


Figure 3-1. Defining a structure.

## Defining fields

To define the necessary fields in your new structure, along with their data types and sizes,

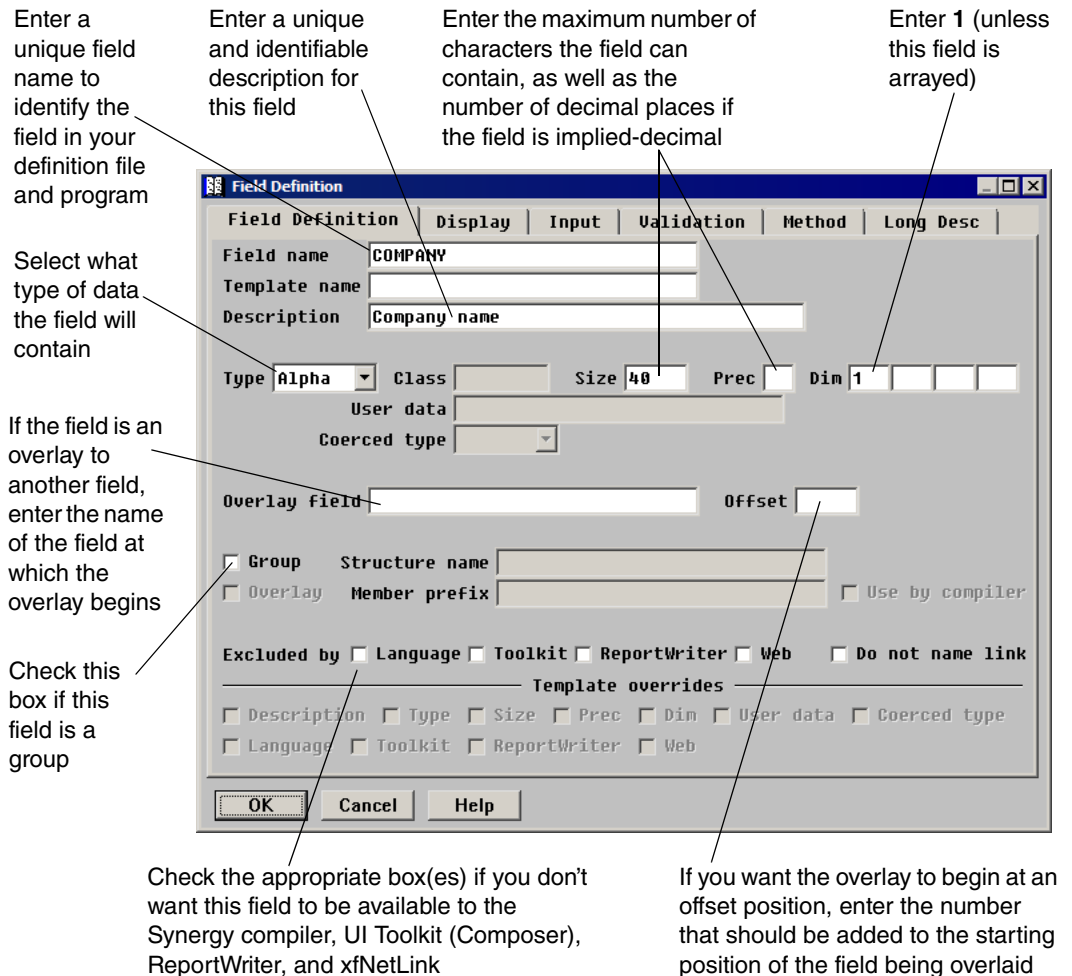
1. With the new structure highlighted, select Edit Attributes from the Structure Functions menu.
2. From the Attributes menu, select Fields.
3. From the Field Functions menu, select Add Field.

The Field Definition input window is displayed. (See [figure 3-2](#).)

4. Enter the desired information in each input field, using the example fields listed on [page 3-3](#), and then click the OK button. (You can also define display, input, validation, and method information by moving to those tabs before clicking OK. These tabs are discussed in “[Defining field attributes](#)” on [page 3-9](#).)

Make sure the Excluded from Language field is not checked; you will need to be able to access the fields you define later. You can ignore the Template overrides section for this example.

5. Repeat steps 3 and 4 for each field you want to define. We suggest you define all of the example fields except the **fax**, **modem**, and **notes** fields, which you can define by following the instructions in “[Defining a field by copying an existing one](#)” on [page 3-5](#).



*Figure 3-2. Defining a field.*

## Defining a field by copying an existing one

If a field you're defining is similar to an existing field, you can make a copy of the first field and then modify it to create a new field. For example, in our sample application, you can create the **fax** and **modem** fields by copying the **phone** field.

To copy a field,

1. Highlight the field you want to copy in the Field Definitions list.
2. From the Field Functions menu, select Copy Field.
3. Enter a unique name for the new field and modify the information in any of the remaining input fields as desired; then exit the input window.

## Setting Up Your Repository

### Defining a Record Layout for Use in an Application

#### Reordering fields

The order in which the fields are listed determines the order in which they will exist within the structure. To move a field definition,

1. Highlight the field you want to move in the Field Definitions list.
2. From the Field Functions menu, select Reorder Fields.

The highlighted field is now enclosed in square brackets ([ ]), indicating that it can be moved.

3. Use the UP ARROW and DOWN ARROW keys to move the bracketed field to another position in the list.
4. Select Reorder Fields again to get out of move mode.

#### Saving your structure

When you attempt to exit the structure you're working on, Repository prompts you to save your changes.

To save your structure when exiting,

1. From the General menu, select Exit as many times as necessary. (For example, from the Field Definitions window, you'll need to select Exit twice.)
2. Select **Yes** when prompted to save your changes.

You can either define another structure in the Structure Definitions list or you can select Exit again to return to Repository's main menu.



## Defining User Interface Characteristics

The data fields you define in Repository can be read into Composer as predefined input fields. Such centrally defined defaults simplify the process of supporting an application: when you modify a repository definition (and rebuild the applications that use that repository), that change is inherited by every object that refers to the original definition—regardless of which application the object is in. As a result, not only are the data definitions consistent from one application to another, but the user interface is consistent as well. In addition, many changes required to localize or customize an application can be accomplished by making changes in the repository, which enables you to customize your user interface more quickly, with less chance of error.

When you define fields for use in Composer, you'll want to define not only the fields themselves but also the fields' attributes and formats. Then, once you've added the fields to an input window in Composer, you can modify the fields and add features in the interface designer's visual, WYSIWYG environment.

Here's what the primary input window in our example application is going to look like:

The screenshot shows a 'Contact Folder' dialog box with the following elements:

- Input fields for Company, Address, City, State, and Zip.
- Radio buttons for Mr., Mrs., Miss, and Ms., each followed by a label (Last, Phone, E-mail, Notes) and a corresponding input field.
- Input fields for First, Last, Phone, Fax, and Modem.
- Two dropdown menus at the bottom left.
- A grid of checkboxes for various licenses: Licensed for SL, PVCS, Tk, ODBC, RPS, and DTE.
- Buttons for OK, Cancel, and Help at the bottom.

## Defining a structure

Just like when you defined data fields for use by the Synergy compiler, the first step is defining a structure, as described on [page 3-3](#).

Instead of defining another new structure here, you can use the structure you created on [page 3-3](#) for our example user interface.

- ▶ From the Modify menu, select Structures.

## Defining how input is redisplayed in a field

When you define your fields' display attributes, you will have the option of selecting a predefined format to use when data is entered. For example, in our sample user interface, we'd probably want to assign a display format for the telephone number fields, Phone, Fax, and Modem.

So, to plan ahead, you can define two types of formats:

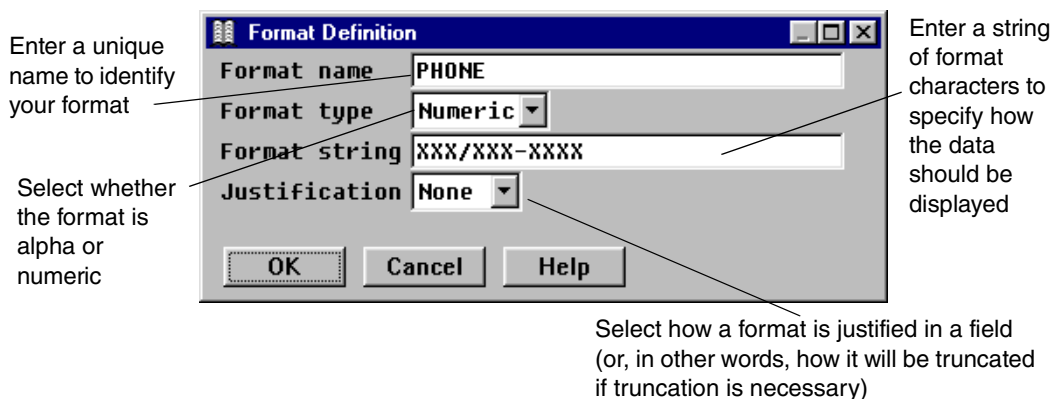
- ▶ Global
- ▶ Structure-specific

A global format can be used by a field definition in any structure. A structure-specific format is defined for a particular structure and can only be used by the fields in that structure.

To define a structure-specific format,

1. Highlight the structure for which you want to define a format in the Structure Definitions list.
2. From the Structure Functions menu, select Edit Attributes.
3. From the Attributes menu, select Formats.
4. From the Format Functions menu, select Add Format.

The Format Definition input window is displayed. (See [figure 3-3](#).)



*Figure 3-3. Defining a format.*

5. Enter the desired information in each input field and then exit the input window.
6. Repeat steps 4 and 5 for each additional format you want to define.
7. From the General menu, select Exit.

If you want your format to be global instead of structure-specific, simply define it by selecting Formats from the Modify menu in Repository's main menu. Steps 4 through 7 are the same, regardless of the type of format you defined.

## Defining fields

The next step in creating a user interface is to define the required input fields. In our example, we're going to use the same fields we defined on [page 3-4](#).

1. With your structure highlighted, select Edit Attributes from the Structure Functions menu. (If the Attributes menu is already present on your menu bar, go directly to step 2.)
2. From the Attributes menu, select Fields.
3. To view or edit the definition for an existing field, highlight that field and press ENTER.
4. Make sure the Excluded from Toolkit field is not checked for any of the fields; you will need to be able to access the fields you define later.

## Defining field attributes

Because we are designing a user interface, we need to define the appearance of each field on the screen as well as the field's behavior.

### Determining how the field will look

Repository refers to the field's appearance as "Display information." To specify display information for a field from the Field Definition input window,

1. On Windows, click the Display tab or press CTRL+TAB until the Display tab is displayed. On UNIX or OpenVMS, press TAB until the Display tab is displayed. (See [figure 3-4](#).)
2. Enter the desired information in each input field and then exit the dialog box or move to a different tab in the dialog box to define additional information.

(You can also get to the Display tab from the Field Definitions list. Highlight the field you want to modify, and select Edit Display Information from the Field Functions menu.)

### Determining how the field will behave

Repository breaks down the field's behavior into the categories "Input," "Validation," and "Methods." Input information determines how input must be entered and how it will be displayed and interpreted. Validation information defines what input is considered valid. Method information specifies any arrive, leave, drill, hyperlink, or change method subroutines associated with a field.

#### Specifying how input will be entered and displayed

To specify how input will be entered and displayed, do the following from the Field Definition input window:

1. On Windows, click the Input tab or press CTRL+TAB until the Input tab is displayed. On UNIX or OpenVMS, press TAB until the Input tab is displayed. (See [figure 3-5](#).)
2. Enter the desired information in each input field and then exit the dialog box or move to a different tab in the dialog box to define additional information.

## Setting Up Your Repository

### Defining User Interface Characteristics

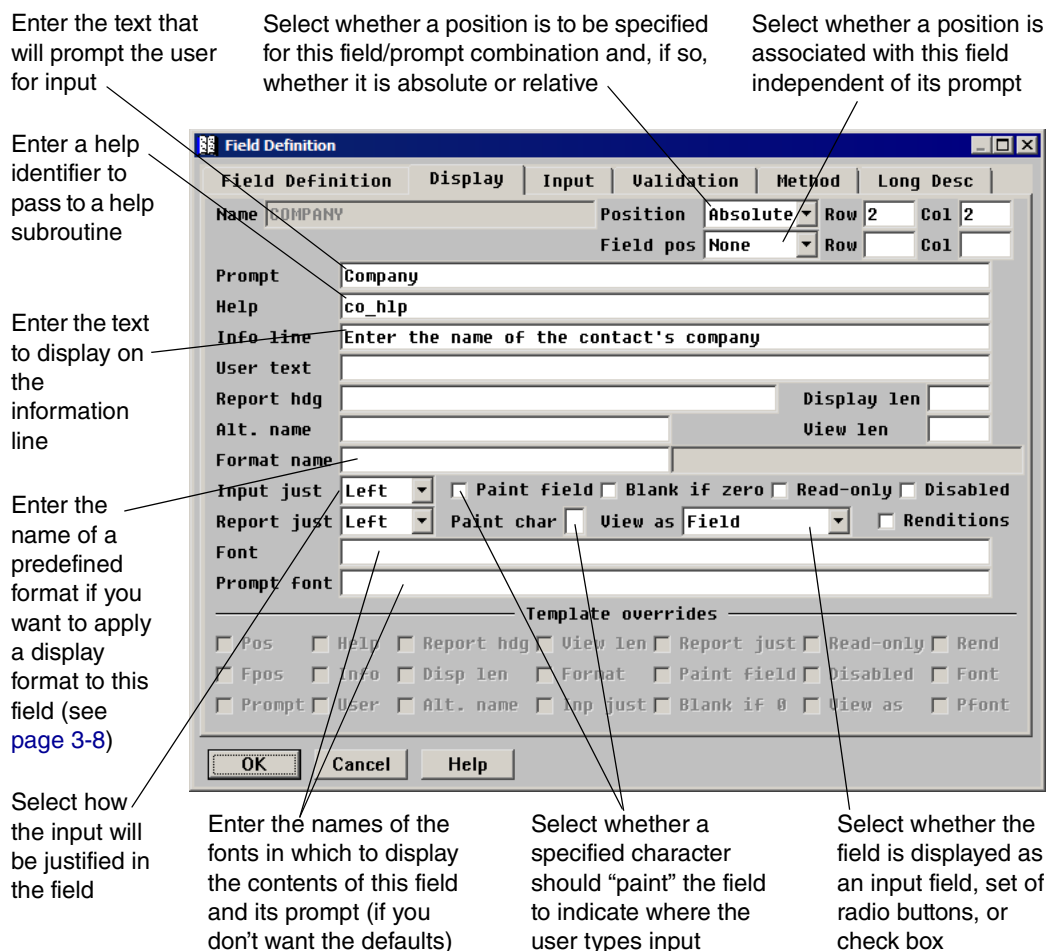


Figure 3-4. Defining display information.

(You can also get to the Input tab from the Field Definitions list. Highlight the field you want to modify, and select Edit Input Information from the Field Functions menu.)

### Specifying how input will be validated

To specify how input will be validated, do the following from the Field Definition input window:

1. On Windows, click the Validation tab or press CTRL+TAB until the Validation tab is displayed. On UNIX or OpenVMS, press TAB until the Validation tab is displayed. (See figure 3-6.)
2. Enter the desired information in each input field and then exit the input window or move to a different tab in the dialog box to define additional information.

(You can also get to the Validation tab from the Field Definitions list. Highlight the field you want to modify, and select Edit Validation Information from the Field Functions menu.)

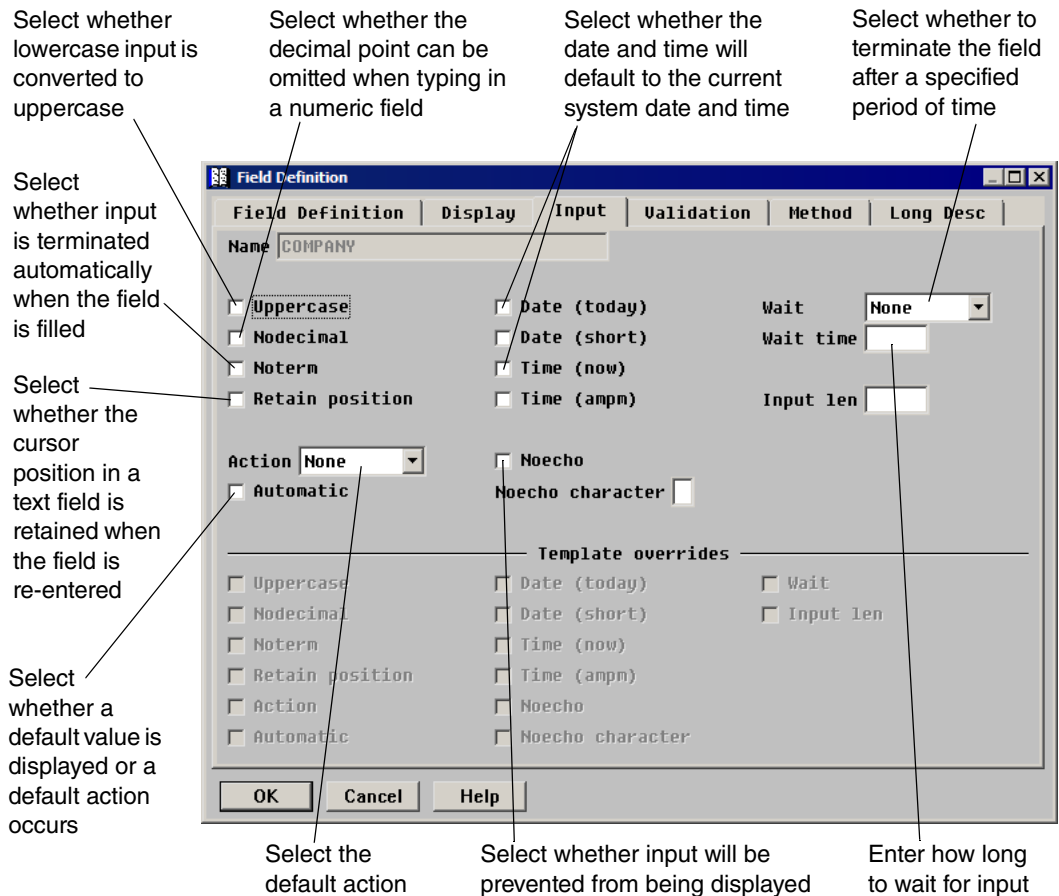


Figure 3-5. Defining input information.

### Specifying method subroutines for a field

You can assign the following types of method subroutines to an input field:

- ▶ Arrive method
- ▶ Leave method
- ▶ Drill method
- ▶ Hyperlink method
- ▶ Display method
- ▶ Edit format method
- ▶ Change method

## Setting Up Your Repository

### Defining User Interface Characteristics

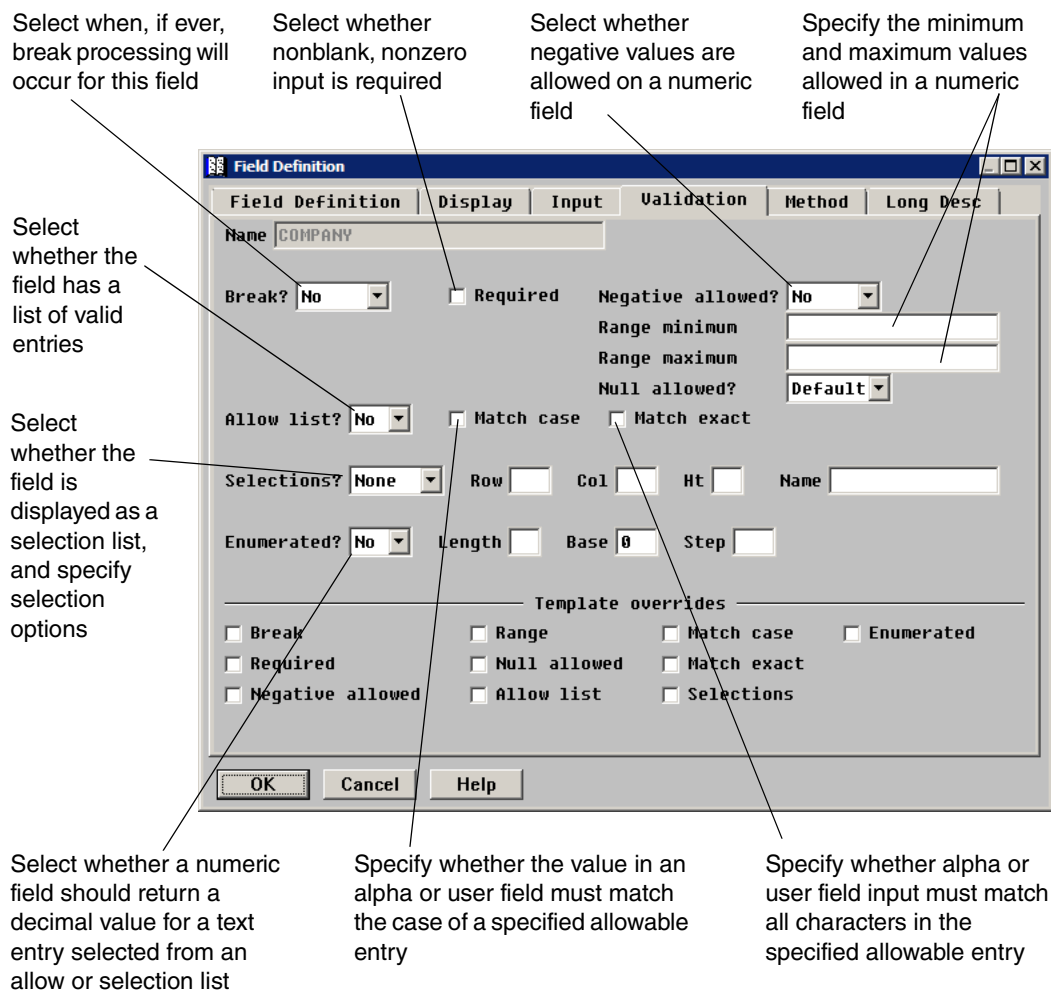


Figure 3-6. Defining validation information.

An *arrive method* subroutine is called to perform special processing before an input field is processed, while a *leave method* subroutine performs additional processing after an input field is processed (for example, validating the input).

If a *drill method* subroutine is specified, a drilldown button is displayed after the field in Windows environments. The subroutine is called when the user clicks the drilldown button (in Windows) or selects a drilldown menu entry (in Windows or non-Windows environments). A drill method is primarily used to look up additional information or display an input window.



A *hyperlink method* subroutine is called when the user clicks on an input field prompt. When a prompt is associated with a hyperlink method, that prompt is a hyperlink and the foreground color of the prompt is green.

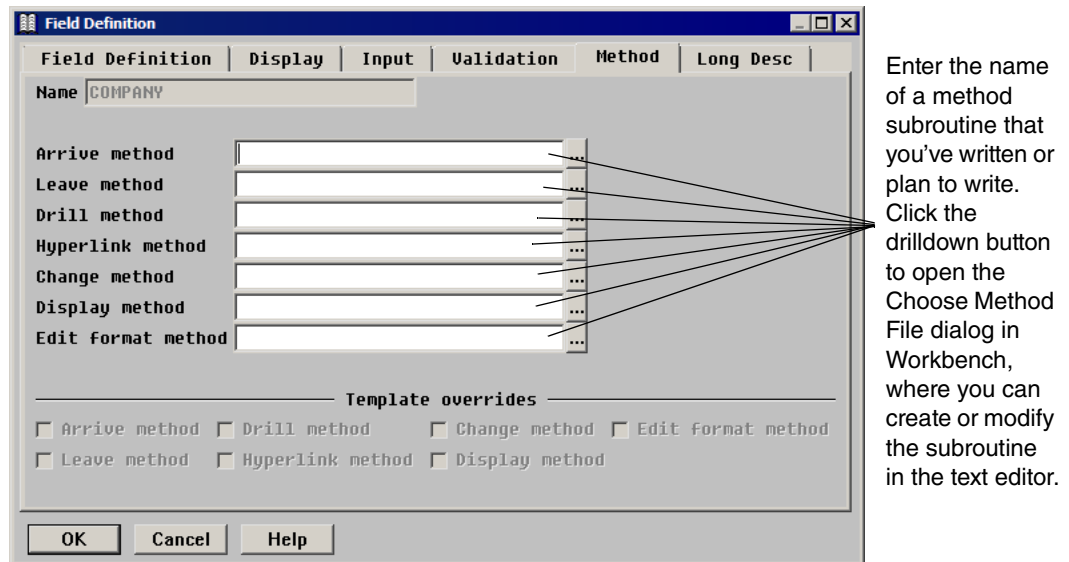
A *change method* function is called after a field is validated by the UI Toolkit I\_INPUT subroutine. It performs additional processing after an input field is changed (for example, validating radio button and check box fields).

A *display method* function is called before UI Toolkit displays the contents of an input field. Your display method can modify the display format of the input field, as well as its color and attributes, thus enabling you to override Toolkit's display format for the field.

An *edit format* method function is called before UI Toolkit has formatted the contents of an input field to be edited. Your edit format method can modify the edit format of the input field, as well as its color and attributes, thus enabling you to override Toolkit's edit format for the field.

To specify method subroutines for a field, do the following from the Field Definition input window:

1. On Windows, click the Method tab or press CTRL+TAB until the Method tab is displayed. On UNIX or OpenVMS, press TAB until the Method tab is displayed. (See [figure 3-7](#).)



*Figure 3-7. Defining method information.*

2. Enter the desired information in each input field and then exit the input window or move to a different tab in the dialog box to define additional information.

(You can also get to the Method tab from the Field Definitions list. Highlight the field you want to modify, and select Edit Method Information from the Field Functions menu.)

# Defining Files for ReportWriter

Repository seamlessly supplies information to Synergy/DE ReportWriter for creating reports. When you define fields for use in ReportWriter, you need to define not only the fields themselves but also the way the field will be used and displayed in a report, the keys that determine the relationships between files and how those keys will be linked with keys from other structures, and which files use which structures.

## Defining a structure

As when you were defining data fields for use by the Synergy compiler, the first step is defining a structure.

1. From the Modify menu, select Structures.
2. Select the structure you defined on [page 3-3](#).

## Defining fields

The next step in creating a user interface is to define the required input fields. In our example, we're going to use the same fields we defined on [page 3-4](#).

1. With your structure highlighted, select Edit Attributes from the Structure Functions menu. (If the Attributes menu is already present on your menu bar, go directly to step 2.)
2. From the Attributes menu, select Fields.
3. To view or edit the definition for an existing field, highlight that field and press ENTER.
4. Make sure the Excluded by ReportWriter field is not checked for any of the fields; you will need to be able to access the fields you define later.

## Determining how each field will be displayed in a report

In addition to defining the field's general appearance, which we did on [page 3-9](#), "Display information" contains field data that affects how the field is used and displayed in a report.

To specify display information for a field,

1. Highlight the field you want to modify in the Field Definitions list.
2. From the Field Functions menu, select Edit Display Information.

The Display Information input window is displayed. (See [figure 3-8](#).)



Enter the text to display as the column heading in a report

Enter the name of a predefined format if you want to apply a format to this field

Select how the data will be justified within the report column

Figure 3-8. Defining how a field will be displayed in a report.

3. Enter the desired information in the Report hdg, Format name, and Report just input fields and then exit the input window. (See [page 3-15](#) for instructions on predefining a format.)
4. Repeat steps 1 through 3 for each field you want to define.

## Defining a format

When you specify display information for a field, you can specify a predefined format to use with that field in a report generated by ReportWriter.

If you defined a format for an input field on [page 3-8](#), you can use that same format here. Otherwise, follow the instructions on [page 3-8](#) to define a display format.

## Defining a key to your record

A key is the portion of the data record that identifies the record and is used to access it. For example, if you define a company name field as a key with no duplicates, a record can be uniquely identified based on the company name. The keys you define in Repository also determine what relationships you can set up between database files, which in turn determine what additional information ReportWriter can access outside of a particular file.

## Setting Up Your Repository

### Defining Files for ReportWriter

The first key you define (or the first key in the list) is the primary key. A primary key must be an access key.

To define a key,

1. Highlight the structure you want to define a key for in the Structure Definitions list.
2. From the Structure Functions menu, select Edit Attributes.
3. From the Attributes menu, select Keys.
4. From the Key Functions menu, select Add Key.

The Key Definition input window is displayed. (See [figure 3-9](#).)

Enter a unique name for the key

Select whether duplicate values for this key are allowed in more than one record

Select whether the value of this key can be changed

If duplicates are allowed, select whether they'll be inserted at the front or end of a list of records that have the same key value

Select whether the key is a true key in the database file (Access) or not (Foreign)

Select the order in which the key field data is returned

Select whether this key can have a null value

Select whether the key segment type is field (F), literal (L), or external (E)

Enter the name of a field in the current structure (for F), a field in a different structure (for E), or a literal string (for L)

Enter the name of a different structure (for E)

**Key Definition**

Key name: COMPANY NAME  
Description: Company name  
Key type: Access  
Sort order: Asc  
Null key?: No  
Null value:   
Key of ref:   
Key density:   
Compress index:   
Compress record:   
Compress key:   
Excluded by ODBC:   
Dups allowed:   
Insert at:   
Modifiable:   
Compress index:   
Compress record:   
Compress key:   
Excluded by ODBC:   
OK Cancel Help

Seg	type	Field name or Literal	Structure name	Type	Order
1	F	COMPANY			
2					
3					
4					
5					
6					
7					
8					

Figure 3-9. Defining a key.

5. Enter the desired information in each input field and then exit the input window.
6. Repeat steps 4 and 5 for each key you want to define.
7. When you're finished defining keys, select Exit from the General menu.

## Defining a relation between two structures

To enable ReportWriter to cross-reference data between files, you must create *relations* between structures. A relation enables you to link the keys of one structure with the keys of another structure. For example, if you relate a company name key in a contact management file with a company name key in a sales transaction file, ReportWriter can access sales information for each company when you create a report of your business contacts. We recommend that you set up every relation you can think of that a ReportWriter end user might possibly need.

To define a relation,

1. Highlight the structure you want to define a relation for in the Structure Definitions list. (If the Attributes menu is already present on your menu bar, skip steps 1 and 2 and go directly to step 3.)
2. From the Structure Functions menu, select Edit Attributes.
3. From the Attributes menu, select Relations.
4. From the Relation Functions menu, select Add Relation.

The Relation Definition input window is displayed. (See [figure 3-10](#).)

Enter the name of the access or foreign key you want to relate

Enter the name of the structure to which you want to relate the first structure

Enter the name of an access key to which you want to relate the "From" key

Figure 3-10. Defining a relation.

5. Enter the desired information in each input field and then exit the input window.
6. Repeat steps 4 and 5 for each relation you want to define.

## Defining a file

Defining your database files through Repository enables you to access those files from ReportWriter. Once you define a file you can assign one or more structures to it, thus specifying which structures can be used to access that file.

To define a file,

1. From the Modify menu in Repository's main menu, select Files.
2. From the File Functions menu, select Add File.

The File Definition input window is displayed. (See [figure 3-11](#).)

Enter the name of the actual database file, including the logical (or physical) path

Enter a unique name for your file definition

Select whether the file is ASCII, ISAM, relative, or user-defined. The file type must match that of any structure you want to assign

Do not select this box if you want this file to be available in ReportWriter

File Definition

Filename: CUSTOMER

File type: DBL ISAM

Description: Customer master file

Open filename: DAT:customer.ism

Structure: 0 structures assigned

Record type: Fixed

Page size: 1024

Key density:

Addressing: 32-bit

Size limit: 0

Record limit: 0

Portable ints:

File text:

Temporary ☐ Track changes ☐

Compress ☐ No rollback ☐

Static RFA ☐ Terabyte ☐

Stored GRFA ☐ Network encrypt ☐

OK Cancel Help Assign

Figure 3-11. Defining a file.

3. Enter the desired information in each input field and then exit the input window.
4. Assign a structure to this file by following the instructions in [“Assigning a structure to a file”](#) on [page 3-19](#).

## Assigning a structure to a file

You must assign a structure to a file in order for the file to be able to use that structure. You can only assign a structure that has the same file type as the file to which you're assigning.

1. From the File Definitions list, select Assign Structures from the File Functions menu.
2. From the Structure Functions menu, select Add Structure.
3. Enter the name of a structure to assign to the file.
4. Repeat steps 2 and 3 for each structure you want to assign.
5. From the General menu, select Exit twice to return to Repository's main menu.

# Defining a Database Schema for xfODBC

A component of xfODBC, the **dbcreate** utility, uses repository data definitions to generate a system catalog, which prepares a Synergy database for ODBC access. A system catalog describes a Synergy database in a way that the xfODBC driver can understand. You can run **dbcreate** either from the command line or from within the xfODBC Database Administrator (DBA).

When you define data for use by xfODBC, your repository should contain a complete set of structures, tags, fields, and file information; templates for similar fields; and well-chosen keys and relations. See “[Setting Up a Repository](#)” in the “Preliminary Steps” chapter of the *xfODBC User’s Guide* for detailed instructions.

# 4

## Designing Your User Interface

Now that you've set up your repository, you can start designing your user interface. This chapter introduces you to S/DE Composer, UI Toolkit's visual user interface designer for Windows environments. We will take you through the steps of designing an input window and several of the objects it can contain.

### **Important Terminology 4-2**

Defines several of the terms used in this chapter.

### **What Is Composer? 4-3**

Describes what Composer is, what it looks like, and how to run it.

### **Using Composer 4-8**

Walks you through the design of an input window that contains predefined input fields imported from your repository, radio buttons, check boxes, selection list fields, a drilldown to a second input window, lines, standard input fields, and command buttons. This section also describes how to save and close a script file, close a project, and compile your script.

# Important Terminology

## What is an object?

In this manual, when we refer to an *object* we mean any window, list class, menu column, window field, input field, selection window entry, menu entry, text, line, box, or button. Each object is an independently designed element that has certain characteristics and values and exhibits certain behavior.

## What is a window?

The term *window* refers to the window you're designing and encompasses general windows, input windows, and selection windows.

- ▶ A *general window* usually conveys information, such as error or informational messages.
- ▶ An *input window* contains one or more defined input fields into which the user can enter data.
- ▶ A *selection window* contains a group of predefined selections from which the user can choose.

## What are attributes and properties?

An *attribute* is a characteristic of an object, and a *property* is the value of an attribute. For example, color is an attribute, and red is a property.

## What is a script file?

A *script file* is an editable text file that contains special script commands to define and control user interface objects and their characteristics. When you design your user interface in Composer, the script commands are generated into a script file for you. Once your script file is created, it must be compiled.

The advantage of using script files is that your user interface objects are defined outside of your programs. You can modify object properties without changing or recompiling your Synergy DBL subroutines.

## What is a project?

Composer organizes your script files in *projects*. A project is a collection of one or more related script files (for example, all of the script files for a particular application).



# What Is Composer?

S/DE Composer is a powerful user interface designer that enables you to create the elements of your interface graphically using the mouse and keyboard on Windows systems. You can easily move, resize, and change the characteristics of your interface objects in a WYSIWYG environment. Then, after you interactively design your general windows and input windows, Composer will generate the appropriate window scripts.

## Starting Composer

To start Composer, do one of the following:

- ▶ From the Workbench toolbar, select Composer.
- ▶ At a command prompt, type

```
dbr SYNBIN:composer
```

If you are not in the directory that contains **dbr.exe**, DBLDIR\bin must be in your path. Likewise, the SYNBIN environment variable must be in your path, and it must be set to the directory in which Composer is installed.

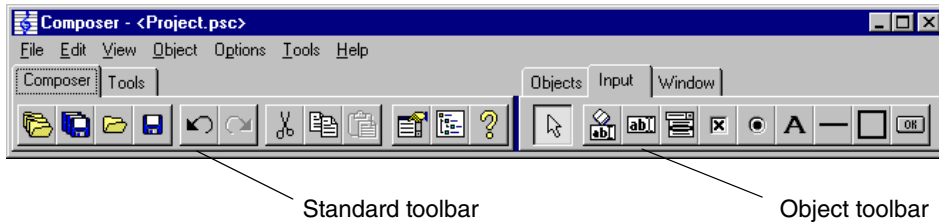
## What's on your Composer screen?

Composer consists of four windows:

- ▶ The Control Bar window
- ▶ The Application window
- ▶ The Properties window
- ▶ The Object Manager window

## The Control Bar

The Control Bar manages the entire Composer application. It contains Composer's menu bar and toolbars. To exit Composer, close the Control Bar window.



*Figure 4-1. The Control Bar window.*

Composer has two toolbars, separated by a line:

- ▶ The Standard toolbar
- ▶ The Object toolbar

The Standard toolbar gives you quick mouse access to the most common project management, object editing, and window and tool access functions. It has two tab sets: Composer and Tools.

The Object toolbar enables you to create and manipulate user interface objects quickly. It consists of an arrow pointer button and a tabbed toolbar. The arrow pointer button enables you to select objects in the Application window. The toolbar has three tab sets: Objects, Input, and Window.

To display the name of a toolbar button, hold your mouse pointer over the button for two seconds.

## The Application window

The Application window provides an area in which you can design your user interface. This design area contains a grid that represents cell-based rows and columns. When you move or size user interface objects, they snap to the grid. Objects created in the design area also contain grids, so that objects created within those objects will snap to row/column boundaries as well. You can turn off the grids if you need to (for example, when you want to print your screen).

The title bar for the Application window contains the name of the current script file.

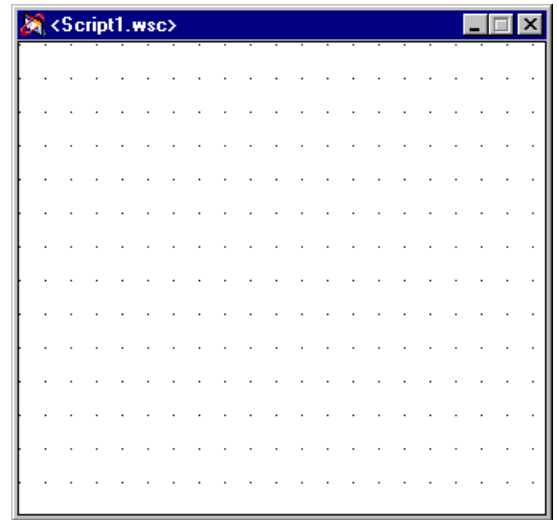


Figure 4-2. The Application window.

## The Properties window

The Properties window contains a list of design object attributes, followed by the property, or value, for each attribute. The attributes and properties displayed always belong to the object that's currently selected in the Application window. If no object is selected in the Application window, the properties displayed are those of the active script file.

Some attributes have subattributes and must be expanded before you can view or modify the subattributes. Such attributes are preceded by a plus sign (+). When the attribute is expanded, it is preceded by a minus sign (-). To expand or collapse an attribute, double-click on it.

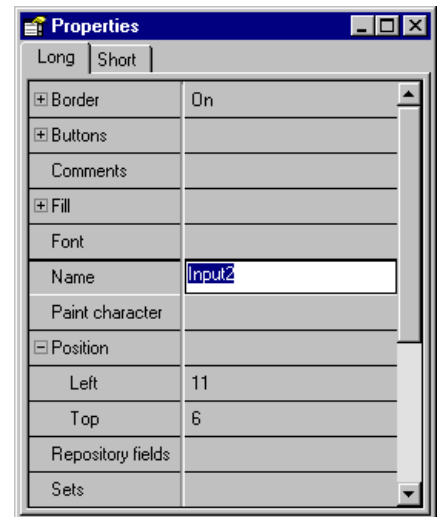


Figure 4-3. The Properties window.

## The Object Manager

The Object Manager window displays a visual representation of the project file, script file(s), and user interface object hierarchy in the following order:

- ▶ Project file
- ▶ Script file
- ▶ Containing object
- ▶ Contained object

From Object Manager, you can move, copy, delete, or rename objects.

The Object Manager window has its own menu bar, which contains functions available in Object Manager. It also has a status bar at the bottom to indicate the activity being performed.

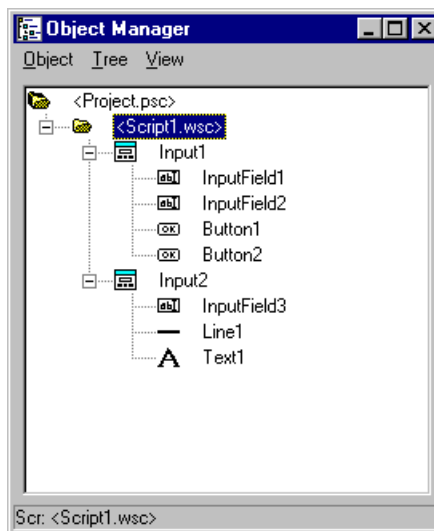


Figure 4-4. The Object Manager window.

The order in which the objects are listed is the order in which they are generated when the script file is written or updated. Files or objects that can be expanded are preceded by a plus sign (+).

Expanded files or objects are preceded by a minus sign (–). To expand or collapse a file or object, double-click on it. Script files or objects that have not been fully compiled display the letter U (for “unprocessed”).

## Using Help

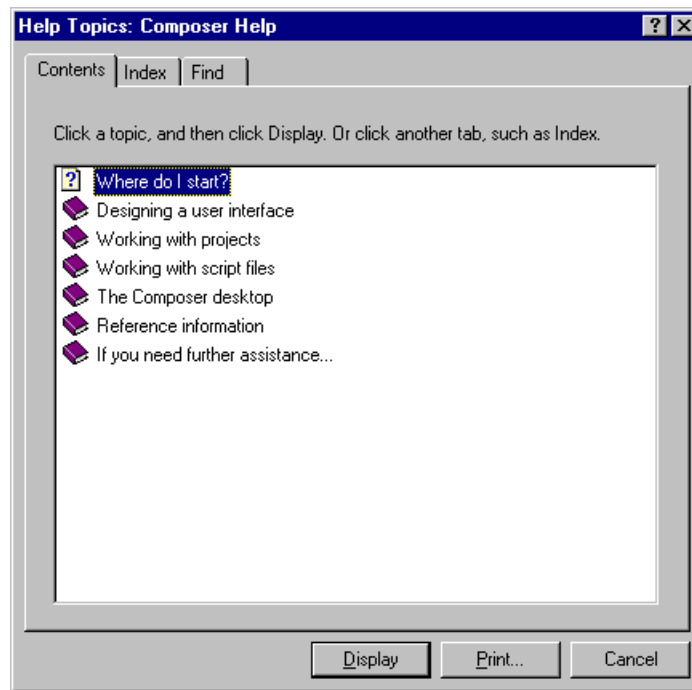
Composer has an extensive online Help system to give you instructions for just about anything you’ll need to do. If you can’t find the information you need in this guide, you can search the online Help for additional options and procedures:

- ▶ From the Help menu, select Composer Help Topics, or click the Help Topics button on the toolbar.



From the Help Topics screen (see [figure 4-5](#)), you have three ways to search for information:

- ▶ Click the Contents tab to browse through topics by category.
- ▶ Click the Index tab to see a list of index entries. Either type the word you’re looking for or scroll through the list.
- ▶ Click the Find tab to do a full-text search of words or phrases that may be in a Help topic.



*Figure 4-5. Using Composer Help.*

Composer also provides help that is specific to the currently selected or highlighted item. To display context-sensitive help for a Composer window, dialog box, property, or object, do one of the following:

- ▶ Select the item and press F1. (From a dialog box, you can also click the Help button.)
- ▶ Point to the item with the arrow pointer, click the right mouse button, and select Context Help from the displayed context menu.

To display help for a menu command,

- ▶ Pull down the menu, highlight the command (without selecting it), and press F1.

## Using Composer

While this manual is not a tutorial, we believe that the quickest way to get you designing with Composer is for you to set up a sample user interface screen. As an exercise, you can use the same application for which you set up a repository in [chapter 3, “Setting Up Your Repository.”](#)

Here’s the primary input window you’re going to design:

The screenshot shows a window titled "Contact Folder" with the following elements:

- Input fields for "Company", "Address", "City", "State", and "Zip".
- Radio buttons for "Mr.", "Mrs.", "Miss", and "Ms." followed by input fields for "Last", "First", "Phone", "Fax", "Modem", "E-mail", and "Notes".
- Two dropdown menus.
- Checkboxes for licensing: "Licensed for SL", "Licensed for PVCS", "Licensed for Tk", "Licensed for ODBC", "Licensed for RPS", and "Licensed for DTE".
- Buttons for "OK", "Cancel", and "Help" at the bottom.

We recommend that you run Composer and actually create this input window (or one of your own) as you read through the procedures below. Don’t be afraid to experiment and make mistakes: you can always click the Undo (or Redo) button if you change your mind.

## Designing an input window using repository fields

### Creating an input window

When you create any object in Composer, you can either let Composer place the object in a default location, or you can specifically place it where you want it to go. These instructions tell you how to create an input window of the size and in the location you desire:

1. Click the Input window button on the toolbar.



2. Click and drag on the desired location in the Application window until the window is large enough to hold the fields shown in the screen above.

To create an input window of a default size in a default location, simply double-click the Input window toolbar button.

### Adding a window title

To specify a title to be displayed in the window's title bar,

1. Select the window by clicking on it in the Application window.
2. Click the Title property in the Properties window and enter the name of the title you desire (Contact Folder, in our example).

## Adding predefined repository fields

You can add input fields you've defined in S/DE Repository to the input window you just created.

1. Select the input window in the Application window if it's not already selected.
2. Click the Repository field button on the toolbar.



The Repository Fields dialog box is displayed. Because this is the first repository field you're adding, you need to add a repository structure before you can place any fields. (If you were adding a second or any subsequent repository fields, you could skip steps 3 through 7 below.)

3. Click the Select button.

The Select Repository Structure dialog box is displayed. (See [figure 4-6](#).)

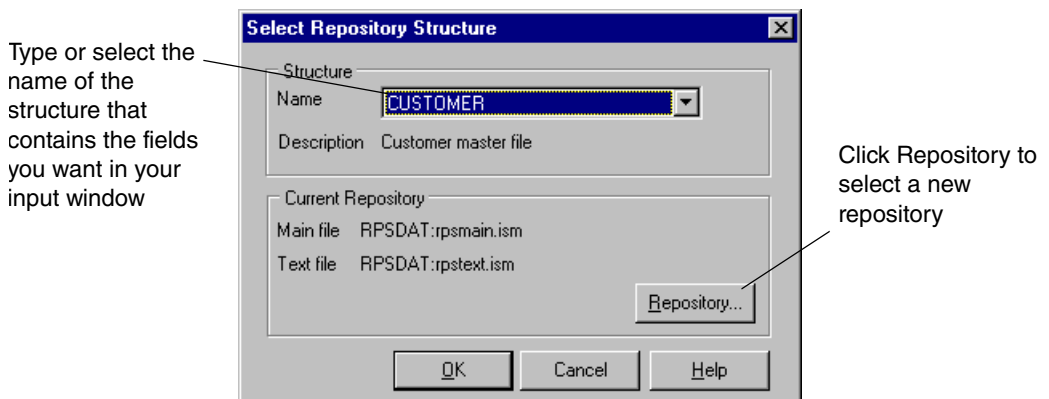


Figure 4-6. Selecting a Repository structure.

4. In the Name field, select the name of the structure that contains the fields you want to add to your input window.
5. Click OK to return to the Repository Fields dialog box. (See [figure 4-7.](#))

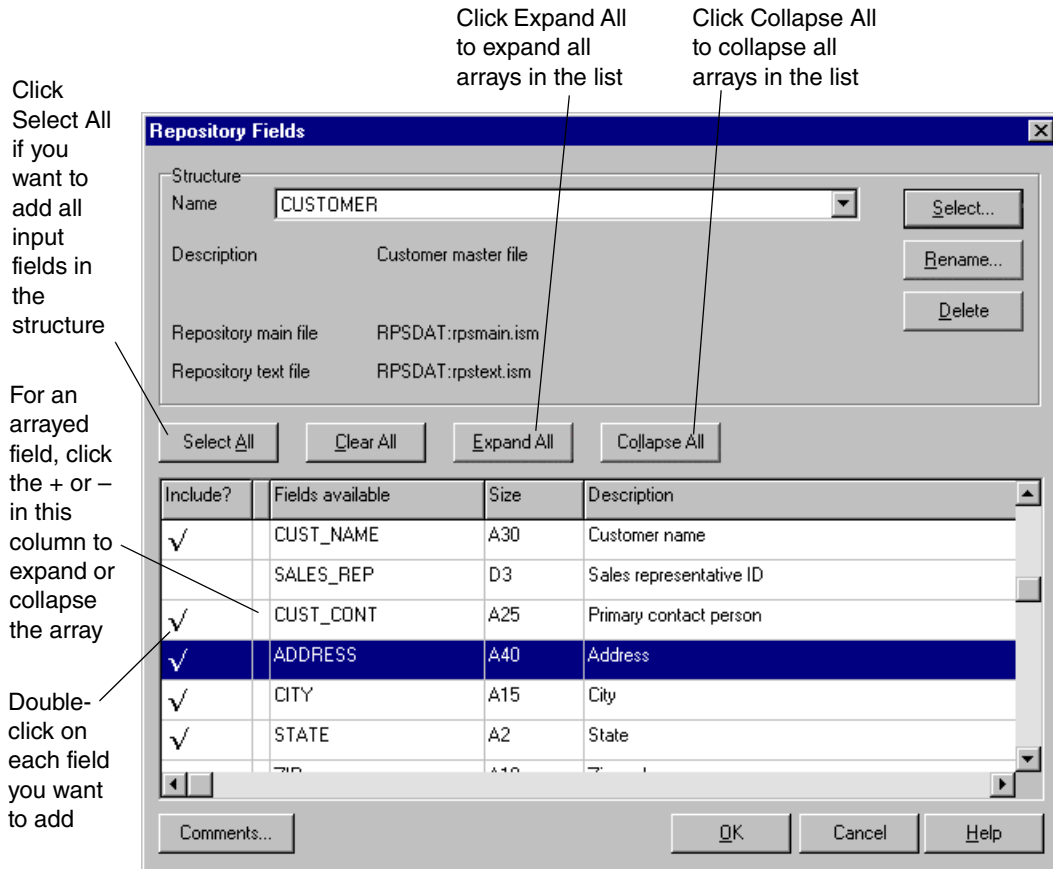


Figure 4-7. Adding Repository fields.

6. From the list of input fields, either double-click on each field you want to add or click the Select All button to add all input fields in the list.

Arrayed fields are indicated by a + or - in the untitled column. Click on the + or - to expand or collapse an array. When an array is expanded, you can select individual elements of the arrayed field to add to the input window.

7. When you're finished adding fields, exit the dialog box.



## Fine-tuning your input fields

### Moving fields

Now that you see how the fields are laid out, you might want to change their positions. To move one or more fields,

1. Select the field or group of fields you want to move in the Application window. (To select a group of fields, click on the first field and then CTRL+click on all additional fields you want to include in the group.)
2. Click and drag anywhere on the field or on any field in the group (except on a sizing handle) until the field's outline is in the location you want.


### Changing a prompt

To change the prompt for an input field,

1. Select the input field in the Application window.
2. Click the Prompt property in the Properties window and type the desired text of your prompt.


## Creating a line

To add a line to your input window,

1. Select the input window by clicking on it in the Application window.
2. Click the Line button on the toolbar. 
3. Click and drag on the desired location in the Application window until the line is the desired orientation and size. (Drag vertically if you want a vertical line or horizontally if you want a horizontal line.)

## Creating a command button

To add an OK button to your input window,

1. Select the input window by clicking on it in the Application window.
2. Double-click the Button button on the toolbar. 
3. In the Properties window, **Text** is already displayed as the Face property, so click the Text subattribute and enter the text OK.
4. Click the Name attribute and enter the menu entry you want this button to generate, in this case I\_OK.

You can repeat these steps to create Cancel and Help buttons or any additional buttons you desire. The Name properties for standard Cancel and Help buttons should be O\_ABANDON and O\_HELP. For nonstandard buttons, you can assign functionality in one of two ways:

- ▶ In the Name property, enter the name of a menu entry (as instructed in step 4 above).
- ▶ In the Method property, enter the name of a method routine that will perform special processing, or click the drilldown button to display the Choose Method File dialog box in Workbench so you can select or create a source file that contains or will contain the method routine code. (See [“Using code templates” on page 2-31](#) for more information.) You can also enter the name of an executable subroutine library in the Library subproperty.

If you want to create a button that displays a bitmap graphic instead of text, simply select **Bitmap** as the Face property and then enter the name of the bitmap file, including the full directory path or logical.

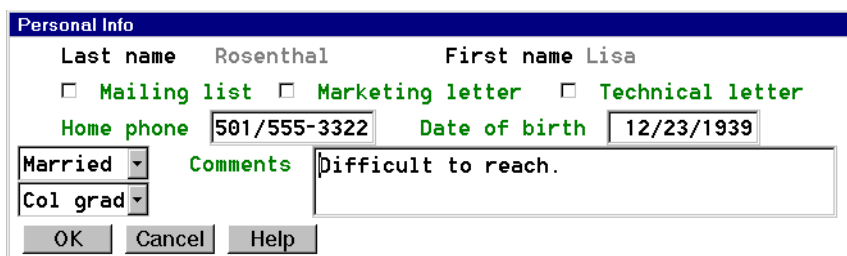
A button can also have a quick-select character, which enables the user to simulate clicking the button in your application by pressing **ALT+character**. If you want the button to have a quick-select character, click the Select character attribute and enter the quick-select character. If the button contains text, the first occurrence of the quick-select character will be underlined.

## Designing an input window from scratch

Now we’re going to create an input window whose fields have not been predefined in Repository.

### Creating a “drilldown” input window

The Last field has a drilldown button, so we’re going to create a second input window that’s a drilldown from the first. In our application, our drilldown method for the field will display and process this second input window. Here’s what it looks like:



To create the second input window in a default location,

1. Double-click the Input window button on the toolbar.



2. Click the Title property in the Properties window and enter the name of the title you desire (Personal Info, in this example).

## Creating new input fields

We haven't defined any input fields for this window in the Repository, so this time you'll need to create the fields from scratch. To add several new input fields to your input window,

1. Select the input window by clicking on it in the Application window.
2. SHIFT+click the Input field button on the toolbar.



3. For each field you want to create, click and drag on the desired location in the Application window until the field is the desired size.
4. Repeat step 3 until you've created as many input fields as you like.
5. Click any other Object toolbar button to cancel creation mode.

## Setting input field properties

### Specifying a prompt

1. Select the input field in the Application window.
2. Click the Prompt attribute in the Properties window and type the desired text of your prompt.

If you want your prompt to be a hyperlink that calls a subroutine to perform special processing whenever the prompt is clicked, double-click the +Methods attribute to display the Hyperlink method attribute. Then click the Hyperlink method attribute and type the name of a hyperlink method subroutine you've written or plan to write, or click the drilldown button to display the Choose Method File dialog box in Workbench so you can select or create a source file that contains or will contain the method routine code. (See [“Using code templates” on page 2-31](#) for more information.) Hyperlink prompts are displayed in green.

### Setting size

You'll probably want to make sure your input fields are the right size. To size a field,

1. Select the field by clicking on it in the Application window.
2. In the Properties window, look at the Size property.
3. If the size is not what you want, type a new size or click and drag on one of the field's sizing handles in the Application window.

### Adding a check box

You can either display an existing input field as a check box or create one from scratch using the Check box toolbar button.




To display an existing input field as a check box,

1. Select the input field by clicking on it in the Application window.
2. In the Properties window, under the Type property, set the View as subproperty to Check box.

### Adding a selection list field

Two of the fields in our example are selection list fields (sometimes referred to as “combo boxes”). You can either display an existing input field as a selection list field or create one from scratch using the Selection list toolbar button.

To create a selection list field using the Selection list button,

1. Select the input window in the Application window.
2. Double-click the Selection list button. 
3. Click the Selections attribute in the Properties window and then click the drilldown button.
4. In the Selections dialog box, select **Selection list** in both the Type and View as fields. (If you have a predefined selection window, you can select **Selection window** as the Type.)
5. Replace Entry 1, Entry 2, and Entry 3 with the selection items of your choice, pressing ENTER after each.
6. Exit the dialog box.

### Adding an editable text field

The Comments field in our example is an editable text field, which is a real alpha array. When the user enters input into a text field, the text wraps automatically.

To create an editable text field,

1. Create an input field or select an existing input field in the Application window.
2. Set the Dimension subproperty (under Type in the Properties window) to a value greater than 1.

Specifying information line text

You can display instructions or other text on the information line of your application screen when the user moves the cursor to a field. For instance, in our Personal Info example, you might want to display the text “Select the marital status of this contact” for the first selection list field.

To specify information line text for a field,

1. Select the input field in the Application window.
2. In the Properties window, set the Information line property to the text you want to display when this field is active.

Specifying methods

You can specify routines to be called in the following situations:

To specify a routine to be called	Use this method
Before an input field is processed	Arrive
After an input field is processed	Leave
When the field contents are being edited	Edit format
When the field’s contents have been validated	Change
Before the field’s contents are displayed	Display
When the user clicks on the field’s prompt	Hyperlink
When the user clicks the field’s drilldown button	Drill

These method routines enable you to perform additional processing, such as validating or formatting the input. If you don’t specify these subroutines, no special action is taken.

To specify method routines,

1. Double-click the +Methods attribute to display the method attributes.
2. Click the desired method attribute, and either type the name of a method routine you’ve written or plan to write or click the drilldown button.
3. If you click the drilldown button, Workbench will be launched (or brought to the top), and the Choose Method File dialog box will be displayed if the specified method is not in any of the source files in the current project. In the Choose Method File dialog, select or create a source file that contains or will contain the code for the method you are specifying.

(In [chapter 6, “Implementing Your User Interface with UI Toolkit,”](#) you will write sample arrive and leave method subroutines.)

### Saving your work

When you're finished defining the input windows in our exercise, you have several options:

- ▶ Close your project.
- ▶ Save or close the current script file.
- ▶ Continue defining user interface objects in this script file or create and modify other script files for additional practice.

### Closing your project

When you close your project, Composer will prompt you to save any unsaved script files, as well as the project itself. To close the active project,

1. From the File menu, select Close Project.
2. When prompted as to whether you want to save changes to your script, click Yes.

Because your script still has a temporary name, you are prompted to enter a permanent name.

3. In the Save <Script*n*.wsc> As? dialog box, select the desired drive and directory, and type the desired script filename in the File name field.
4. Click OK.

Composer generates a script file with the name you specified. You are also prompted to save changes to your project.

5. In the Save <Project.psc> As? dialog box, select the desired drive or directory and type the desired project filename in the File name field.
6. Exit the dialog box.

### Saving a script file

To save a new or existing script file,

- ▶ Click the Save Script button on the toolbar.

If the script has the temporary name <Script*n*.wsc> (where *n* is a number), you are prompted to enter a script filename.

### Closing a script file

When a script file is closed, all of its open objects are removed from the Application window. To close your script file,

- ▶ From the File menu, select Close Script.

If the script has not been saved since the last time you made changes, you are asked whether you want to save changes to your script.

## Compiling your script

You must compile your script before you can use it in your application. To specify compilation options,

1. From the File menu, select Compile Scripts Setup.

The Compile Scripts Setup dialog box is displayed. (See [figure 4-8](#).)

Select Overwrite to overwrite the existing library file on compilation or Append to append the current compilation to the existing library file

Type or select the name of the library file to use

Either select the Select all check box to select all script files in the project for compilation OR select the script files you want to compile by checking the box to the left of each script.

Type or select the name of a file to which the compiler will write any errors encountered during compilation

Click Compile to compile all of the specified script files

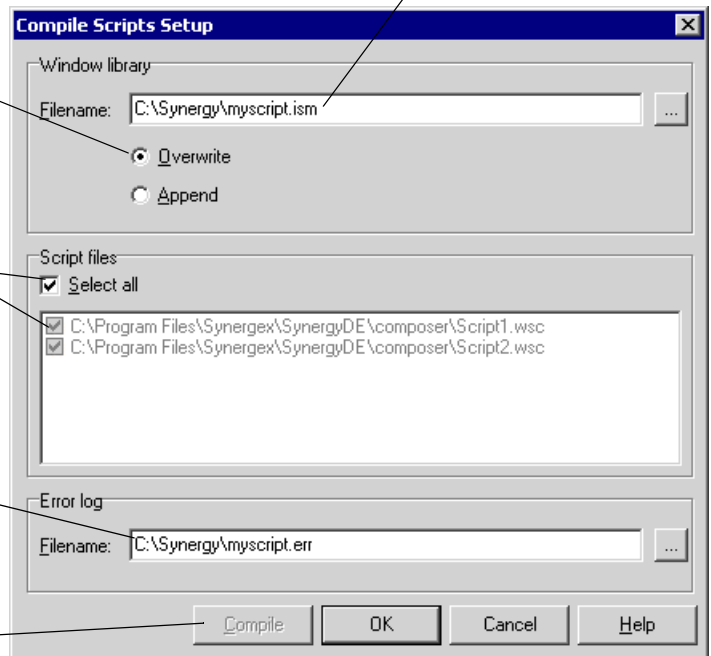


Figure 4-8. Compiling a script.

2. Select the scripts you want to compile and enter the desired information in the other input fields.
3. If you want to compile the selected scripts right now, click Compile. If you want to compile later, click OK to exit the dialog box.

When you compile, the Script compiler reads the selected script files and converts them to a window library (ISAM file).

To compile scripts later,

- From the File menu, select Compile Scripts.

If you have not set up any script compilation options, this command compiles the default set of scripts (which is all scripts in the project).

### Exiting Composer

To exit Composer, do one of the following:

- ▶ Click the Control Bar's Close button.
- ▶ From the File menu, select Exit.



# 5

## Programming in Synergy DBL

This chapter introduces Synergy DBL and steps you through building and running a simple application. It also acquaints you with features of DBL that will help you optimize performance and simplify maintenance.

### **What Is Synergy DBL? 5-2**

Defines what Synergy DBL is and briefly describes the structure of a Synergy program.

### **Compiling, Linking, and Running Your Program 5-5**

Describes the procedures required to transform your source modules from text files into object files and finally into an organized structure that is executed by the Synergy runtime. This section also provides a short explanation of object libraries and executable libraries.

### **Debugging Your Program 5-9**

Explains how to include and use the debugger in your application.

### **Advanced Features 5-12**

Describes how to use dynamic memory and how to dispatch routines dynamically.

### **Programming Tips 5-18**

Provides a variety of suggestions and introduces several capabilities of Synergy DBL that will help your programs run more efficiently and make them easier to maintain.

# What Is Synergy DBL?

The fundamental component of Synergy/DE is Synergy DBL. Most of the other elements are intended to work as layered tools on this basic component. Synergy DBL provides the framework for integrating all other required components of Synergy/DE into a seamless development environment that will ultimately help you develop your total business solution. Its comprehensive capabilities and features make it easy to develop, maintain, and extend your applications.

One of the most significant benefits of Synergy DBL is the fact that applications written in DBL are source-code portable to a multitude of hardware and software platforms, including Windows, OpenVMS, and popular flavors of UNIX. (Contact your Synergy/DE account manager for a full list of currently supported platforms.) In many cases, recompiling is not even necessary; in others, compiling and linking are the only requirement.

Synergy DBL provides many system-level functions directly from within the language. This means you don't have to worry about getting system-level expertise to do things like set system environment variables; perform sorts; obtain system values; and create, delete, or rename files. Each of these functions is performed from within the program through a call to a system-supplied external subroutine with a standard interface that does not change between platforms. By using these routines, you can standardize your installation procedures and simplify your maintenance overhead.

In addition to providing you with a mechanism for having a single set of sources for multiple platforms, Synergy DBL provides you with an excellent methodology for making data portable across platforms. If you use the Synergy DBMS utilities and take advantage of the system-supplied subroutines for ISAM file creation, creating multikeyed access files on any supported platform is quite painless. You do not need expertise in creating files on the target platform; simply run your creation program and populate your database files with the supplied utilities. The process is the same on any supported platform. Synergy/DE makes porting an opportunity, not a problem.

## Creating a source file

If you are creating your source files for the first time, it is important that you do it correctly, as you may be able to use some of these routines as templates for future development.

## Selecting an editor

Professional Series Workbench includes a Synergy DBL-sensitive visual editor that automates code formatting and provides keyword recognition and completion, popup argument lists for Synergy routines, and integration with the Synergy compiler. If you're developing on Windows, we recommend you use this visual editor to simplify your editing process.

If you do not use the Workbench visual editor, you may use any popular word processing or text editing software (such as Microsoft Word or Notepad) or an editor from the command line. It really does not matter, as long as the editor you use is capable of writing out the final result as an ASCII text file, with no additional formatting or header information embedded in the file. Most word processing products will generate this type of file if you save your document as text only.

If your editing tool appends its own extension to your files, you may want to change that at the system level to take advantage of the defaults of the Synergy/DE components or to adhere to standards in your development organization. We recommend using the default extension **.dbl** for Synergy DBL source files.

## Creating your modules

Once you have chosen your editing tool, you can begin creating or modifying your source code. Establishing a standard for your development is an important part of the decision process for a successful development effort. Once development has been ongoing for some time, it is difficult to retrofit standards into existing code. Choose some standard methodology and try to stick to it. You can obtain our suggested coding standard by contacting your Synergy/DE account manager.

A major benefit of Synergy DBL is that you can group multiple routines in a single source module. This enables you to combine subroutines that are unique to a program within the same source module, thus reducing the number of compilations required to generate program objects. All of your definitions are maintained across the routines, requiring you to put definitions in only one place.

## Structure of a Synergy program

A Synergy program contains one or more prototype imports, structures, namespaces, classes, and routines. A Synergy DBL routine is composed of two main parts: a data division and a procedure division. The data division contains most of the declarations, directives, and statements necessary to identify the various data structures that will be referenced by the program statements. The procedure division contains all of the operational statements that act on the data structures contained in the data division. Any data structure that is referenced in the procedure division must either be defined in the data division of the routine with which it is associated or in the procedure division as a stack local variable. You can define data structures that are not referenced in the procedure division, but you cannot have references in the procedure division that are not previously defined in the routine.

## Identifying your routine

Your routine should start with a statement that identifies what type of routine you are creating. The statements that identify routine types are **MAIN**, **SUBROUTINE**, **FUNCTION**, and **METHOD**. Each one of these statements tells the compiler that this is the beginning of the data division or parameter section for this routine. For a more comprehensive discussion of these statements, see the [“Synergy DBL Statements”](#) chapter of your *Synergy DBL Language Reference Manual*.

## Data division

A data division contains classes, structures, records, fields, groups, literals, temporary definitions, references to data segments located outside of the program, and possibly definitions of external functions that are referenced in the procedure division. In addition, we highly recommend that each routine contain comments that describe the purpose of the routine and define any interactions with other routines. If the routine is an external subroutine, function, or method, the arguments that are passed to and returned from the routine should also be defined.

The end of the data division and the start of the procedure division is defined by the PROC statement.

## Procedure division

The procedure division contains the logic and operational statements that will be executed to make your program perform the task you desire. Each statement will be executed according to the syntax and semantics defined in the *Synergy DBL Language Reference Manual*. Synergy DBL allows for data manipulation, file and terminal I/O, program logic control, arithmetic operations, and conditional execution. By combining these capabilities, you should be able to create a routine (or group of interacting routines) that solves any business problem.

The end of the procedure division is defined by the END, ENDMAIN, ENDSUBROUTINE, ENDFUNCTION, or ENDMETHOD statement. These statements tell the compiler that the routine is complete and prepares it to deal with the next routine.

## See also

Your *Synergy DBL Language Reference Manual*, which contains the syntax and specifications for every statement and system-supplied subroutine in Synergy DBL. Refer to this manual for further information.

# Compiling, Linking, and Running Your Program

Once you've written your source modules, you must compile, link, and run your programs. Here are the steps you should follow:

1. Compile each source module. See [“Compiling your program”](#) below.
2. If desired, combine your compiled routines in an object library. See [“Creating object libraries” on page 5-6](#). Creating an object library simplifies the linking process (as well as your distribution strategy).
3. Link your compiled routines or object library, generating an executable library if desired. See [“Linking your program” on page 5-6](#).
4. Test your program by running it. See [“Running your program” on page 5-8](#).

## Compiling your program

The Synergy compiler interprets the ASCII code you have written in your source modules and, using the rules of Synergy DBL, creates another file that contains the instructions to perform the program actions you have specified. The output from the compiler is called object code and is sometimes referred to as an object file. Most applications are composed of many of these individual object files that are bound (or linked) together into a single executable program.

By default, the compiler expects the input source module to have the extension **.dbl**. If your programs follow this convention, you will not have to specify a filename extension in your compiler commands. The compiler creates output files with the following default extensions:

Extension	File type
.dbo	Generated object file
.lis	Listing file

We recommend using these default filename extensions so that other tools (for example, Windows Explorer) will know what type of file it is.

For instructions on compiling your program, refer to the [“Building and Running Synergy Applications”](#) chapter in *Synergy Tools*. You can also compile your program directly from Professional Series Workbench by doing the following:

1. Make sure the file you want to compile is open.
2. From the Project menu, select Compile.



There are many other ways to request a source compile on various platforms. For example, Serena ChangeMan Builder's **make** command is an excellent choice for program builds.

---

## Creating object libraries

Once you've created a number of related external subroutines and have tested them thoroughly, you may want to group them together so you can reference them as a single entity. Instead of having to remember to include all of the object files that are referenced in each program every time you link the application, you can create an object library using the Synergy librarian.

An object library is a collection of object files that have been compiled and stored in a special file that can be referenced by the Synergy linker. Any routines that are included in the object library will be extracted from the library at link time. Thus, instead of distributing hundreds of **.dbo** files, you can distribute a single **.olb** file that contains all of the compiled source code routines.

For instructions on creating an object library, refer to the [“Building and Running Synergy Applications”](#) chapter in *Synergy Tools*.

## Linking your program

After you've compiled your source code into object files, you must gather the object files into a cohesive unit so they can be executed as a single program. This gathering is done by the linker program. The linker also performs many other functions, such as resolving addresses for global symbols, figuring out where external data references are located, identifying the exact location of external routines so your program can call them, and associating all program information with the required system resources for your system. The output from the linker is an executable program: a complete, self-contained group of instructions capable of being executed by the runtime.

By default, the Synergy linker expects your object files to have the extension **.dbo**. If your programs follow this convention you will not have to specify a filename extension in your linker commands. The linker creates output files with the following extensions:

Extension	File type
.dbr	Executable file
.map	Map file
.elb	Executable library

If any of your object files have been changed, you must recompile them before relinking your application for the changes to take effect. You do not need to recompile object files that have not been changed. When you relink your application, your changes will be incorporated into the new executable program.

For instructions on linking your program, refer to the “[Building and Running Synergy Applications](#)” chapter in *Synergy Tools*. You can also link your program directly from Professional Series Workbench by doing the following:

1. Make sure the file you want to link is open.
2. From the Project menu, select Build.

If the file was not previously compiled, selecting Build will compile it.

## Creating executable libraries

As useful as object libraries are, they have limitations. If your source code changes, not only do you have to recompile the module, but you also have to relink every application that included that particular object file. This could be time-consuming if your application is large and the object file you have changed is common to most of your programs.

To address this issue, as well as others, Synergy DBL provides a feature called executable libraries. An executable library is different from an object library in that the object file is not included in the executable program. Instead, the linker includes a referencing pointer to where the routine is located in the executable library. When the Synergy runtime executes your program and the routine is called, the runtime knows how to execute the code from the executable library.

Four advantages of using an executable library instead of (or in addition to) an object library are

- ▶ smaller programs. If you have a subroutine that is called by several programs and you’re not using an executable library, each executable program contains a complete copy of the compiled subroutine. As a result, your programs are larger in size and use more memory when executing. Using an executable library can significantly reduce the size of your program images.
- ▶ time savings. As with an object library, if you change an object file, you have to recompile the file and replace the old object file with the new one. However, you don’t have to do anything else. Because your programs contain only a pointer to the object file to be executed, and the executable library keeps track of where the new object is located, you don’t have to relink your programs to take advantage of the change. When your program is executed, the Synergy runtime merely gets the new copy from the executable library.
- ▶ more efficient distribution process. Because your executable program contains only a referential pointer to another program image, you can simply replace the executable library, instead of redistributing an object library and the commands necessary to relink the application. When the new executable library is installed, your changes are already in effect.
- ▶ creation by the Synergy linker. You can either use an existing object library and create an executable library that contains all of your object files, or you can have the linker put the object files directly into an executable library.

For instructions on creating an executable library, refer to the “[Building and Running Synergy Applications](#)” chapter of *Synergy Tools*.

#### Restrictions

Once an image is inserted into an executable library, it cannot be removed. If you want to delete some images from an executable library, you must delete the library and rebuild it from scratch.



To facilitate the process of rebuilding an executable library, you might want to keep an object library from which you can regenerate your executable library. The Synergy librarian provides the necessary tools for managing individual object files in an object library.



Executable libraries are not implemented on OpenVMS systems. On those systems, the functionality has been implemented as OpenVMS shared images.

---

## Running your program

Now you've come to the easiest part: actually running your program. This is the final step in program development. If you've done your job completely, you will have a working program. If not, you will have to figure out where changes need to be made, change the source code, and then recompile, relink, and retest your program.

By default, the Synergy runtime expects your programs to have the extension **.dbr**. If your programs follow this convention, you will not have to specify a filename extension in your runtime commands.

For instructions on running your program, refer to the [“Building and Running Synergy Applications”](#) chapter in *Synergy Tools*. You can also run your program directly from Professional Series Workbench by doing the following:

1. Make sure the file you want to run is open.
2. From the Project menu, select Execute.



# Debugging Your Program

No one writes perfect code, at least not all of the time. Because almost every program has a few bugs that need to be fixed, a debugger is a valuable tool.

Built into Synergy DBL is a powerful utility that enables you to interactively control program execution, examine the data structures referenced by your program, modify those data structures to contain whatever values you choose, and validate memory references for correctness. You can instruct the debugger to “watch” a variable and report when its value changes, what the old value was, and what the new value is. You can identify a particular statement (or multiple statements) as a stopping place. You can decide whether to step through routines or execute them in their entirety.

To run a program under the control of the Synergy debugger,

1. Compile your program with the **-d** option.
2. Link your program with the **-d** option.
3. Run your program with the **-d** option.

You can also run a program in debug mode directly from Professional Series Workbench by selecting Debug from the Project menu.

Much of debugging is common sense: finding out where the program is going wrong and stopping the execution before the problem happens, then stepping through the program one statement at a time, looking at variables that affect the processing, changing values to create conditions that are potential problems, and trying to validate your program logic by tracing the program flow. As you interact with your programs, you'll get a sense of what kinds of mistakes cause what classes of problems, and identifying the source of problems will become easier.

## See also

The “[Debugging Synergy Programs](#)” chapter of *Synergy Tools*. We highly recommend reading this chapter to become familiar with the different commands and capabilities of the debugger, and for instructions on running the debugger remotely. The debugger is a tool that will save you a lot of time if you use it correctly.

## Saving and restoring debugger settings

You can save the current break points, watch points, and option settings of the debugger so these settings can easily be restored the next time you run the debugger.

Use the `SAVE file` debugger command to save debugger settings to the specified file. Use the `@ file` debugger command to restore the saved settings. See the “[Debugging Synergy Programs](#)” chapter of *Synergy Tools* for details about these commands.

For information about saving and restoring the current debugger state to a file from Professional Series Workbench, see “[Debugging a project](#)” on page 2-36.

## Debugging with bounds checking

Bounds checking is a very powerful feature of the debugging capabilities in Synergy DBL. Running your application with bounds checking enabled will identify any situations in which data is being stored into structures that are referenced beyond the “bounds” of their normal definition. Trying to monitor situations like this manually is a debugging nightmare.

Many of the legacy languages (ANSI DIBOL and Synergy DBL) take advantage of the capability that allows you to reference subsequent data structures as a subscripted array element of a previous data structure. While this may have been a solution to some problems, it opened the door to a much bigger problem: unknowingly writing or referencing data beyond expected limits. In some cases these data reference operations are detected by the system when the program is run, resulting in errors. In other cases the reference operation goes undetected and remains in the application like a time bomb, waiting for the most inopportune time to overwrite a critical variable that will cause another routine that depends on that value to malfunction. Debugging one of these “transient” error conditions is one of the hardest and most frustrating exercises in software engineering.

Synergy DBL will find this class of error for you automatically if you compile your application with bounds checking enabled. When the program is run, it will report any and all references that result from an “out-of-bounds” condition.

When you compile your programs with bounds checking enabled, all pseudo arrays (such as a field defined as **10d5**) are converted to real arrays (for example, **[10]d5**). While you are in development mode, you should build all routines in your application with bounds checking enabled. When you are ready to release your application to production, simply compile without bounds checking enabled, and the size of the image will be reduced significantly. Below are examples of conditions that will be reported when a program is compiled with bounds checking enabled.

### Examples

When the following program is run, the runtime will report an out-of-bounds condition, because the code is actually referencing **var[1](1,10)**, the first element of the array, which has a “real” length of 2. Because you are trying to write 10 characters into a two-character field, the runtime will report an error.

```
main myroutine
record
    var          , [10]d2

proc
    var(1,10) = "0001020304"
endmain
```

The following example will report an out-of-bounds condition if the subroutine is compiled with bounds checking enabled and the calling routine is compiled with bounds checking disabled. This example illustrates why it's important to compile all your routines with bounds checking enabled.

```
record
    var      ,10d2
    .
    .
    .
    xcall subr(var)
    .
    .
subroutine subr
    arg      ,d
    .
    .
    arg(2)   = 10
```

The first statement below will generate an out-of-bounds condition, because **ivar** is defined as being **i4**. The correct way to clear both of these integer variables at the same time is to reference the named record as an integer, as the second statement does.

```
record name
    ivar      ,i4
    ivar2     ,i4
    .
    .
    .
    clear ivar(1,8)
    clear ^i(name)
```

Both of the statements below will generate an out-of-bounds condition. While both types of data reference are common techniques in many legacy programs, they are references outside the bounds of the definition of **var** and, as such, will be reported.

```
record
    var      ,d2
    var2     ,d2
    .
    .
    .
    var(1,4) = 1010
    var(2)   = 10
```

# Advanced Features

## Using dynamic memory

Most applications need to allocate space to store varying amounts of data. In the past, this was accomplished by considering what the “worst case” would be and defining sufficient storage space to accommodate this situation. This is quite inefficient for two reasons. The first is that it causes the program to require more memory at runtime and more storage space on the disk. The second is that if the application at some point in time exceeds the original estimate of the “worst case,” the code has to be changed, with all of the inherent inconvenience associated with code change.

A better solution is to allocate memory dynamically as it is required by the program. When the program requires memory, it simply tells the system how much it needs. The system allocates the memory and returns a pointer to the base of the memory segment. We refer to this pointer as a *handle*. All future references to this memory will use this handle. There is no practical restriction on the amount of memory available, and once used, the memory can be released back to the system. The amount of memory is totally dynamic: it can grow or shrink as required by the application. As new memory is allocated, it is logically appended to the existing memory, and as memory is released, it is logically truncated from the existing memory.

## Defining data handles

The pointer for each memory segment must be allocated in the data division. Multiple segments are allowed, but each segment must have its own handle. A handle is an **i4** integer and should be aligned on an even longword boundary for maximum performance:

```
.align long
record
    handle1    ,i4           ;The handle for one segment
    handle2    ,i4           ;The handle for another segment
```

## Defining memory structures

Memory allocation and reference is done in conjunction with structures. Structures are defined in the data division using the STRUCTURE statement and function the same as the Synergy DBL RECORD statement, except they do not allocate any space in the program. Structures can be .INCLUDED from the repository, .INCLUDED from files, or hard-coded in your application.

```
structure cards
    value      ,i4
    suit       ,a1
    rank       ,a1
```

## Manipulating dynamic memory

Dynamic memory is manipulated by the `%MEM_PROC` function, which performs four operations:

- ▶ Allocation
- ▶ Resizing
- ▶ Deallocation
- ▶ Registration

### Allocating memory

Memory allocation is performed by specifying the `DM_ALLOC` value as the first argument to the `%MEM_PROC` function and any decimal expression as the second argument. The function value is assigned to the `i4` variable defined as the handle for the memory segment. The second argument is the number of bytes of memory that will be allocated. For example:

```
handle1 = %mem_proc(DM_ALLOC, ^size(cards)*52)
```

Using the structure definition from the previous example, this code will allocate 312 bytes of memory ( $6 \times 52$ ) and return the pointer to the memory in the integer named **handle1**. The contents of the memory segment are undefined.

### Resizing memory

Existing memory segments can be expanded or collapsed by specifying the `DM_RESIZ` value as the first argument to the `%MEM_PROC` function, a decimal expression representing the new size of the memory segment as the second argument (either greater than the original or smaller than the original), and the handle of the original memory segment as the third argument. The return value will be the new handle of the memory segment. Here's an example of expanding memory:

```
handle1 = %mem_proc(DM_RESIZ, ^size(cards)*52*4, handle1)
```

Using the previous definitions, this code will allocate 1248 bytes of memory and take the contents of the original 312-byte memory segment and copy it to the first 312 bytes of the new memory segment. The contents of the remaining memory in the segment is undefined. The pointer to the new memory segment will be returned in the variable **handle1**.

To return unwanted memory to the system, simply specify a lesser value as the second argument. For example:

```
handle1 = %mem_proc(DM_RESIZ, ^size(cards)*52*2, handle1)
```

This code will remove the last 624 bytes from the memory segment. The size of the memory segment will now be 624 bytes. Any information that existed in the returned memory will be lost. The pointer to the memory segment will be returned in the variable **handle1**. Do not assume that this pointer will be unchanged.

### Deallocating memory

To return memory to the system, specify the `DM_FREE` value as the first argument to the `%MEM_PROC` function and the handle of the memory segment as the second argument. The function value will be returned as zero (0), and we recommend that this value be assigned to the handle. Any data reference operations against a handle with a zero value will generate an error condition that can be trapped. For example:

```
handle1 = %mem_proc(DM_FREE, handle1)
```

This code releases the memory that was previously allocated and sets the value of **handle1** to zero.

### Registering memory

Your program may call external routines written in other languages or system functions that return pointers to memory segments that were allocated outside of Synergy DBL. You can reference these segments from within your program if they are registered within your program. The process of registration does not allocate memory; it makes memory segments that are allocated externally available to your program as if they had been allocated by your program.

To register memory, specify the `DM_REG` value as the first argument to `%MEM_PROC`, a decimal expression that represents the size of the memory segment as the second argument, and a platform-specific-sized integer address of the memory segment as the third argument. The value of the function will be the handle of the memory segment. For example:

```
.align quad
record
    addr      ,D_ADDR
    size      ,i4
    :
    :
proc
    :
    :
    xcall some_routine(%val(size),%ref(addr)) ;Call an external routine
    handle1 = %mem_proc(DM_REG, size, addr)   ;Register the memory
```

This code will register the address that was passed into the variable **addr**. Expressing the type and size of this variable by referencing the `.DEFINED` value `D_ADDR` ensures that this variable will match the system requirement of all platforms. On 64-bit systems it will allocate an **i8** field; on 32-bit systems it will generate an **i4** field. `D_ADDR` is conditionally defined for you by the compiler. After the `%MEM_PROC` function call, the memory segment will behave exactly as if it were allocated from within this program.

## Accessing memory

Once memory has been allocated, we use the ^M data reference operation to address the memory locations. In effect, a memory segment can be considered to be a dynamic array that can be addressed in the same manner as a multidimensioned group.

The following example uses the %MEM\_PROC dynamic memory function to allocate a dynamically sized array, which will be resized as needed. The routine reads the records from a customer file into memory and then sorts the records in memory and prints them out in sorted order. This example presumes that the developer can supply the local routine “print” and the QSORT sort routine “sort\_by\_past\_due.” (Refer to [QSORT](#) in the “System-Supplied Subroutines and Functions” chapter of the *Synergy DBL Language Reference Manual* for more information.) Note that this routine does no error trapping, so it presumes that the customer records will all fit into available memory.

```
.align
.define D_INITIAL_ALLOC      ,10      ;Initially allocate for 10 records max
.define D_INCR_ALLOC         ,5       ;If we need to resize, go up by 5
.define D_CUST_CHAN          ,12      ;Customer channel number
.define D_FMT_MONEY          , "Z,ZZZ,ZZZ,ZZX.XX- "

record
    handle          ,i4              ;Handle to dynamic memory
    nmalloc         ,i4              ;Number of records allocated
    nmloaded        ,i4              ;Number of records actually loaded
    ix              ,i4              ;A scratch index

structure customer                      ;Customer record structure
    group rec          ,a
        number         ,d6
        name           ,a30
        address        , [3]a30
        current_due    ,d12.2
        over_30        ,d12.2
        over_60        ,d12.2
        over_90        ,d12.2
    endgroup

record pline                          ;Print line buffer
    pcust             ,a6
                        ,a2
    pname             ,a30
                        ,a2
    pover90           ,a17
                        ,a2
    pover60           ,a17
                        ,a2
    pover30           ,a17
```

```
proc
;First, allocate an array and read in the customer records
nmalloc = D_INITIAL_ALLOC           ;Allocate for 10 records
handle = %mem_proc(DM_ALLOC, nmalloc)
clear nmloaded                       ;None loaded yet

open(D_CUST_CHAN, "I:I", "DAT:customers") ;Open customer file
repeat
  begin
    if (nmloaded .ge. nmalloc)       ;Need to increase array size?
      begin
        nmalloc += D_INCR_ALLOC      ;Bump it by 5
        handle = %mem_proc(DM_RESIZ, nmalloc, handle)
      end
    incr nmloaded;Loading one now
    reads(D_CUST_CHAN, ^m(customer[nmloaded].rec, handle), eof)
  end
eof,
close D_CUST_CHAN                   ;Close customer file
decr nmloaded                       ;EOF on the last one

;Now do an in-memory sort based on some complex criteria
xcall qsort(^m(customer.rec, handle), nmloaded, "sort_by_past_due")

;Now print them out in that order
for ix from 1 thru nmloaded
  begin
    clear pline
    pcust = ^m(customer[ix].number, handle), "XXXXXX"
    pname = ^m(customer[ix].name, handle)
    pover90 = ^m(customer[ix].over_90, handle), D_FMT_MONEY
    pover60 = ^m(customer[ix].over_60, handle), D_FMT_MONEY
    pover30 = ^m(customer[ix].over_30, handle), D_FMT_MONEY
    call print
  end

  xreturn ;Because the allocation was not static, this releases it
end
```

## Static vs. volatile handles

Handles are classified as one of two types, static or volatile:

- ▶ Static handles are persistent and do not get released when the activation level of the generating routine is exited. They are stored as positive numbers.
- ▶ Volatile handles are dynamic and go away along with the routine activation level. They are stored as negative numbers.

Both static handles and volatile handles go away when the entire program is exited or the handle is explicitly released.



## Dispatching routines dynamically

Synergy DBL provides a system routine (XSUBR) that enables programs to determine at runtime what external routine will be called. This capability provides a multitude of opportunities for the application developer to provide flexibility in routines. Consider the case where the name of a routine to be called is returned to a UI Toolkit program with a special prefix. You could add a completely new feature to the code simply by changing the menu column in the window library and adding the routine to an associated executable library. You wouldn't have to change any code or even relink the application.

Consider the following script definition:

```
.column functions, "Functions"
.entry s_rolodex, "Rolodex"
.entry s_calculate, "Calculator"
.entry s_diary, "Diary"
.entry s_mailbox, "Mail"
.end
```

The code to process this script could be as simple as the following:

```
xcall m_process
if (g_select) ;Menu selection
    case g_entnam of
        begin case
            "O_EXIT": exitloop
            "O_ABOUT": xcall u_about(TITLE, VERSION,%datecompiled)
            "S_": xcall x_subr(g_entnam - "S_")
        end case
```

Adding a new routine would not require changing this code at all. For instance, an application could have matched sets of window libraries and executable libraries, distributed as pairs, that would work with the same executable image but provide very different capabilities. If the application went one step further and built the menu columns on-the-fly, simply updating a database file and the executable library would allow calls to the new routines.

## Programming Tips

### Referencing data indirectly

Environment variables (or logicals) give your application tremendous power to reference data in an indirect manner. You should use environment variables to simplify your coding and standardize the way you address the location of the files that are opened by your application. In most cases, environment variables are a convenience, but in some cases they are a necessity. For instance, there is a 31-character restriction on the file specification for the executable library that is passed to the Synergy linker. If your full path exceeds this limitation, your link command will return an error.

In terms of convenience, environment variables enable you to reference different file locations without having to change your source code, which brings with it the associated overhead of recompiling and relinking your code. In addition to the time lost, there is always the possibility that you may have made a typographical error, executed an erroneous compile or link command, or forgotten to include a required file. Using environment variables enables you to adjust where the database files are located and then execute your program, with the same program referring to a different set of data.

### Three cases for environment variables

One of the most powerful uses of this tool is that you can code your application to point to a data set that is referenced by an external environment variable and test your application against a test data base. When you're done testing, you simply reset the environment variable; the application now points to the real data, without the need for you to touch the application in any way.

Another great feature of this paradigm is that your application may be installed at multiple customer sites. Instead of having to go into each program module that contains a file specification and customize the file references to the individual site, you can just use a set of environment variables in your application and set them at each customer site. Not only do you have a faster and more standard installation procedure, but you also have a single set of sources for multiple installations.

A third reason to use environment variables is that on different operating systems the file specifications are formatted differently. Consider the following actual file specifications that reference a Synergy ISAM file that must be opened in an application on three different platforms:

System	File specification
Windows	c:\myapp\finance\gen_ledg.ism
UNIX	/usr/apps/myapp/finance/gen_ledg.ism
OpenVMS	user\$disk1:[myapp.finance]gen_ledg.ism;20

You could take advantage of environment variables by coding the OPEN statement to refer to this file on all systems in a generic manner. Your application would address this file with a statement like the following:

```
open (chan_no, "I:I", "FINAPP:gen_ledg")
```

By simply setting an environment variable named FINAPP on each system, your application would open the correct file regardless of the difference in format for each system. Note also that we have taken advantage of the default file extension capabilities and have not specified an extension for the file.

## Setting environment variables

How environment variables are set is system-dependent, as each operating system requires a somewhat different syntax, but the basic concept is the same. On each system, we tell the operating system the name we are going to use as the environment variable, and we also tell it what we want the environment variable to mean when we use it in our application or command line references.

In the example above, we would set the environment variables in the following manner:

System	Environment variable definition
Windows	set FINAPP=c:\myapp\finance
UNIX	FINAPP=/usr/apps/myapp/finance ;export FINAPP or setenv FINAPP /usr/apps/myapp/finance
OpenVMS	define FINAPP user\$disk1:[myapp.finance]

As you can see, depending on your system, you will need to set the environment variables in different places and using slightly different syntax. Consult the “[Environment Variables](#)” chapter of *Environment Variables & System Options* for a more comprehensive discussion on how to set environment variables on your system. Where you set your environment variables is usually a function of the scope that your environment variables must have. If they are going to be needed by everyone who is on the system, it may be useful to set them in some system initialization file. If they are going to be used by just a few individuals, it may be better to define them in individual log-in command (or **.profile**) files. Talk with your system administrator to decide where and how environment variables should be set in your particular environment.

## Comparing data

Two separate groups of relational operators are available to the Synergy DBL developer to evaluate the relationship of alpha data. Most developers know of the first group but are not aware of the significant difference in the behavior of the second group. The two groups and their operators are as follows:

Relational operators	String relational operators
.EQ.	.EQS.
.LT.	.LTS.
.GT.	.GTS.
.NE.	.NES.
.GE.	.GES.
.LE.	.LES.

The difference in behavior between these groups is based on the length of the comparison that is made. Relational operators perform their comparison based on the shorter of the two operands. String relational operators perform their comparison based on the longer of the two operands, with the shorter being logically extended with blanks (spaces) until the shorter operand is the same size as the larger operand. This means that comparing “A” to “ABC” with .EQS. is logically equivalent to comparing “A ” to “ABC”, and the resulting truth value is FALSE. Performing the same comparison with .EQ. is logically equivalent to comparing “A” to “A”, and the resulting truth value is true. This behavior holds for all of the string relational operators.

This distinction is most important when considering how the CASE and USING statements are evaluated. These statements use the relational operator .EQ. in performing their comparisons. This is a double-edged sword: your application may take advantage of this feature to generate matches for multiple values with a single entry, or your application may not behave as expected and may match on values that were not intended. Consider the following sample code:

```
case value of
  begincase
    "A":  call a_process           ;Catches every entry that starts with "A"
    "AB": call ab_process         ; That means you can never get here!
    "ABC": call abc_process       ; Or here!
  endcase
```

The CASE and USING statements perform evaluations in a top-down manner. Therefore, in the above code, any value that would match the second or third case would by definition have to match the first. To make this work correctly, the order of the cases must be reversed as follows:

```
case value of
  begincase                                ;Matches the following values
"ABC": call abc_process                    ; ABC, ABCC, ABCD, ABCDE...
"AB":  call ab_process                     ; AB, ABD, ABE, ABB...
"A":   call a_process                      ; any remaining values starting with A
  endcase
```

Understanding the behavior of the different relational operators will enhance your productivity and provide you with more options as you code your application.

## Manipulating dates

Synergy DBL provides the capability to transform dates to and from a numeric representation, which enables you to perform mathematical operations on the dates. Adding and subtracting periods of time, determining differences between dates, and determining what day of the week a particular date falls are simple function calls. The algorithm is based on the Gregorian calendar and calculates the days since December 31, 4713 BC.

Four function calls provide this capability:

- ▶ %JPERIOD converts a date to a numeric value.
- ▶ %DATE converts a numeric value to DD-MMM-YY (or YYYY) alpha format.
- ▶ %NDATE converts a numeric value to YYYYMMDD numeric format.
- ▶ %WKDAY returns the ordinal number of a weekday (Sunday is 1).

## Converting dates to a numeric value using %JPERIOD

%JPERIOD accepts either an alpha representation of the date in the form DD-MMM-YYYY or a numeric representation of the date in the form YYYYMMDD. If a date is not passed as an argument, the system date is taken as the default.

Consider the following statements:

```
integer = %jperiod("25-DEC-1997")
integer = %jperiod(19971225)
integer = %jperiod
xcall jperiod(integer, 19970101)
```

Both the first and second statement are functionally equivalent and would store 2451125 in the integer variable. The third statement would store the numeric value of the current system date in the integer variable. The fourth statement is an example of how this function can be called as an external subroutine, specifying a variable as the first argument. The integer variable would contain 2450767.

## Converting numeric values to alpha dates

`%DATE` transforms any numeric value to its equivalent alpha representation of the date formatted as DD-MMM-YYYY, DD-MMM-YY, or a truncated version of the latter. If no value is passed, it will return the current system date as the default. If the length of the alpha variable is too small to contain the entire date, it will be truncated.

```
record
    avar11      ,a11
    avar9       ,a9
    avar6       ,a6
:
:
avar11 = %date(2450767)      ;avar11 = 01-JAN-1997
xcall date(avar9,2451125)    ;avar9 = 25-DEC-97
xcall date(avar6,2451125)    ;avar6 = 25-DEC
```

## Converting numeric values or alpha dates to numeric dates

`%NDATE` transforms any numeric value to its equivalent numeric representation of the date formatted as YYYYMMDD or YYMMDD. Alternatively, it converts an alpha formatted date to a numeric formatted date. If no value is passed, it returns the current system date as the default. If the length of the destination is too small to contain the entire date, the date will be truncated.

```
record
    avar4       ,a4
    avar6       ,a6
    avar9       ,a9
:
:
avar4 = %ndate(2451125)      ;avar = 1225
avar6 = %ndate("25-DEC-1997") ;avar = 971225
xcall ndate(avar9,2451125)   ;avar = 19971225
```

## Converting numeric and alpha dates to a day of the week

`%WKDAY` takes either a numeric formatted date or an alpha formatted date and returns the ordinal day of the week for that date. If the alpha format is used, any portion of the date that is omitted will default to the system date.

```
record
    day          , [7]a*,    "Sunday", "Monday", "Tuesday", "Wednesday",
    &            "Thursday", "Friday", "Saturday"
    group crimbo ,d8
    year         ,d4
    month        ,d2
    crimbo_day   ,d2
endgroup
```

```
proc
  open(1, o, 'tt:')
  crimbo = %ndate("25-DEC")
  incr year
  writes(1, "Christmas is on a " + %atrim(day[%wkday("25-DEC")]) +
    &      "; next year it is on a " + %atrim(day[%wkday(crimbo)]) + ".")
end
```

If this program were run in the year 1997 (the current year is assumed because the year is omitted), the result would be “Christmas is on a Thursday; next year it is on a Friday.”

## Using compile-time definitions

Your application can take advantage of compile-time definitions to provide a level of indirection in your code as well as make the code much more self-documenting. An additional benefit is that compile-time definitions do not allocate any space in the data division. These definitions can be contained in external files that you can conditionally include into your programs or code directly into your source programs. Thus, you can edit your code by modifying the value of the definition in a single-source module that is included in your source programs.

## Using integer data

For performance reasons, we recommend that you use longword-aligned **i4** variables for any variable in your program that won't be stored on disk. This includes, but is not limited to, variables for things like loop counters, values that are tested for conditionals, and variables used in mathematical computations. Many RISC platforms do not provide native math instructions that deal with nonaligned integers, so Synergy DBL uses emulated math operations if the integers are not on a longword boundary. By using aligned integers, you will realize a significant improvement in performance. We strongly recommend that you do not store integer data in your data records, as this could impede your ability to migrate your software to other platforms in the future.

## Using CASE vs. USING

Synergex recommends using the USING statement, which always generates the most efficient code. The structures that are available (matching on ranges, matching on multiple values, matching on expressions, matching the null case, matching on variables) in the USING statement have always made it more powerful and more functional; now the performance matches the functionality.

Using the CASE statement is only practical when the match strings are a series of alpha literals. A further restriction on the CASE statement is that it must be bounded by a BEGIN-END block if it is nested within an IF-THEN-ELSE structure. Even if a CASE statement is not currently within an IF-THEN-ELSE structure, Synergex recommends encapsulating all CASE statements within a BEGIN-END block to prevent possible confusion should an IF-THEN-ELSE be introduced into the code or that code segment be moved or copied to another location.





# 6

## Implementing Your User Interface with UI Toolkit

This chapter introduces S/DE UI Toolkit and its relationship to application development with Synergy/DE. It explains features, describes programming techniques, and provides sample code that can be used as a template for your own development. S/DE Repository is used to define the data for our sample application that we began in [chapter 3](#).

### **What Is UI Toolkit? 6-2**

Provides an overview of the capabilities of UI Toolkit.

### **Starting UI Toolkit 6-3**

Explains the UI Toolkit screen and the initialization of the Toolkit environment, as well as the style of programming necessary for application development with UI Toolkit, how to let Toolkit manage your files, and using variables and defined values.

### **Managing Display Levels with Environment Processing 6-7**

Defines Toolkit environments and describes techniques to save and restore program displays.

### **Managing Window Libraries to Store and Retrieve Display Components 6-9**

Describes the definition, creation, and use of window libraries.

### **Creating Script Files and Window Libraries 6-10**

Explains how to create menu columns, windows, and lists and how to write code to process them.

### **Implementing Online Help 6-33**

Explains how to add online help to your application.

### **Organizing Your Display with Tabbed Dialogs 6-37**

Describes how to create and process tab sets from within a UI Toolkit application.

### **Using Composite Windows to Combine Windows and Lists 6-40**

Describes how to combine multiple windows and/or lists into a composite window.

### **Using Methods 6-43**

Defines methods and how to apply them to add power and flexibility to your UI Toolkit application.

## What Is UI Toolkit?

S/DE UI Toolkit is a collection of external subroutines and functions that can be called from your programs. It is not another language but rather an extension to Synergy DBL that enables you to create and process screens for your applications. The Toolkit is involved in every aspect of the terminal user interface. Enhanced capabilities include data presentation, interactive data input and editing, Windows pull-down menu processing, demand-loaded dynamic lists, and tabbed dialogs. On Windows systems, the UI Toolkit manages mouse interactions, providing your application with a truly native “Windows” look and feel. (For more information about Windows-specific UI Toolkit features, refer to the “[Windows Development](#)” chapter of your *Professional Series Portability Guide*.)

Your application is still a Synergy program. UI Toolkit features are contained in an executable library (**WND:tklib.elb** on most systems) against which your application is linked. These Toolkit routines perform the appropriate operation on each of the platforms supported by Synergy DBL. What this means to your application is that your screen I/O is platform independent. Regardless of where your application is run, your code does not have to change; it lets the Toolkit routines handle any system differences. It is even possible to create a single set of source files that runs as a Windows application on Windows systems and as a cell-based application in a non-Windows environment.

UI Toolkit does not change your program logic beyond the terminal interface. Using Toolkit does not change the way you handle the data once it has been entered by your user. So if you plan to convert an existing application, much of your existing code may not need to be replaced.

## Performing terminal I/O

To use UI Toolkit, you must change your perception about how terminal I/O is performed. All terminal I/O is done through the Toolkit routines. Instead of doing I/O at the field level, you will do it at the record level. Also gone is the need to position the cursor, take the input, refresh the screen after errors, and then process the data. Most data validation can be handled by Toolkit as well. Gone is the need to manipulate each field in a record on an individual basis. Your window definition can specify attributes for an entire record. When processing the window, you specify a data area and pass control to Toolkit. When Toolkit returns, you have a complete, correct data record, with all fields entered and verified for accuracy. All that remains for you is to process that complete record.

## Starting UI Toolkit

To use UI Toolkit, your program must call `U_START`, the Toolkit's start-up routine. `U_START` initializes the Toolkit's memory, opens the terminal, opens the window library where window definitions are contained, and establishes the parameters of the Toolkit screen. Other options set the size of the display regions, establish upper and lower bounds for Toolkit channel allocation, and set the maximum number of levels for environment processing.

## The Toolkit screen

The Toolkit screen consists of five sections. The default parameters for a terminal screen are 80 characters by 24 lines.

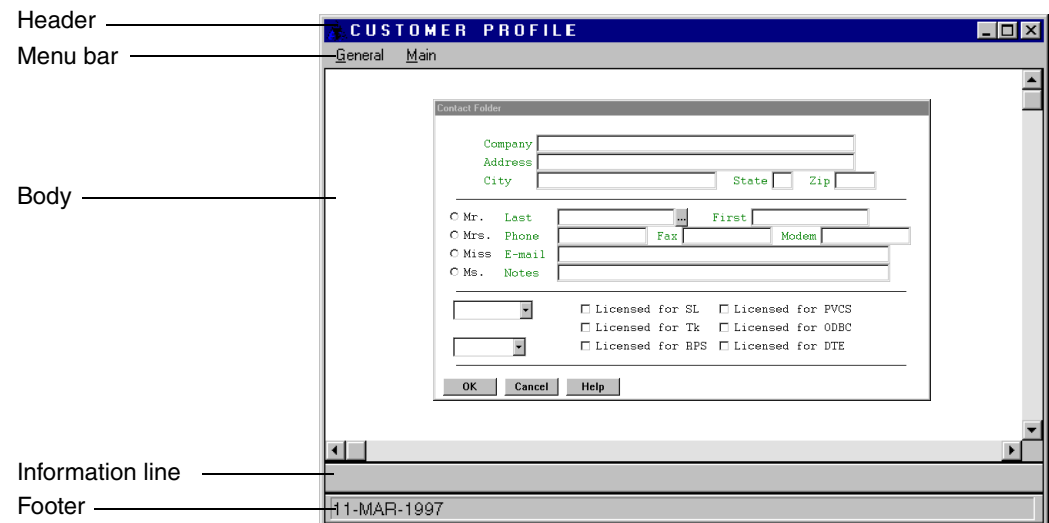


Figure 6-1. A sample UI Toolkit screen.

The five screen sections are

- ▶ **Header.** On UNIX and OpenVMS, the screen header can be zero to four lines. On Windows platforms it should be set to one line and becomes the window's "caption," or title. The application name, customer name, date, or other application-specific information is often displayed in the header.
- ▶ **Menu bar.** The menu bar is a single-line mandatory region that appears just below the header. All active menu columns are placed on the menu bar. When a menu column is placed on the menu bar, it is placed immediately to the right of the existing columns. When a menu column is removed, other columns shift to the left to fill in the void.

- ▶ **Body.** This region is where all of your windows, lists, and tabs are displayed. It occupies the entire area between the menu bar and the information line.
- ▶ **Information line.** This single-line section between the body and the footer is used to display dynamic, screen-specific information. For example, a brief description of the input required for the current input field might be displayed here.
- ▶ **Footer.** This is an optional section that is placed on the bottom of the screen, immediately beneath the information line. It can be zero to four lines. The footer is used in conjunction with the header and the information line to present information to your users. Like the header, the footer usually contains more static, application-specific information.

The following code is executed once, in the start-up routine. It initializes Toolkit and loads descriptive text into the header and the system date into the footer. No other Toolkit routine can be called until U\_START has been called. As the chapter progresses, more code will be added to this start-up routine.

```
startup,  
  xcall date(date)  
  xcall u_start("cust_lib", 1, 1) ;Initialize  
  xcall e_sect("C U S T O M E R   P R O F I L E",  
&          D_HEADER, D_CENTER) ;Place text in header  
  xcall e_sect(date, D_FOOTER, D_LEFT) ;Place text in footer  
  return
```

## Letting Toolkit manage your files

UI Toolkit needs to manage the files that are open on the system. Not only does it open your window library, it opens some files of its own as well. Toolkit keeps track of all your files and closes them automatically when you no longer need them. To take advantage of Toolkit's file management capabilities, and to avoid conflicts with the files Toolkit opens, you need to go through Toolkit to open and close your database files.

UI Toolkit's open routine is U\_OPEN. U\_OPEN opens your file on the next available channel and registers the file. When you are done with the file, you close it with the U\_CLOSE subroutine. U\_CLOSE closes the file and *deallocates* it (removes it from Toolkit memory).

Take a look at the sample code below. Notice the similarity between U\_OPEN and Synergy DBL's OPEN statement. (See the "[Synergy DBL Statements](#)" chapter of your *Synergy DBL Language Reference Manual*.) The first argument is the channel, but instead of specifying the channel, we pass a variable that is returned by U\_OPEN with the next available channel. The second argument is an alpha literal that specifies the open mode. Next is the filename.

The primary difference between U\_OPEN and OPEN is the way errors are handled. Because U\_OPEN is an external subroutine, ONERROR or the I/O error list doesn't work. Instead, open errors are handled by passing an error variable in the sixth position. If an error occurs on the open, it is trapped and the error number is returned in the error variable. The loop we have set up doesn't

exit until the error variable returns false. If the error variable returns true, control returns to the top of the loop and a new file is created. All calls to `U_OPEN` should pass an error variable and test it before continuing.

```
do
  if (error)
    begin
      ;Create data file only if it doesn't exist
      xcall isamc("cdat", ^size(customer), 2, "start=1, length=45",
        & "start=127, length=32, DUPS, MODIFY")
      xcall u_open(customer_ch, "u:i", "cdat",,, error)
    end
  until (.not.error)
```

`U_CLOSE` is refreshingly simple. To close the file we just opened, we call `U_CLOSE` and pass the file's channel variable. If we had other files to close, we could pass their IDs here as well.

```
xcall u_close(customer_ch)
```

## Using event-style programming

To realize the full benefit of UI Toolkit, you should incorporate an “event-driven” style of programming. Event-style programming means that after all the components are in place, your program will call a Toolkit routine to get its user input. This routine will manage all interaction with the user until one of a set of special events causes it to exit. Your program then tests to determine the event that occurred and takes the appropriate action. Usually, after the action has taken place, your program will want to return to the Toolkit routine that generated the event to get further input from the user. Therefore most Toolkit routines that get input from the user are placed at the top of a loop.

## Including `tools.def`

Every UI Toolkit program must `.INCLUDE “WND:tools.def.”` Contained in `tools.def` are the global variables that enable your application to communicate with the Toolkit routines. With these global variables, your programs can test for the event that caused a Toolkit routine to exit, determine the current state of a Toolkit component, instruct a Toolkit routine to perform a task or function in a particular way, specify to a Toolkit load routine the channel on which the primary window library is open, and pass or retrieve many other pieces of valuable information.

Also in `tools.def` are the defined values (with `.DEFINE`) used as arguments to the Toolkit routines. Most of these arguments are just a numerical value. If you examine `tools.def`, you can see most of the defined arguments consist of a descriptive name preceded by `D_`. For instance, the defined values for `D_FOOTER`, `D_CENTER`, and `D_CLEAR` are 3, 12, and 6. Using these definitions makes your code more self-documenting than if the corresponding numbers were used.

Consider the following:

```
xcall e_sect("Synergex", D_FOOTER, D_CENTER, D_CLEAR)
```

and

```
xcall e_sect("Synergex", 3, 12, 6)
```

Both of these statements do exactly the same thing: erase the footer region and center the text “Synergex” on the first line of the footer section. But the first example is much more expressive and far easier to maintain.

## Using variables for identifiers

Just as channel numbers are assigned to designate files and devices in your Synergy DBL I/O statements, every UI Toolkit component (window, menu column, list, toolbar, or tab set) has a unique identifier. These identifiers are integer variables you define in the data division of your program. When a UI Toolkit component is loaded, the Toolkit load routine assigns the next available value to that component and returns it in the identifier you passed. From that point on, when your application needs to reference that component, you will specify its ID variable (*not* its name). For performance reasons, we suggest you use longword-aligned **i4** variables for these identifiers.



In our sample programs, you will notice that we try to convey information about the type of variable and its use by the name we choose. Defined values are uppercased and begin with **D\_**, global variables begin with **g\_**, subroutine arguments begin with **a\_**, menu column IDs have a **\_col** suffix, input window IDs an **\_inp** suffix, list IDs a **\_lst** suffix and so on. We encourage you to adopt a similar approach in the applications you develop.

---

## Managing Display Levels with Environment Processing

Among the most tedious tasks an application programmer must deal with is writing the code that captures the current screen so it can be restored after some interruption has taken place. In fact, many applications simply do not allow any external interference with the display during input. But no matter what kind of application you write, there will be situations in which you would like to alter some or all of the screen to display information or perform input, and then, when done, return the screen to its former state.

This ability to take a “snapshot” of the screen and then clean up and restore its original state at some future point is called environment processing. Instead of writing hundreds of lines of code each time you need to alter the screen, you simply make a single Toolkit subroutine call to enter a new environment. When you enter a new environment, a snapshot is taken of the screen, saving all of the characteristics of the previous environment. In the new environment, you can alter the display—add or remove screen components, open files, get input, modify screen sections. When you’re done, another simple subroutine call exits the environment and restores the original screen.

What makes this capability so powerful is that you can “nest” this processing. If you need to save multiple layers, you simply take multiple snapshots. By encapsulating your code in callable routines with a single point of entry and a single point of exit, you can have display routines themselves save and restore the screen. It does not matter which routine calls a display routine; the routine starts by entering a new environment, thus preserving the existing screen. When the routine is done, it simply exits the environment, restoring the screen to its former state.

You cannot skip environments. Environment levels are not identified; they are managed on a stack and are exited in the reverse order from which they were created. The routines that are used to save and restore environments are the simplest routines in UI Toolkit.

To save a copy of the current screen and enter a new environment:

```
xcall e_enter
```

To exit an environment and restore the screen to its previous state:

```
xcall e_exit
```

These routines have no arguments.

## Local and global screen components

By default, when you load a window or column, it is *local* to the current environment. This means that any subsequent environment cannot delete it from Toolkit memory (although it can be removed from the screen), and when the environment that loaded it is exited, the window or column is deleted. If you want any environment to be able to delete a window or column, or if you don't want a window or column to be deleted when the environment that loaded it is exited, you can promote the window or column to *global* status by passing an argument to the Toolkit routine that loads it.

### See also

The “[Environment Routines](#)” chapter of your *UI Toolkit Reference Manual* for more information about environment processing.



## Managing Window Libraries to Store and Retrieve Display Components

Much of what you will do as you develop with UI Toolkit is to separate your procedural code from your display information. The procedural code will remain in your program source, but the display information will reside in script files. These script files will be processed into special ISAM files, called window libraries, that store the definitions of Toolkit screen components: input windows, text windows, selection windows, menu columns, and list classes. These definitions are in a special binary format that is optimized for processing by Toolkit.

### Benefits of window libraries

Window libraries enable you to make changes to the visual portion of your application without having to rebuild the associated code. Because the joining of these two parts is not done until the program is executed, you can change the visual portion of your application by changing your script files and rebuilding the associated window library.

A further benefit of window libraries is that you can have multiple libraries that use the same procedural code. Your basic application can be exactly the same, but you can have a different window library for each customer or department. For example, your procedural code could process a module that determines a user's security level. Based on this information, you could open a different window library that matches the security level associated with that user. One window library has an opening menu with 10 choices; another has an opening menu with 5 choices. Your application's procedural code does not require any change to restrict access to choices that are not on the menu: the choices simply do not exist for a user if the associated menu entries are not displayed.

### Specifying a window library

When you initialize UI Toolkit (using `U_START`), the first argument you specify is the name of your primary window library. The channel number on which this library file is opened is stored in the global variable `g_utlib`. Our examples contain many references to this variable.

However, your application can also have other window libraries open. To do so, simply use Toolkit's open routine, `U_OPEN`, to open the library in input mode. To access any secondary window library, simply pass the channel variable you passed to `U_OPEN` to the load routine.

# Creating Script Files and Window Libraries

Script files are text files created by Composer or a text editor. You can create window libraries using Composer, Script, or Proto. For information on how to use Composer, see [chapter 4, “Designing Your User Interface.”](#) For information on how to use Script and Proto, refer to the “Script” and “Proto” chapters of the *UI Toolkit Reference Manual*.

## Creating and processing menu columns

UI Toolkit provides windows-style pull-down menus in both Windows and non-Windows environments.

A menu column is a list of entries that pull down from the menu bar. The menu bar can accommodate many menu columns, although only one can be pulled down at any given time. The menu bar (and its associated columns) are activated by pressing ALT (on Windows) or CTRL+P (on UNIX and OpenVMS). Navigation through the columns is controlled by the arrow keys and by each entry’s “quick-select” character. In Windows environments, full mouse support is enabled. In addition, when a menu column is not pulled down, special key *shortcuts* can be assigned to select a particular menu entry.

### 1. Define menus

The first thing you must do to use Toolkit menu processing is define your menu columns. You can define menu columns with Composer or a text editor. When you have finished defining your menus, you need to add these definitions into a window library. See [“Managing Window Libraries to Store and Retrieve Display Components” on page 6-9](#) for more information about window libraries.

#### *Assigning shortcuts*

An optional menu shortcut enables the associated entry to be selected when the menu column is not pulled down (for example, while the user is doing input or viewing a list). Pressing a shortcut is the equivalent of pulling down a menu column, highlighting an entry, and pressing ENTER. For an entry’s shortcut to be accessible to the user, its menu column must be “placed” (visible) on the menu bar. Valid shortcut keys include control, function, and arrow keys.

#### *Assigning quick-select characters*

When a menu column is pulled down, pressing an entry’s quick-select character selects that entry if the quick-select character is unique. If the quick-select character is not unique, the entry will be highlighted. By default the quick-select character is the first character in the displayed text. Multiple entries can use the same quick-select character; the entries will be dealt with sequentially. Thus, in the sample menu script below, pressing an “a” (or “A”) when the first menu is pulled down would position you to the “Abort” choice. Pressing “a” again would position you to the “About” choice.

***Using reserved entry names***

The menu entries described so far return as events to be processed by your program. But another class of entries is handled automatically by UI Toolkit, without ever exiting the Toolkit routine from which they were selected. These are called *reserved entries*. When any menu selection is made, Toolkit checks the entry name before returning to your program. If it recognizes the entry as one of the set of reserved entry names, Toolkit performs the associated task and then resumes processing without returning to your program.

These reserved entries are used to activate many of the standard functions of UI Toolkit, so you don't have to. Commands to control text editing, field navigation, context-sensitive help, and list navigation are among those enabled by reserved entries.

To take advantage of these capabilities, choose the functions you want to enable, include the appropriate reserved entry name in a menu column, and then place the column on the menu bar. You don't have to write any code, you don't have to call any routines—just activate the feature by enabling your user to select it from the menu bar.

Below is a list of reserved prefixes to avoid when naming a menu entry that you want to return as an event to your program. A detailed list of each reserved entry and its associated function can be found in [Appendix B](#) of the *UI Toolkit Reference Manual*.

C_	Composite window functions
E_	Editing routine functions
I_	Input routine functions
O_	Key mapping or renditions
S_	Selection window and list navigation functions
T_	Text window viewing and display functions
TS_	Tab set functions
U_	Hot-entry processing

***Sample menu script***

The following commands define three menu columns. This code would reside in a script file.

```
.column general, "General"
.entry o_help, "Help", key(F1)
.entry o_exit, "Exit", key(F4)
.entry o_abandon, "Abort", key(^A)
.entry g_about, "About"
.end

.column main, "Main"
.entry customer, "Customers"
.entry vendor, "Vendors"
.end
```

```
.column input,      "Input"  
.entry i_prev,     "Previous field", key(UP)  
.entry i_next,     "Next field",     key(DOWN)  
.entry e_left,     "Move left",      key(LEFT),select(l)  
.entry e_right,    "Move right",     key(RIGHT),select(r)  
.end
```

The first three qualifiers in each menu column definition (the command, the name, and the text) are required and must be specified in order. In each `.COLUMN` line, the first qualifier after `.COLUMN` is the column name. This name is used in the program to load the column. The second qualifier (in quotation marks) is the header text. This text is visible on the menu bar when the column is *placed*, or made available to your user.

In the `.ENTRY` line, the qualifier in the second column is the entry name. When an entry is selected, the entry name is returned in uppercase to the program (using the Toolkit global variable `g_entnam`) so the program can determine the event that caused the Toolkit routine to exit. The third qualifier in the `.ENTRY` line contains the text that is displayed in the menu column. The entry options begin in the fourth column and can be specified in any order. The **key** keyword indicates the shortcut to be associated with the menu entry; **select** is the entry's quick-select character.

In most applications, a general menu column is available at all times to provide the basic functions the user can enter at any time (Help, Exit, Abandon, About, and any application-specific functions you choose). The first column in the sample script is an example of a general menu column.

The third menu column in our example (**input**) contains only reserved menu entries. When selected, these entries are processed automatically by UI Toolkit without returning to the program.

Note that each column definition is terminated with a `.END`. This is required.

## 2. Load the menus

To use menus in your program, you first have to load their definitions into UI Toolkit's memory using the `M_LDCOL` subroutine. This Toolkit routine locates the specified menu column in the window library and loads its definition into the Toolkit memory area. It then returns a value in the variable you have passed as the first argument. From this point on, every reference to this menu column is accomplished by referencing this variable. Like all other identifiers used by Toolkit, column and window IDs should be **i4** variables.

The following code loads several menu columns:

```
startup,  
  xcall date(date)  
  xcall u_start("cust_lib", 1, 1)          ;Initialize--1 header line,  
                                           ; 1 footer line  
  xcall e_sct("C U S T O M E R   P R O F I L E",  
&          D_HEADER, D_CENTER)          ;Place text in header  
  xcall e_sct(date, D_FOOTER, D_LEFT)     ;Place text in footer  
  xcall m_ldcol(gen_col, g_utlib, "general",,, D_GLOBAL)  
  xcall m_ldcol(options_col, g_utlib, "options")
```

```

xcall m_ldcol(input_col, g_utlib, "input", D_NOPLC)
xcall m_ldcol(select_col, g_utlib, "select", D_NOPLC)
return

```

U\_START places the channel for the primary window library (the first argument) in the global variable **g\_utlib**. All of the columns loaded above reside in **cust\_lib**. In this example, the **input** and **select** menu columns are loaded but not placed on the menu bar. Because this is the only place in the application that loads these columns, and this code is only executed once, there is no need to pass the optional search argument.

Notice too that the **general** column is promoted to global status. All global menu columns are placed on the menu bar to the left of local columns, regardless of their placement order. By making the **general** column global, we can also take advantage of UI Toolkit features that allow placement and removal of columns by their local or global status.

### 3. Process menus

The following sample code demonstrates basic menu processing. While placed menu columns and their entries are accessible in almost every UI Toolkit routine that receives input from the user, **M\_PROCESS** is the Toolkit routine that forces the menu bar to process. Below is one method for giving your user a list of options at the start of an application. It assumes that the entry names returned by **M\_PROCESS** match the name of the programs they activate.

```

do
  begin
    xcall m_process("[customer]")
    if (g_select)
      begin
        xcall e_enter
        xcall m_column(D_REMOVE, D_LOCAL)
        xcall xsubr(g_entnam)
        xcall e_exit
      end
    end
  until (done_flg)

```

The code starts a loop that explicitly processes the menu bar until the user makes a selection. When the menu bar is first activated, the **customer** menu entry is highlighted. Until a selection is made, UI Toolkit controls the interface. When a selection is made, **M\_PROCESS** exits and the program needs to determine the event that occurred.

We start by testing the global variable **g\_select**. If this variable is true (in other words, nonzero) UI Toolkit is telling us that the reason it returned from **M\_PROCESS** was that a menu entry was selected. Next we enter a new environment and prepare for the new program to be called by removing all local columns (those columns that are no longer valid now that a selection has been made). Since a new environment has been entered, whatever program gets called by the **XSUBR** subroutine can modify the Toolkit screen in any way necessary; these changes are reversed when

the program exits and E\_EXIT is called. When the user is done, he or she selects “Exit,” which returns O\_EXIT in **g\_entnam**. Our external subroutine O\_EXIT sets the global variable **done\_flg** equal to true, and the program exits the loop.

Another way of processing a menu column is with a CASE or USING statement. Consider the following example:

```
repeat
  begin
    xcall m_process("[customer]")
    if (g_select)
      begin
        xcall e_enter
        xcall m_column(D_REMOVE, D_LOCAL)
        using (g_entnam) select
          ("CUSTOMER, VENDOR"), xcall customer
          ("OTHER"), xcall other
          ("O_EXIT"), exitloop
        endusing
        xcall e_exit
      end
    end
  end
```



UI Toolkit uppercases the return values before moving them to **g\_entnam**. If you specify your match values in lowercase, they will *not* match.

---

Each of the menu selections has a corresponding match value except **o\_help**. **O\_help** is a reserved entry that UI Toolkit processes directly. We will discuss help in [“Implementing native Toolkit help” on page 6-34](#).

Note that the “OTHER” label has no corresponding menu entry. This entry can never be accessed by this program while the menus are defined as they are in this example. To enable this selection, a menu choice would have to be added to an existing menu column, or another menu column that contains this entry would need to be placed on the menu bar. This is a prime example of how you can distribute a complete application and only enable certain portions of the code, based solely on the composition of the window libraries. If your customer wanted to pay for the additional features, you would simply have to provide a window library with a column that contains the additional entry—the customer would have access to that entry, and you wouldn’t need to change any code.

While the CASE or USING approach may require a little more code, it is more self-explanatory: anybody looking at this code can see exactly what happens with each menu event. Of course, if the number of possible menu selections is large, the selection statement can become quite unwieldy, making the XSUBR approach more desirable. XSUBR is also more flexible, enabling you to create a generic menu processing routine and also to add an unlimited number of menu entries without modifying your code.

What has been discussed here is only a portion of the capabilities of UI Toolkit menu processing. Consult the “[Menu Routines](#)” chapter of your *UI Toolkit Reference Manual* for a comprehensive description of the Toolkit routines that affect menu processing. Additional options offer such features as menu creation at execution time, manipulation of menus in environments, and submenus. Because menu processing drives all Toolkit processing, a thorough understanding of how menus work is essential.

## Creating and processing input windows

With an understanding of menu processing, we are ready for the next logical step. How do we display and retrieve information from our users? The answer: input windows.

To use a UI Toolkit input window, your perspective has to change. In your old style of programming, you had to deal with each field as a separate entity, taking care to position the cursor correctly, display the prompt, and then read the data. Once your program had the data, you had to decide if the data was valid and perhaps reformat it. If an input error was detected, you had lots of code to erase the screen section, reposition the cursor, acquire the input again, redo the edits—until you got acceptable data. Only when this process was complete could you move on to the next field.

With UI Toolkit input windows, you no longer have to think in terms of processing individual fields in a record. Instead, you deal with them as a group that is managed by Toolkit on your behalf.

Field information originates as an input window definition in a script file. The script file can either define field options locally, pull information from the repository, or do a combination of both. Since most fields in an input window have a corresponding field in the data area of your program, it makes sense to define this data once, in the repository, and reference the definition in both your source and script files. If you have input fields that will be used in more than one window, it's also helpful to use S/DE Repository to store field information (such as position, prompt, and validation). UI Toolkit's ability to extract information from Repository is one of its most useful features.

Most of the edits that you are used to making on input data can now be done automatically by UI Toolkit's input processor. For instance, you can specify that a particular field is decimal and must contain a value between 100 and 1000. If the user enters a value that is outside that range, or that is not decimal data, Toolkit will detect the error, display the appropriate message, erase the field, and reposition the cursor for input. For alpha fields, you can create a list of correct entries to be displayed for the user; the user will be able to select only from that list of valid options.

Of course, many other data validation options are available: you can require nonblank or nonzero input to a field, specify the help window for the field, provide text to be displayed on the information line when the field is processed, define a field's paint character, specify a field's display format string, identify routines to call when the user enters or leaves a field, and more. (For more information on arrive and leave methods, see “[Using Methods](#)” on page 6-43.)

With Repository you can define a field's characteristics once, and all input script references to that field definition are assured the same characteristics. If you need to change a field attribute (for instance, you have a department field that has an associated selection list and you want to add another department) all you need to do is add that department to the selection list in your repository

and rebuild your window library. The next time your application is run, every instance of that field, on every screen in the application, will contain the additional department. You can also override any Repository characteristic (except the data type and size) in your script file.

#### 1. Load navigation columns

To handle interfield and intrafield movement in a non-Windows environment, UI Toolkit provides you with a number of reserved menu entries. The three primary reserved entry types are those that apply to every field (**I\_** and some **E\_**), those that apply to selection windows and lists (**S\_**), and those that apply to text fields (**E\_**). Define a separate menu column for each of these entry types.

Load (but don't place) each of these columns at start-up. When you call **I\_INPUT**, pass the ID for the "input" column in the fourth argument position, the "select" column in the fifth position, and the "text" column as the sixth argument. **I\_INPUT** will place and remove each column when appropriate, and when a selection is made from any of these columns, it will perform the designated task without returning to your program.

Because these tasks are handled automatically on Windows, UI Toolkit on Windows does not place these menu columns. If you plan to run your application as both Windows and non-Windows, don't mix reserved and nonreserved (to be returned as events to be processed by your application) menu entries in a column to be placed by **I\_INPUT**. If you do, that column will not be placed on Windows, and events your program expects will never be generated.

#### 2. Define input windows

Like all other UI Toolkit screen components, input windows are defined in script files and processed into window libraries. To define an input window, you can use Composer or a text editor. The following is a script file definition of an input window. In this example, all the field information is defined locally. This approach gives you the ability to view the entire structure of the input window, including the **.FIELD** options, at a glance.

```
.input customer, 14, 71
.placement 3, 5
.title "Customer Folder", color(3)
.line WndLin1, 65, pos(5, 4)
.line WndLin2, 65, pos(10, 4)
.line WndLin3, 65, pos(14, 4)
.repository_structure CUSTOMER
.field cmpny, a45, prompt("Company "), pos(2, 8), fpos(2, 16), break, -
    drill_method("cmpny_drill"), hyperlink_method("hyperlink")
.field address, a45, prompt("Address "), pos(3, 8), fpos(3, 16), -
    hyperlink_method("hyperlink")
.field city, a25, prompt("City "), pos(4, 8), fpos(4, 16), -
    hyperlink_method("hyperlink")
.field state, a2, prompt("State "), pos(4, 44), fpos(4, 50), -
    hyperlink_method("hyperlink")
.field zip, d5, prompt("Zip "), pos(4, 55), fpos(4, 59), -
    hyperlink_method("hyperlink")
```



```
.field a4, salutation, fpos(6, 3), -
    select(0, 0, 4, "Mr. ", "Mrs.", "Miss", "Ms. "), radio, -
    select(0,0,1, "Mr.", "Mrs.", "Miss", "Ms."), -
    hyperlink_method("hyperlink")
.field lname, a16, prompt("Last "), pos(6, 11), fpos(6, 19), -
    help("h_lname"), drill_method("contact_drill"), -
    hyperlink_method("hyperlink")
.field fname, a16, prompt("First "), pos(6, 41), fpos(6, 47), -
    hyperlink_method("hyperlink")
.field phone, d10, prompt("Phone "), pos(7, 11), fpos(7, 19), -
    hyperlink_method("hyperlink"), format("XXX/XXX-XXXX")
.field fax, d10, prompt("Fax "), pos(7, 33), fpos(7, 37), -
    hyperlink_method("hyperlink"), format("XXX/XXX-XXXX")
.field modem, d10, prompt("Modem "), pos(7, 51), fpos(7, 57), -
    hyperlink_method("hyperlink"), format("XXX/XXX-XXXX")
.field email, a47, prompt("E-mail "), pos(8, 11), fpos(8, 19), -
    hyperlink_method("hyperlink")
.field notes, a47, prompt("Notes "), pos(9, 11), fpos(9, 19), -
    hyperlink_method("hyperlink")
.field type, a10, fpos(11, 4), hyperlink_method("hyperlink")
.field status, a10, fpos(13, 4), hyperlink_method("hyperlink")
.field sl, d1, prompt("Licensed for SL "), fpos(11, 22), checkbox
.field tk, d1, prompt("Licensed for Tk "), fpos(12, 22), checkbox
.field rps, d1, prompt("Licensed for RPS "), fpos(13, 22), checkbox
.field pvcs, d1, prompt("Licensed for PVCS "), fpos(11, 42), checkbox
.field odbc, d1, prompt("Licensed for ODBC "), fpos(12, 42), checkbox
.field dte, d1, prompt("Licensed for DTE"), fpos(13, 42), checkbox
.button I_OK, text("OK")
.button O_ABANDON, text("Cancel")
.button O_HELP, text("Help")
.button_set bottom(3)
.set customer, CUSTOMER, cmpny, address, city, state, zip, salutation, -
    lname, fname, phone, fax, modem, email, notes, type, status, sl, -
    tk, rps, pvcs, odbc, dte
.set nokey, CUSTOMER, address, city, state, zip, salutation, lname, -
    fname, phone, fax, modem, email, notes, type, status, sl, tk, rps -
    pvcs, odbc, dte
.end
```

Take a look at the input window below. It's the same input window, but in this example its field information is pulled from the repository. The advantage to defining your fields in Repository is that all the qualifiers for each field are defined only once, no matter how many times the field is referenced. There is no need for the .STRUCTURE command, because the structure information is part of the repository definition. If you include the repository definition in your program as well (as you should), a match between the data in your program and the fields in your window definition is ensured: the input processor will automatically know where to put the data for each field, regardless

of the order specified or gaps left by the exclusion of any fields. A downside to the repository approach is that to view field information, you must select the structure in Repository and look at each field definition separately.

Notice in the example that the **lname** and **fname** fields have a **required** qualifier. Any qualifier not specified in the repository can be added in the script file. If any qualifiers conflict, the one in the script file takes precedence. You can also turn off repository qualifiers in the script file.

```
.input customer, 14, 71
.placement 3, 5
.title "Customer Folder", color(3)
.line WndLin1, 65, pos(5, 4)
.line WndLin2, 65, pos(10, 4)
.line WndLin3, 65, pos(14, 4)
.repository_structure CUSTOMER
.field cmpny
.field address
.field city
.field state
.field zip
.field salutation
.field lname, required
.field fname, required
.field phone
.field fax
.field modem
.field email
.field notes
.field type
.field status
.field sl
.field tk
.field rps
.field pvcs
.field odbc
.field dte
.button I_OK, text("OK")
.button O_ABANDON, text("Cancel")
.button O_HELP, text("Help")
.button_set bottom(3)
.set customer, CUSTOMER, cmpny, address, city, state, zip, salutation, -
    lname, fname, phone, fax, modem, email, notes, type, status, sl, -
    tk, rps, pvcs, odbc, dte
.set nokey, CUSTOMER, address, city, state, zip, salutation, -
    lname, fname, phone, fax, modem, email, notes, type, status, sl, -
    tk, rps, pvcs, odbc, dte
.end
```

Note that both input window definition methods have some things in common. Anything that does not pertain to a field definition is specified entirely in the script file. A default screen position is set, a title is specified, and lines are drawn to organize the screen into logical sections. The .SET commands create input sets: groups of fields to be processed or accessed as a unit. And on Windows systems, three buttons, “OK,” “Cancel,” and “Help” will be displayed. The .BUTTON\_SET command specifies that these buttons will appear horizontally at the bottom of the screen (three buttons per row).

### 3. Load input windows

Just like we had to load our menu columns with UI Toolkit, we also must load our input windows. The routine that does this is I\_LDINP.

```
xcall i_ldinp(customer_inp, g_utlib, "customer", D_NOPLC)
```

Notice in the sample that the definition of the window is taken from the default window library (the file open on the channel contained in **g\_utlib**), and that we are not placing it on the screen at this time (D\_NOPLC). It is a common practice to load all windows and menu columns in your initialization code and then place them only when needed.

### 4. Display an existing record

To display read-only data to a user, use I\_DISPLAY to “display” or load the data into the window. Then the U\_POPUP routine can be used to hold the information on the screen until the user presses ENTER.

```
display_record,
    xcall e_enter                                ;So we can restore the
screen
    xcall u_window(D_REMOVE, D_ALL, D_PLACE, customer_inp)
    xcall e_sect("View customer info", D_INFO, D_CLEAR, D_LEFT)
    xcall i_display(customer_inp,, customer)      ;Fill the window with data
    xcall u_popup(g_utlib, "customer")           ;Freeze the screen
    xcall e_exit                                  ;Then restore the screen
    return                                       ;Return to where we were
```

In this example, a new environment is entered to enable us to reverse screen changes when we are done. Next, U\_WINDOW is called to remove all other windows and place the customer window. I\_DISPLAY is then called to load the window with data. Once the window contains the data to display, U\_POPUP is called to update and freeze the screen. When the user presses ENTER, the new environment is exited, returning the screen to the state it was in when **display\_record** was called.

#### 5. Add a new record

An input window that is used to get user input is processed in a loop. Consider this example:

```
process_window,
  xcall e_enter
  xcall u_window(D_PLACE, customer_inp)      ;Place at default position
do
  begin                                     ;Begin input loop
    xcall i_input(customer_inp, "customer", customer, input_col,
    &      select_col, text_col)
    if (g_setsts) then                      ;Menu entry or break field
      begin
        if (g_select) then
          call menu_choices                  ;Menu selection
        else
          call break_fields                  ;Break field
        end
      end
    else
      call record_complete                  ;Input set complete
    end                                     ;End input loop
  until done
  clear done
  xcall e_exit
  return

break_fields,
  using (g_fldnam) select
    ("CMPNY"), begin                        ;Check after each field
      if (C_LNAME.and.C_FNAME)              ;Is key complete?
        call test_for_duplicates
        if (duplicate) then
          call init                          ;Initialize for next
        end
      end
    endusing
  return

init,
  xcall u_message(%trim(cmpny)+" already exists")
  xcall i_init(customer_inp, "customer", customer)
  return

menu_choices,
  using (g_entnam) select
    ("O_EXIT","O_ABANDON"), done = TRUE
    ("G_ABOUT"), xcall u_about(TITLE, VERSION,
%datecompiled)
  endusing
  return
```

```
record_complete,
    store(customer_ch, customer) [$ERR_NODUPS=store_error]
    call init
    return
```

Here the input processor has control of all input until one of three events occur:

- ▶ The user makes a menu selection.
- ▶ A “break” field is processed.
- ▶ Every field in the input set has been input to.

After the call to `I_INPUT`, we test for one of these three events and call an internal subroutine to handle the event.

The key to understanding input processing is understanding the structure of the input processing loop and the tests performed to determine the exit event. As we did in menu processing, we use global variables provided by UI Toolkit to determine the event that caused `I_INPUT` to exit. In our example we first examine `g_setsts` to find out if input processing is incomplete. If the value is true (nonzero), we know input processing is incomplete—either a menu selection or a break has occurred. Next we test `g_select`. If it is true, we know the user made a menu selection. A `USING` statement determines the menu selection that was made. If `g_select` is false, the exit event was a break field; this time the `USING` statement determines the field that activated the break. If `g_setsts` is false, no further processing needs to be done on this input set. We store the completed record and initialize the window in preparation for the next record.

When `I_INPUT` exits, it retains the *context* for the next time it is called. The context is simply the next field to process. By default, it is always the field after the field that caused `I_INPUT` to exit. So after a break field is processed or a menu selection is made, when the program returns to the top of the loop and calls `I_INPUT` again, processing resumes right where it left off. `I_NEXT` (see the example below) changes the input context, and `I_INIT` resets the input window to its initialized state. The context for an initialized window is the first field in the input set.

See “[Modify an existing record](#)” below for another example of how to add a record.

## 6. Modify an existing record

To use your input window to modify an existing record, load the data into the window with `I_DISPLAY`. Use `I_NEXT` to set the context (the input field to be processed with the next call to `I_INPUT`).

```
process,
    xcall e_enter
    set = "customer"
    do
        begin
            xcall i_input(customer_inp, set, customer, input_col, select_col)
            if (g_setsts) then ;Check for incomplete input processing
                if (g_select) then ;Menu processing
                    xcall xsubr(g_entnam) ;Entry name matches subroutine name
```

## Implementing Your User Interface with UI Toolkit

### Creating Script Files and Window Libraries

```
        else
            begin
                ;Break processing
                using (g_fldnam) select
                    ("CMPNY"), call dup_chk
                endusing
            end
            ;Break processing
        else
            begin
                ;Input set complete
                if (load_flg) then ;Either MODIFY mode...
                    begin
                        read(customer_ch, cmpny, cmpny) [$ERR_TOOBIG=cont]
cont,
                        write(customer_ch, customer)
                        clear load_flg
                    end
                else ;... or ADD mode
                    using (set) select
                        ("customer"), store(customer_ch, customer) [ERR=updtterr]
                        ("nokey") , write(customer_ch, customer) [ERR=updtterr]
                    endusing
                if (FALSE)
                    begin
                        ;Store failed
updtterr,
                        xcall u_message("Error updating customer file")
                    end
                    xcall init ;Initialize window, enable cmpny field
                end
                ;Input set complete
            end
            until (done_flg)
            xcall e_exit
            return
        dup_chk,
            find(customer_ch, customer, cmpny) [$ERR_KEYNOT=newrec,
            & $ERR_EOF=newrec]
            reads(customer_ch, customer)
            xcall i_display(customer_inp, set="nokey", customer)
            xcall i_next(customer_inp, set, "*FRST*")
        newrec,
            return
```

In this example we take advantage of multiple input sets to either add or modify data. If we determine in the **dup\_chk** internal subroutine that the record exists, we read the data and load it into the input window with **I\_DISPLAY**. Notice that we change the input set from **customer** to **nokey**. This is because we will be modifying an existing record and don't want the user to modify the primary key. If you look in the script definition for the **customer** window, you'll see that the

**nokey** input set contains all fields except the primary key, **cmpny**. Because **I\_DISPLAY** flags every field as having input entered in it, **I\_NEXT** is called to set the context to the first field in the **nokey** input set. When **dup\_chk** returns to the input processing loop and re-executes **I\_INPUT**, the input window will contain the data to modify, and the user will not be able to access the **cmpny** field.

If the **FIND** statement fails to find a matching record, it skips the code that updates the input window and returns to the input loop to continue “add” processing.

## Creating and processing selection windows

Selection windows are a powerful way to present a set of valid options to your user. If you specify a list of values for a field (in either its script or repository definition), when that field is processed, a selection window containing those choices appears. Your user can only select from those choices.

If several of your input windows contain fields that share a set of valid choices, you can create a single selection window and associate it with each of those fields. Thus, you maintain the list of choices in only one place, and by changing just that window, every field that uses the window is changed.

Note that although only static selection windows are discussed in this section, UI Toolkit also provides routines that enable you to build selection windows at runtime. This feature enables your application to create and modify selection windows based on factors that are not determined until the program executes. For example, selections can be loaded from a file, based on security or license status. See the “[Selection Routines](#)” chapter in the *UI Toolkit Reference Manual* for more information.

### 1. Define selection windows

Selection windows are quite simple to create and maintain. You can use Composer or a text editor to create selection windows. (Composer uses its own text editor to create selection windows.) The following sample code defines two selection windows:

```
.select yes_no
.placement 2, 2
.border on, color(1)
.item "Yes"
.item "no"
.end

.select marital_stat, 2
.placement 2, 2
.border on, color(1)
.item "Married"
.item "Divorced"
.item "Widowed"
.item "Single"
.end
```

The first selection window is a generic window for yes or no answers. The choices are displayed vertically. In most applications, you would also create a **no\_yes** selection window with the items reversed. This is because the default choice is the first one listed; assigning the appropriate selection window to your fields (with the **selwnd** .FIELD qualifier) makes your application more user-friendly. The second window is a marital status list. It has four entries. The “2” on the .SELECT command is the number of rows to display; the entries in this column are split into two two-row columns.

## 2. Process selection windows

To move about in your selection windows in a non-Windows environment (it is handled automatically on Windows), create a menu column that contains the selection window reserved menu entries (S\_). In most cases, you will associate each entry with a shortcut. (The arrow keys are a logical choice.) If you pass the column ID as the fifth argument to **L\_INPUT**, the column will be placed whenever a selection field is processed and removed as soon as that selection field is exited. The sample below uses the reserved entries and associates them with the arrow key shortcuts. It is to be loaded (but not placed) at start-up.

```
.column sel_col, "Selection keys"
.entry s_up, "Up", key(UP)
.entry s_down, "Down", key(DOWN)
.entry s_right, "Right", key(RIGHT)
.entry s_left, "Left", key(LEFT)
.end
```

## Creating and processing text windows

One of the most difficult things to code is a text editor. Many applications require editing capabilities, whether it be to allow entry of comments on a purchase order, special instructions on a delivery order, or justification on a General Ledger entry. Some applications address the problem by calling a system utility to perform the editing. But what happens when you move to another platform and that utility is not available? Or you upgrade your system and the utility you previously used is not yet available on the new version? Your application doesn't work, or its capabilities are severely diminished. To address this problem, and to give your application true platform independence, UI Toolkit provides text-editing capabilities through **T\_EDIT** (and related text routines) and through **U\_EDIT**.

**T\_EDIT** is the original Toolkit text editing routine, and it's part of a group of routines that work with text windows (windows set up with **T\_SETUP**). For example, once text has been edited, you can use **T\_VIEW** to display the text in read-only mode. **U\_EDIT** on the other hand, was created for more Windows-like editing capabilities, so unlike **T\_EDIT**, it preserves hard returns. It enables you to pass in multiple lines of text separated by hard returns when it starts, and it preserves hard returns in resulting text when control returns from **U\_EDIT**. The following sections outline steps for using **T\_EDIT** and other text routines to edit text in a text window. For information on **U\_EDIT**, see [U\\_EDIT](#) in the “Utility Routines” chapter of the *UI Toolkit Reference Manual*, which includes an example that illustrates its use.



### 1. Define menu columns for text functions

UI Toolkit enables you to edit or simply view text. Both capabilities are handled via text windows and reserved menu entries. Edit functions are activated by the **E\_** reserved entries, and the text view functions (scrolling) by the **T\_** reserved entries. Each set of entries should reside in its own column, with a unique shortcut key assigned to each entry. This script shows typical edit and view columns:

```
.column      textedit,      "Edit text"
.entry       e_left,        "Move left",              Key(left)
.entry       e_right,       "Move right",             Key(right)
.entry       e_emov,        "End of line",             Key(end)
.entry       e_bmov,        "Beginning of line",       Key(home)
.entry       e_xup,         "Move up",                 Key(up)
.entry       e_xdown,       "Move down",               Key(down)
.line
.entry       e_cdel,        "Delete character",        Key(del)
.entry       e_lclr,        "Clear line",               Key(^X)
.entry       e_edel,        "Clear to EOL",             Key(^E)
.entry       e_ilin,        "Insert a line",            Key(ins)
.entry       e_join,        "Join lines",               Key(^J)
.end

.column      textview,      "View text"
.entry       t_top,         "Top of window",            Key(^T)
.entry       t_bottom,      "Bottom of window",         Key(^B)
.entry       t_lside,       "Left side of window",      Key(^L)
.entry       t_rside,       "Right side of window",     Key(^R)
.line
.entry       t_pagup,       "Scroll up page",           Key(prev)
.entry       t_pagdown,     "Scroll down page",         Key(next)
.entry       t_scrup,       "Scroll up half page",      Key(f8)
.entry       t_scrdown,     "Scroll down half page",    Key(f7)
.end
```

### 2. Define the text window

The text window should be large enough to contain the text to be viewed or edited. If the window is too large for the screen, you must specify a display area that fits the screen. UI Toolkit will use the reserved entries your user selects to manage the scrolling of the display. This script window definition can be created in Composer or a text editor.

```
.window text, 99, 73
.display_area 1, 1, 20, 73
.placement 2, 2
.end
```

The sample above defines a window that is 99 lines long and 73 characters wide. The display area is 20 by 73, and starts in row 1, column 1 of the window. By default, the window will be placed at row 2 column 2 of the display region. **U\_WINDOW** can be used to change the default placement.

#### 3. Load the window and menu columns

Just as we have done with all of our other Toolkit objects, we need to load our window and our menu columns. The routine used to load a display (noninput) window is `U_LDWND`. Notice in the example below that neither the window nor the columns are placed. The window is placed when it is time to use it, and the UI Toolkit text routine places and removes the columns automatically.

```
xcall u_ldwnd(text_win, g_utlib, "text", D_NOPLC)
xcall m_ldcol(view_col, g_utlib, "textview", D_NOPLC)
xcall m_ldcol(edit_col, g_utlib, "textedit", D_NOPLC)
```

#### 4. Convert the window

Once the window is loaded, it must be converted into a text window. `T_SETUP` establishes the controls for the display of the window and the default behavior for subsequent data that is loaded into the window. Display characteristics such as margin settings, paragraph treatment, display color and renditions, text wrapping, and display size can all be set with `T_SETUP`.

For our example, the window is placed as specified in the script file. We use the `T_SETUP` defaults and clear the window of any text that might have remained from the previous edit.

```
xcall e_enter
u_window(D_PLACE, text_winid)           ;Place at default position
xcall t_setup(text_winid, D_INIT)       ;Initialize the window
```

#### 5. Add data to the window

To edit the text window, we place the call to `T_EDIT` in a loop. Exit from the loop is controlled by menu entries in a column placed before the call to `T_EDIT` (a column that doesn't contain any reserved menu entries). We allow `T_EDIT` to load our reserved entry menu columns for us. The example takes all of the default text processing modes (start at row 1, column 1; set insert mode; edit in a forward direction; allow lowercase input). By passing the variables in the row, column, insert, and case positions, we save the exit value for each. When the program returns to the top of the loop and calls `T_EDIT`, editing resumes in exactly the same place, in the same mode.

```
repeat
  begin
    xcall t_edit(text_win, row, col, insert, dir, case, edit_col,
    &               view_col,, "text_help")
    if (g_select)
      case g_entnam of
        begincase
          "SAVE":   begin                               ;Save and resume
                      call write_data
                      exitloop
                    end
          "O_ABANDON": exitloop
        endcase
      end
    xcall e_exit
  return
```

## 6. View the contents of the text window

Use `T_VIEW` to enable the user to scroll through the contents of a text window without editing it. The example below does not put `T_VIEW` in a loop because the only event that causes it to exit is “Exit.” When the user selects “Exit,” there is no reason to re-enter. Scrolling through the window is handled by the reserved menu entries contained in the **view\_col** column.

```
view_text,
  xcall e_enter
  u_window(D_PLACE, text_winid, 1, 1)
  xcall t_view(text_win, view_col, "view_help")
  xcall e_exit
  return
```

## Extracting data from a text window

When text in a text window has been edited, we can do one of two things to save the input:

- ▶ Store the contents of the window into a window library.
- ▶ Extract the information from the window into our program’s data area so it can be processed in some manner.

The following extracts the data to the program. To store the window and its contents to a window library, see the `U_SAVE` subroutine in the “Utility Routines” chapter of the *UI Toolkit Reference Manual*.

### 1. Define a data structure to hold the window contents

The first thing needed to extract the data from a text window is an alpha array with at least as many elements as there are rows in the text window. The size of each element should match the number of columns in the window. In the example, we allocate an alpha array whose dimension is based on a compiler definition (`NUMLINES`). We use a `.DEFINE` so we can use the same value as an upper boundary when we unload the window data into the array. If at some point in the future the text window needs to change size, we only have to change the value in the `.DEFINE`; all references to this value will remain synchronized.

```
.define NUMLINES,          99                ;Number of lines in text window
record
  textline                  , [NUMLINES] a73
```

### 2. Unload the data

To unload the data, we call the UI Toolkit routine `T_GETLIN`. Our example routine transfers the data from the text window into the **textline** array, starting with line 1 and continuing through line 99 (`NUMLINES`). Because the user may not have filled the entire window with text, it might be beneficial to know exactly how many lines were retrieved; this value is returned in the **lines\_input** variable. This variable is used as the upper boundary in the routine that stores the data.

```
write_data,
  xcall t_getlin(text_win, textline, NUMLINES, start_line=1,
&                  lines_input)
```

```
for ivar from 1 thru returned           ;Now store the data records
begin
  entry_number = hold_entry
  entry_line = ivar
  entry_text = textline[ivar]
  store(text_ch, diary)
end
return
```

See the “[Text Routines](#)” chapter in your *UI Toolkit Reference Manual* for more information about other text processing features, including the ability to load text into a window and store data with the window in a window library.

## Creating and processing lists

A *list* is a virtually unlimited collection of identically formatted items, its size limited only by the disk space available. In its most basic form, a list is a visual representation of a file. But a list doesn’t have to derive its contents from a single file—you can construct the items in a list of data from any source or any combination of sources. But, like the records in a file, while the contents of each item are different, each item is structured the same.

An input window defines the structure of a single list item. Usually you create this input window for the sole purpose of associating it with a list. To display the list on the screen, the list processor makes multiple copies of this input window, each with its own data.

Of course, you may want to do some things a little differently for your list input windows. If you want your application to be portable to Windows platforms and want to use multiline list items, you will need to use the ActiveX list control when processing your list. With a UI Toolkit list, you are restricted to single-line list items (and thus a single-line list input window). In most cases, your list will have a header, so having prompts in your window will not make much sense. Also, if you pull the field definitions from your repository and the repository contains default values for *pos* and *fpos*, make sure you override them in the script definition.

In your script file you will also define the *list class*. While an input window defines the structure of a list’s items, the list class defines the characteristics for the entire list. Things like the number of items visible at one time, the list’s position on the screen, any *methods* (special subroutines called by the list processing routines) associated with the list, and the number of header and footer lines are all part of the list class.

When the list processor is called, it tries to perform the request your program passed to it. If this request requires an item that hasn’t been loaded onto the list, the list processor calls your *load method*. A load method is a subroutine written by you that the list processor calls each time it needs a new item. Once an item is loaded, the list processor manages that item itself, storing its information in its own temporary files. The load method is called only once per item, regardless of the number of times that item is accessed.

A list item consists of two components:

- ▶ The display component, which is the formatted information as it is displayed on the screen
- ▶ The data component, which is data that you associate with the item

In the simplest case, the display component matches the data component, but there is no requirement that they be related. Your load method should load the list's display component into its input window and the data component into its data area.

For more information, see the “[List Routines](#)” chapter in your *UI Toolkit Reference Manual*. List processing is truly the most powerful display tool in UI Toolkit. The example here demonstrates only the most basic aspects. The possibilities for managing the display of data, from doing input directly into an existing list to advanced search capabilities, are extensive.

### 1. Define the display window

Our sample window contains a field that will be loaded (as the title indicates) with the company and contact names. The data to be loaded into this field is constructed in the load method, from the **company**, **fname**, and **lname** fields.

```
.input cstlst_inp, 1, 64
.placement 2, 2
.title "Company, Contact"
.field display, a64, fpos(1,1)
.end
```

### 2. Define the list class

As you can see, there isn't much to a list class definition. In the sample below, we define a page as containing five items, reserve one line for the header, and specify the load method. The list will be placed at row 1, column 15.

```
.listclass customer_list, items(5), -
                                headers(1), -
                                load_method("load_cust")

.placement 1, 15
.end
```

### 3. Create the load method

Because your application does not call the load method directly, you do not control the arguments passed to it—you must write the routine to conform to the arguments that the list processor passes. The arguments must match the format below exactly.

Communication between the subroutine and the list processor is accomplished through the request argument (**a\_request**). A list can be *expanded* (a new item added) at the top, at the bottom, or at the top or bottom, depending on settings specified when the list is loaded from the window library. If the list is being loaded in both directions, your load method will check the request argument to determine whether the next new item is to be added to the top or the bottom.



Do not depend on the order in which items are requested when two-way loading is enabled, because the user can change the order in which items are loaded for any given list.

In the example below, each new item is added to the bottom, so you don't need to check **a\_request**. Using a global variable for the input channel (the file was opened at start-up in the main routine), the load method reads sequentially through **customer.ism** from top to bottom (one record per call), constructs the display string, and calls **I\_DISPLAY** to update the list's input window with the display for each new item.

In addition to the visible portion, data must also be associated with each item. **A\_data** is the data area passed to the list processor (**L\_SELECT** or **L\_PROCESS**) and the list creation routine (**L\_CREATE**). Once the item's data has been returned by the load method to the list processor, your program can use it to search the list for a specific item, determine the current list item, perform file look-ups, load an input window for modification or viewing—just to name a few things. It is important that you pass the data area to be associated with the list to all the list routines and that you load it with the appropriate data in your load method.

When the load method **READS** encounters end of file, it skips the load logic and sets **a\_request** equal to **D\_LEOF**. This tells the list processor that no more items are to be added to the list. From this point on, the list processor will not call the load method again, and instead will manage all list items itself.

```
subroutine load_customer
  a_listid      ,n      ;List ID
  a_request     ,n      ;RETURNED - LP communication variable
  a_data        ,a      ;Data area (customer record)
  a_inpid       ,n      ;Input window ID
  a_disabled    ,n      ;Flag for disabling an entry
  a_itemindex   ,n      ;The item's ordinal position in the list

  .include "WND:tools.def"
  .include "ids.gbl"

  record
    display ,a65

  proc
    begin
      reads(custload_ch, customer, eof)
      xcall i_display(a_inpid,,(display=%atrim(cmpny)+",
&                      "+%atrim(fname)+" "+lname))
      a_data = customer
      exit
    eof,
      xcall i_init(list_inp)
      a_req = D_LEOF
    end
    xreturn
  endsubroutine
```

Because load methods are just external subroutines, your application program can use all of the power of Synergy DBL to select or construct the items to add to the list. If you choose not to specify the load method in your `.LISTCLASS` definition, or if you want to use a different load method, the `L_METHOD` subroutine enables you to specify or change the load method at runtime.

If your load method loads items sequentially from a file, the record pointer *must* be on the next record to be loaded. If the load method retrieves data on the same channel used to update the database file, there is no assurance that the pointer is on the correct record. Therefore, you must open the input file on a channel dedicated to the load method. No other I/O can occur on this channel. If the list is being expanded in both directions, the file must be opened twice: once for the forward READS, and once for the reverse READS. In other words, a channel must be dedicated to the list load method *for each load direction*.

#### 4. Load the list input window and selection column

Before you can associate your list input window with a list, the window must be loaded. And, like other UI Toolkit routines that get input from the user, the list processor's selection routine recognizes a set of reserved menu entries. The following statements to load both of these list components appear in the program's start-up routine. Make sure you load your list input window and selection column with the `D_NOPLC` argument—the input window and selection column will be placed and removed with the list, automatically.

```
xcall m_ldcol(lsel_col, g_utlib, "list_sel", D_NOPLC)
xcall i_ldinp(customer_lst_inp, g_utlib, "cont_l_inp", D_NOPLC)
```

#### 5. Create the list

All of the components are in place and ready to be assembled. We create our list with a call to the UI Toolkit routine `L_CREATE`. Although the syntax is different, `L_CREATE` can be compared to Toolkit's load routines, in that it goes out to the window library, finds the specified definition, and loads it into memory.

The creation of the list establishes the controls that will be used by UI Toolkit to manage the list. This is where the list's display and data components are assigned—the second argument to `L_CREATE` is the ID of the list input window, and the third argument is the data area to be associated with the list. Each of these variables is passed by the list processor as arguments to your load method.

```
xcall l_create(customer_lst, customer_lst_inp, customer, g_utlib,
&               "listclass",,, D_NOPLC)
```

This sample code creates a simple list that will be loaded from top to bottom (the default). The list is loaded into UI Toolkit memory at start-up but is not placed on the screen. The **customer** record is established as its data area—it must be passed in all calls to the list processor as well.

`L_CREATE` also has additional arguments that control such things as the manner in which the list is loaded and its placement on the screen.

#### 6. Process the list

The template for processing a list is quite similar to that for processing other UI Toolkit objects. A loop structure calls the Toolkit processing routine, `L_SELECT`. This routine processes the list selection-style. The first time `L_SELECT` is called, the list processor determines that it needs an item. It calls the load method, which returns with an item to be added to the list. The list processor adds the item, and because the list class says there are five items on a page, it repeats this step four more times.

As soon as a page has been filled, `L_SELECT` puts a selection window on the screen. The user can move around through all the visible items (using the shortcuts associated with the reserved menu entries, or on Windows, using the mouse and arrow keys). With any request for an item not yet loaded—for example, if the user presses the shortcut to move down a page—the list processor once again calls the load method until the request has been filled. A request for an item (or page of items) that's already loaded does not initiate a call to the load method. Instead the list processor retrieves the item (or items) from the *file stack*, a temporary file management system the list processor uses to manage the list.

```
repeat
begin
    xcall l_select(customer_lst, request, customer,,,,, lsel_col)
    using (g_entnam) select
        ("G_ABOUT"),    xcall u_about(TITLE, VERSION, %datecompiled)
        ("O_EXIT"),    exitloop
        ("P_REMOVE"),  call remove_entry
        ("P_MODIFY"),  call modify_entry
        ("P_ADD"),     call add_entry
        (),             if (request)                ;No menu entry
                        call process_request        ;Process list request
                        else
                        call display_entry          ;Display selection
    endusing
end
return
```

`L_SELECT` exits when a menu selection is made or when the user selects an item by highlighting it and pressing ENTER. Though it isn't displayed here, the **display\_entry** routine determines the item selected by checking the data area passed to `L_SELECT` (as the third argument). It is *essential* that you pass to `L_SELECT` the same data area specified in the third argument to `L_CREATE`. If you don't, there is no way to determine which item was selected.



# Implementing Online Help

Toolkit has routines that support three types of online help: native Toolkit help, HTML Help (**.chm**), and WinHelp (which is now obsolete). Native Toolkit help is the default mechanism for displaying context-sensitive help. It uses Toolkit windows to display autonomous help topics (as opposed to a help system). To implement native Toolkit help, you'll associate help windows with fields and/or some routines, and you'll use the O\_HELP menu entry to activate help. See [“Implementing native Toolkit help”](#) below.

With HTML Help and WinHelp, on the other hand, your help system can include a table of contents, index, and search (as well as different types of windows). Once the help system is open, users can use these and other features to navigate to other help topics. To implement HTML Help or WinHelp, you'll call %U\_HTMLHELP or %U\_WINHELP. These routines wrap most of the functionality of the Microsoft HTML Help API and WinHelp API. The state of the help system when it opens depends on the options you pass in the call and the features available in the help system (table of contents, index, etc.).

No matter which of these help formats you use, you can use Toolkit's built-in context-sensitive help features to associate a field and, in some cases, a routine with a help topic. These features include a replaceable help method, the O\_HELP reserved menu entry, and context IDs for fields and some routines (as discussed in [“Implementing native Toolkit help”](#) below).

One way to implement HTML Help or WinHelp is to register your own Toolkit help method, and have that help method make the %U\_HTMLHELP or %U\_WINHELP call. If you do this, the O\_HELP menu entry invokes your help method, and context IDs you've defined are automatically passed to the method. For example, with the following code an, HTML Help system (**myhelp.chm**) opens when the user presses F1 or selects Help from the menu. A context ID may be passed to the help method, so the help method has an argument that accepts a context ID. (For information on the cases in which a context ID is passed to the method, see [EHELP\\_METHOD](#) in the “Environment Routines” chapter of the *UI Toolkit Reference Manual*.) If a context ID is passed to the subroutine, the %U\_HTMLHELP call displays the help topic for the context ID. If no context ID is passed (or if there's no help topic for the context ID), the help system opens with the table of contents displayed.

```
proc

xcall e_method(D_METH_HELP, "help_method") ;This registers the help
                                           ; method defined below.

.
.
xcall mb_entry(cont, "O_HELP", "Help", F1_KEY)
.
.
xcall ib_field(build_id, 'select1', D_FLD_SIZE, 10, D_FLD_TYPE,
&          D_DECIMAL, D_FLD_POS, 2, 2, D_FLD_PROMPT,
&          "Enter a number:", D_FLD_FPOS, 2, 19,
&          D_FLD_HELP, "Alink_B")
```

```
.
.
;-----
;Help Method

subroutine help_method
    a_ident      ,a          ;Context ID. This is what you specify
                        ; with the help qualifier for .FIELD,
                        ; the help_id argument for AX_INPUT, etc.

.include 'WND:tools.def'

proc

if (^passed(a_ident)) then
    u_htmlhelp(D_HH_HELP_CONTEXT, "myhelp.chm", a_ident)
else
    u_htmlhelp(D_HH_DISPLAY_TOC, "myhelp.chm")

xreturn
endsubroutine
```

## Implementing native Toolkit help

Toolkit includes features that enable you to easily provide context-sensitive help in your application. You define your help windows in a script file and then compile them into a window library. Toolkit enables you to specify (with a `.FIELD` option or a Toolkit subroutine argument) which help window to display when your user requests help. When help is requested, UI Toolkit displays the help window specified for the context and removes it when the user clicks the close button on the help window.

### 1. Activate context-sensitive help

As we stated earlier, `o_help` is the reserved entry that activates the UI Toolkit help routine. You need to make this menu entry available wherever you want the user to have access to help information. We suggest that the `O_HELP` reserved entry be included in your General menu column.

### 2. Create the help windows

Creating the text for your help windows may be easier than you think. In fact, you may already have the bulk of the work done and simply need to reformat existing text into window definitions. For example, you may be able to borrow text directly from existing documentation, using an editor to place it in a UI Toolkit script window definition. As you will see from the example below, you can create a template for your help windows that will give all of them the same “look and feel” and yet allow for variable-length text in each window. Modifications can be made to the window contents without having to worry about reformatting the data for presentation.

Note that your window script should contain a text window named **h\_general**. This is a generic help window to be displayed when the UI Toolkit help routine can't find the specified help window or when no help window was specified. This window should contain a generic message that is appropriate across the entire application. If Toolkit cannot find **h\_general**, it displays an error message. Your application will have a more professional look if **h\_general** is defined.

Below is an example of a general help window. Although it is defined to have 10 rows, the .TRIM 1 command removes the empty lines at the bottom, leaving one blank line after the text.

```
.window h_general, 10, 40
.placement 10, 20
.text WndTxt2, position(1, 1)
There is no help available for this function.
.trim 1
.end
```

Two typical help windows are shown below:

```
.window h_lname, 10, 40
.placement 10, 20
.text WndTxt3, position(1, 1)
This field contains the contact's last name. The last name is used to
identify the record and therefore cannot be left blank.
.trim 1
.end

.window h_tk, 10, 40
.placement 10, 20
.text WndTxt4, position(1, 1)
Check the Tk box if this customer is licensed for UI Toolkit.
.trim 1
.end
```

Notice that all of the help windows are defined as being 10 rows by 40 columns and are placed at location 10, 20 in the display region. Using the .TRIM command eliminates the need for you to determine how the text fits in the window. And if you ever modify the text in the window, the resizing will take place automatically when the script file is processed.

You may want to define your help windows in a separate script file, or you may choose to place them in the script file of the window with which they are associated. If you want to use UI Toolkit's help routine as it is distributed, your help windows should reside in the library specified in U\_START. Otherwise, you can replace Toolkit's help routine with your own. See the [EHELP\\_METHOD](#) documentation in the "Environment Routines" chapter of the *UI Toolkit Reference Manual* for details.

### 3. Associate help windows with fields

To simplify the association of help windows with the fields in your input windows, UI Toolkit provides the ability to identify the help window for each field. You can define this association once in your repository, and every instance of that field will inherit this information. Or you can specify it directly with the **.FIELD help** qualifier. The following is extracted from our previous input window script definition:

```
.field lname, a16, pos(1, 4), prompt("Last"), pos(6, 11), fpos(6, 19), -  
    help("h_lname"), hyperlink_method("contact_drill")
```

If the window named **h\_lname** exists in the primary window library and the user selects the **o\_help** reserved menu entry while positioned on the field **lname**, the input processor calls the Toolkit help routine, which displays the appropriate help window and waits for a user response. When the user is done reading the help window, Toolkit removes it, restores the original screen, and resumes processing the input field.

Most UI Toolkit routines that prompt the user for input have a similar mechanism to activate the help routine and display a specific help window. For example, **M\_PROCESS**, **T\_EDIT**, **T\_VIEW**, and **L\_SELECT** all have an optional argument for the name of the help window to display if the user selects the help menu entry. **I\_INPUT** uses the **.FIELD help** qualifier. You can even have a help window for each menu entry.

# Organizing Your Display with Tabbed Dialogs

With UI Toolkit, you can organize windows and lists into a set of tabbed dialogs. While tabs are primarily a Windows feature, Toolkit makes tabs available on both Windows and non-Windows platforms. Each tab element or *dialog* contains an input window or list. All tabs in a group of tabs (called a *tab set*) are placed simultaneously, in an organized stack. Your user can select, via mouse or menu entry, any tab in the current set. The selected tab is brought to the front and its element is available to process. See the “[Tab Set Routines](#)” chapter of the *UI Toolkit Reference Manual* for more information.

## 1. Create a tab set

When a tab set is processed, each member tab and its associated element (a window or list) is accessible to the user. Before a tab can be created, you must define a tab set. The example below creates a tab set. The tab set ID is returned in **contact\_tab**. Each tab will be 8 rows by 71 columns. No tab element can be larger than this.

```
contact_tab = %ts_tabset(DTS_CREATE, "contact_tab", 8, 71)
```

## 2. Load the input windows

Below we create three copies of the same input window, one for each of the three tabs to be created. (To create a copy of an input window, your call to **I\_LDINP** must pass a window name in the eighth position; the load routine loads a copy of the window and assigns it the name passed in position three.) Of course a tab set doesn't need to use the same window—it can consist of a mixture of completely unrelated input windows and lists.

Next we call **W\_BRDR** to create a title for the input window. This is important because the identifying text that displays on the tab is actually the title of the associated input window. Without a title on the associated input window, your user will have no way of distinguishing one tab from another (without selecting it).

```
for cntr from 1 thru 3
  begin
    xcall i_ldinp(contact_inp(cntr), g_utlib, "contact"+%string(cntr),
    & D_NOPLC,,, "contact")
    xcall w_brdr(contact_inp(cntr), WB_TITLE, cont_grp[1].c_lname)
  end
```

## 3. Populate the tab set

With the elements in place, we are ready to create a set of tabs. Below is the same code we used to load the input windows—with one addition. To the loop we added a **%TS\_TABSET(DTS\_WINDOW...)** function call. The **DTS\_WINDOW** argument to **%TS\_TABSET** creates a tab and associates an input window with it. (To create a tab and associate a list, use **DTS\_LIST** instead.) When the user selects this tab, the window in **contact\_inp(cntr)** is brought to the front, and our **PROCESS\_INPUT** routine is called to process it. Since we have three

identical input windows, we can use the same process routine. If you need to process each tab differently (or are mixing different input windows or input windows and lists in the same tab set), you may want to specify a unique process routine for each tab.

```
for cntnr from 1 thru 3
  begin
    xcall i_ldinp(contact_inp(cntnr), g_utlib, "contact"+%string(cntnr),
    & D_NOPLC,,, "contact")
    xcall w_brdr(contact_inp(cntnr), WB_TITLE, cont_grp[1].c_lname)
  end
tabindx(cntnr) = %ts_tabset(DTS_WINDOW, contact_tab,
& contact_inp(cntnr), "process_input")
```

#### 4. Process the tab set

TS\_PROCESS is the tab processing routine. It controls the placement of the current tab and calls the appropriate tab method. Like most UI Toolkit routines, TS\_PROCESS is called in an event loop. When called, TS\_PROCESS *processes* the current tab: it brings the associated window or list to the front and calls the tab method. When the user selects another tab, the tab method returns to TS\_PROCESS, which brings the selected tab (and its associated element) to the front and calls that tab's designated tab method. If a menu entry or button was selected, TS\_PROCESS exits so your processing loop can test for and handle the exit event.

The sample below calls TS\_PROCESS, and tests for an exit event. The **cont\_key** method data is a group that contains an array of key values that identify the record to be loaded into each tab input window. See the code segment in step 5 for an example of how this method data is used.

If, in the tab method, the user selects the "Exit" menu entry or the "Cancel" button, TS\_PROCESS loads **g\_entnam** with the name of the selected event (O\_EXIT or O\_ABANDON) and returns immediately to this processing loop. If, on the other hand, another tab was selected, **g\_entnam** is loaded with the name of the tab, in the form TS\_TABxxxx, where xxxx is the tab number. TS\_PROCESS moves that tab to the front and again calls the tab method, PROCESS\_INPUT, this time without returning to the processing loop.

```
tab_num = 1
repeat
  begin
    ;Processing loop
    xcall ts_process(contact_tab, cont_key)
    if (g_entnam.ne."TS_TAB")
      exitloop
  end
  ;Processing loop
```

#### 5. Create the tab method

The tab method below is called by TS\_PROCESS for each of the tabs. We can use the same tab method because each tab contains a copy of the same input window, an input window that is processed in exactly the same way. PROCESS\_INPUT starts by using the DTS\_ACTIVE option to determine the current or "active" tab. (DTS\_ACTIVE can also be used to change the active tab.) It uses the tab number or "index" to determine the appropriate key to the record to be processed in the

current input window. Once it has this data, `PROCESS_INPUT` loads it and calls the input processor. If the method determines that `I_INPUT` exited with the input set complete, it updates the record and returns to `TS_PROCESS`. Because the current tab set hasn't changed, `TS_PROCESS` calls `PROCESS_INPUT` again with the same tab set active.

If the user selects another tab, `I_INPUT` exits with `g_setsts` and `g_select` true; `g_entnam` contains the name of the selected tab set. `PROCESS_INPUT` returns to `TS_PROCESS`, which calls `PROCESS_INPUT` again with the new tab active (at the front).

If `I_INPUT` exits because a menu entry or button was selected, again `g_setsts` and `g_select` are true, but this time `TS_PROCESS` doesn't recognize the entry in `g_entnam`. It exits to the processing loop in the calling program.

```
subroutine process_input
    a_inpid      ,n
    group contkey ,a
    key_val      ,9a77
endgroup
.include "WND:tools.def"
.include "ids.gbl"
static record
    key      ,i4      ,1
record
    contact_dat ,a198

proc
    key = %ts_tabset(DTS_ACTIVE, contact_tab)
    read(contact_ch, contact_dat, key_val(key), KRF=1)
    xcall i_display(a_inpid, "all", contact_dat)
    xcall i_next(a_inpid, "data", "*FRST*")
    xcall i_input(a_inpid, "data", contact_dat)
    if (.not.g_setsts)
        write(contact_ch, contact_dat)
    xreturn
endsubroutine
```

# Using Composite Windows to Combine Windows and Lists

UI Toolkit enables you to combine multiple windows and/or lists into a single window, called a composite window. For example, you could create a composite window that includes an input window, a table, an ActiveX control, and buttons. To the user, a composite window looks and functions as a single window.

A composite window consists of a parent window (called the composite container window) and child windows or lists. A child can be any type of UI Toolkit window or list, including an ActiveX window, a tab set window, an ActiveX Toolkit list, or another composite window. This section contains the general steps for creating and using composite windows. For details on these steps, additional composite window tasks, and a complete example, see [“Creating and Processing Composite Windows”](#) in the “Composite Window Routines” chapter of the *UI Toolkit Reference Manual*.

## 1. Create the composite container window

Start by using the DC\_CREATE subfunction for %C\_CONTAINER to create the composite container window. The example below creates a composite container window that

- ▶ has a Toolkit-assigned name. (Passing a null string for the *name* argument causes Toolkit to assign a unique name to the composite window.)
- ▶ fills the entire body of the application window. (Passing **g\_bdysiz**, a global variable defined in **tools.def**, instructs Toolkit to use the number of rows in the body of the application window, and passing %W\_INFO with WIF\_SCOLS instructs Toolkit to use the number of columns in the application window.)

Additionally, this example returns the ID of the new composite container window in the **id\_contain** variable.

```
id_contain = %c_container(DC_CREATE, "", g_bdysiz, %w_info(WIF_SCOLS))
```

## 2. Add child windows and/or lists

To add child windows and lists to the composite window, use the DC\_ADD subfunction for %C\_CONTAINER. In this call, you specify the ID of the container window as well as the ID of the window or list you want to add as a child. Additionally, you can set properties for the child, including placement, tabbing position, and a menu column to be loaded when the child is processed. For example, the following adds a list that starts on the first column of the first row of the composite window and loads a menu column with the ID **id\_selcol**:

```
xcall c_container(DC_ADD, id_contain, DC_LIST, id_list, 1,  
1,,,id_selcol)
```



### 3. Place the composite window

To place a composite window, place its container window. Note, however, that when a container window is placed, only child windows and lists that have been placed are displayed in the window. Unplaced child windows and lists remain invisible. Additionally, when you place a child, it remains invisible until its container window is placed. For example, the following call places the composite window whose container window has the window ID **id\_contain**. If a window or list was placed, the window or list will be visible in the composite window.

```
xcall u_window(D_PLACE, id_contain, 1, 1)
```

Note that there are a couple of ways to place child windows and lists. One is to pass the *row* and *col* arguments in the DC\_ADD call for the child, as in the DC\_ADD example above. This instructs Toolkit to automatically place the child. The other is to use the D\_PLACE operation for U\_WINDOW or to use L\_PLACE after the window or list has been added to the container window.

### 4. Process the composite window

To process a composite window, call C\_PROCESS. This routine calls the method for the active child. Toolkit includes default composite window processing methods, but you can create your own methods and specify one in the DC\_ADD call for a child. The following is an example processing loop that tests for menu entries and calls C\_PROCESS, which passes the variables **chan\_icontacts**, **chan\_contacts**, **list\_contact**, and **inp\_contact** to the method for the active child.

```
;
; do_process - run input loop for composite window
do_process,
    xcall c_process(id_contain, chan_icontacts, chan_contacts,
    &                list_contact, inp_contact)
    if (g_select)
        begin
            using g_entnam select
("O_ADD "),      call add
("O_DEL "),      call delete
("O_SEL "),      call select
("O_EXIT "),     call update      ;leaves g_select == TRUE
        endusing
        end
    return
```

#### 5. Remove and delete windows

To remove a composite window, remove the composite container window with the `D_REMOVE` operation for `U_WINDOW`. Use `D_REMOVE` to remove child windows as well. For a child list, use `L_REMOVE`. Note the following:

- ▶ Removing a composite window doesn't remove its child windows and lists; it makes them invisible.
- ▶ Removing a child with `D_REMOVE` or `L_REMOVE` removes the child from the display but doesn't disassociate it from the composite window. To remove a child from the display and disassociate it from the container, use the `DC_REMOVE` subfunction for `%C_CONTAINER`. To delete a composite window, delete its container window. To delete a child, leave the environment it's logged in, or use the `D_DELETE` operation for `U_WINDOW`. Note that deleting a composite container window removes all child windows and lists but does not delete them.

## Using Methods

A method is a program that you write and UI Toolkit calls. You generally do not call a method directly. Instead, you give Toolkit the name of the method and let it make the call. Methods are used for a number of things: by the list processor to load an item and do item entry and exit processing; by the input processor to do field display and change processing; and by U\_START to do special initialization processing—just to name a few.

### Using input methods

Input field methods are very powerful tools that enable you to set up a field prior to input or to validate input before continuing to the next field. While break processing will accomplish many of the things input methods are designed to handle, an application running on Windows cannot assume that fields will be processed sequentially. Your user could be on field A and click on field C, completely bypassing field B. If field C depends on a break activated by field B, your perfectly functional UNIX application doesn't work on Windows. But an input method is specific to the field that activates it and is totally independent of any other field.

Input methods are useful in a non-Windows environment as well. While break processing is handled within the program that calls I\_INPUT, your input methods are a function of the field that activates them, handled externally to the routine that called I\_INPUT. In the method, you can determine the window and field that activated it and process accordingly. This means you can write a single method for a given field, to be called wherever that field is used. You can even write a single method to perform all of your file look-ups, attach the method to any field on which you need to do a look-up, and in the method itself, determine the data and file for the look-up.

```
.field cmpny, a45, prompt("Company "), pos(2, 8), fpos(2, 16), -
  change_method("lookup_lmeth")
```

Input methods are specified as .FIELD options in a script or are registered with IB\_FIELD. The sample script definition above defines a change method for the company name field. When the user completes input to this field, the input processor calls the subroutine LOOKUP\_LMETH, a generic function we have created to validate input data. When LOOKUP\_LMETH returns to I\_INPUT, input processing resumes without returning to your input program.

In the example below, the call to I\_INPUT passes arguments that are passed on to the change method. **Customer\_ch** tells the change method where to perform the look-up; **cmpny** is passed so the change method can disable this field if the find succeeds. The change method returns success if the find succeeds or an error if the find fails.

```
xcall i_input(customer_inp,, customer,,,,,,,, customer_ch, "cmpny")
```

When an asynchronous input method is called, **g\_fldnam** hasn't been loaded with the name of the current field (the field that activated the method). Instead, an argument passed to your method contains information (and pointers to information) about the current field. (See [Appendix D](#) in the *UI Toolkit Reference Manual* for a description of asynchronous methods.)

The following code demonstrates the method for receiving the arguments passed to your change method. **A\_inprec** is the data area passed to I\_INPUT. **WND:inpinfo.def** contains a group layout that matches the data passed as an argument to your method. We use %I\_GETSTRING to get the name of the set the data will be displayed in.

```
function lookup_lmeth, ^val
    a_data_entered ,n          ;Data entered by user
    a_data_stored   ,n          ;Data in storage format
    a_pending_status ,n          ;Result of Toolkit field validation
    .include 'WND:inpinfo.def'   ;Structure for input information
    a_inprec        ,a          ;Input record
    a_chnl          ,n          ;Method data parameter from i_input call
    a_disfield      ,a          ;Method data parameter from i_input call

    .include "WND:tools.def"

proc
    if (a_pending_status .ne. D_OK)
        freturn(a_pending_status)
        fld_name = %i_getstring(inp_wndid, inp fldnam)
        find(a_chnl, a_inprec, a_data_entered) [$ERR_KEYNOT=notfound,
&                                                $ERR_EOF=notfound]
        reads(a_chnl, a_inprec)
        xcall i_display(inp_wndid, %i_getstring(inp_wndid, inp_setnam),
&        a_inprec)
        if ^passed(a_disfld)
            xcall i_disable(inp_wndid, a_disfld)    ;Can't modify the key field
            freturn(D_OK)
notfound,
    xcall u_msgbox('Entry not found')
    freturn(D_EMITTEDERR)
endfunction
```

The contents of **WND:inpinfo.def** are displayed below.

```
group inputinfo ,a
    inp_wndid      ,i4          ;Input window ID
    inp_setnum     ,i4          ;Set number
    inp_setndx     ,i4          ;Set index (field number within set)
    inp_fldnum     ,i4          ;Field number within input window
    inp_nulinp     ,i4          ;Performing null input? (TRUE/FALSE)
    inp_fldtype    ,i4          ;Field type:
                                ; D_ALPHA, D_DECIMAL, D_FIXED, D_TEXT,
                                ; D_INTEGER, D_USERTYPE
    inp_empty      ,i4          ;Is the field empty?
    inp_setnam     ,i4          ;Pointer to name of current input set
    inp_fldnam     ,i4          ;Pointer to name of current input field
    inp_usertype   ,i4          ;Pointer to user-defined data type
    inp_usertext   ,i4          ;Pointer to user text string
```

```
inp_prc_atr    ,i4      ;Input processing attributes
inp_prc_clr    ,i4      ;Input processing color
inp_dsp_atr    ,i4      ;Field display attributes
inp_dsp_clr    ,i4      ;Field display color
inp_clr_atr    ,i4      ;Field clear attributes
inp_clr_clr    ,i4      ;Field clear color
inp_entered    ,i4      ;Data modified?
inp_return     ,i4      ;RETURN key pressed?
inp_navevent   ,i4      ;Type of navigation occurring (see tools.def)
endgroup
```

For more information on Toolkit methods, including input methods, list methods, and environment methods, see the [UI Toolkit Reference Manual](#).



# 7

## Developing with Synergy .NET

With Synergy .NET you can create .NET applications for Windows, Android, iOS, and Linux. (See [“Synergy .NET Basics” on page 7-3](#) for details on support.) The sections listed below document the development processes for these platforms, including basic steps for using Synergy .NET with required third-party products, such as Visual Studio and Xamarin. Note, however, that these sections do not fully document third-party products or the development procedures required to use them. For information on third-party products, refer to the documentation for those products.

### **Synergy .NET Basics 7-3**

Introduces Synergy .NET and lists the platforms it supports. Discusses how it integrates with Visual Studio, where you can get help, other .NET Framework options for Synergy/DE, compiler-time defines for Synergy .NET, and how to set environment variables for Synergy .NET.

### **Synergy .NET Requirements 7-10**

Lists basic requirements for developing and deploying Synergy .NET applications, including information on runtime libraries and licensing.

### **Using Solutions, Projects, and Portable Class Libraries 7-14**

Describes how Synergy projects can be configured to target multiple .NET platforms and how portable class libraries can be used for code that is common to more than one target platform.

### **Developing Windows Desktop and Server Applications 7-17**

Outlines steps for developing desktop and server applications for .NET Framework on Windows.

### **Developing for Universal Windows Platform 7-19**

Outlines steps for developing applications for Universal Windows Platform (UWP). Includes the tutorial [“UWP quick start \(Hello World\)” on page 7-21](#), which shows how to use the Blank App project template for UWP to quickly get a simple UWP application up and running on a mobile emulator.

### **Developing for Android 7-24**

Outlines steps for developing applications for Android devices. Includes the tutorial [“Android quick start \(Hello World\)” on page 7-28](#), which shows how to use the Android Application project template to quickly get a simple Android application up and running on an emulator.

### **Developing for iOS 7-31**

Outlines steps for developing applications for iOS devices. Includes the tutorial “[iOS quick start \(Hello World\)](#)” on page 7-39, which shows how to use the iOS Application project template to quickly get a simple iOS application up and running on a simulator.

### **Developing for .NET on Linux 7-42**

Outlines steps for developing applications for Mono on Linux systems.

### **Developing Portable Class Libraries 7-44**

Outlines steps for developing Synergy portable class libraries, which are class libraries that can target some or all platforms supported by Synergy .NET.

### **Debugging Synergy .NET Code 7-46**

Discusses how Synergy .NET uses the Visual Studio and Xamarin debuggers, and discusses debugging features and issues that are specific to Synergy .NET.

### **Using Data Files on Devices 7-51**

Describes how to deploy and access data files on devices (UWP, Android, and iOS).

### **Performing Common Synergy .NET Coding Tasks 7-55**

Describes how to perform common coding tasks for Synergy .NET applications.

### **Preparing Existing Code for Synergy .NET 7-66**

Describes how to rework existing Synergy code for Synergy .NET, including how to convert xfServerPlus routines for native .NET access.



# Synergy .NET Basics

.NET applications are made up of assemblies: executable assemblies (.exe) and class library assemblies (.dll). Synergy .NET enables you to create .NET executables and libraries for the following desktop/server platforms:

- ▶ **Windows**
- ▶ **Linux 64-bit** (Linux development is currently experimental and unsupported.)

It also enables you to create executables and libraries for the following device platforms:

- ▶ **Universal Windows Platform (UWP)** (UWP development is currently experimental and unsupported.)
- ▶ **Android 32-bit ARM and Android 32-bit x86** (Android development requires Xamarin tools.)
- ▶ **iOS 32-bit and 64-bit** (iOS development requires Xamarin tools and Xcode.)

On Windows platforms, assemblies are interpreted and managed by the Microsoft .NET common language runtime (CLR). On Android, iOS, and Linux, assemblies are managed and interpreted by the Mono CLR.

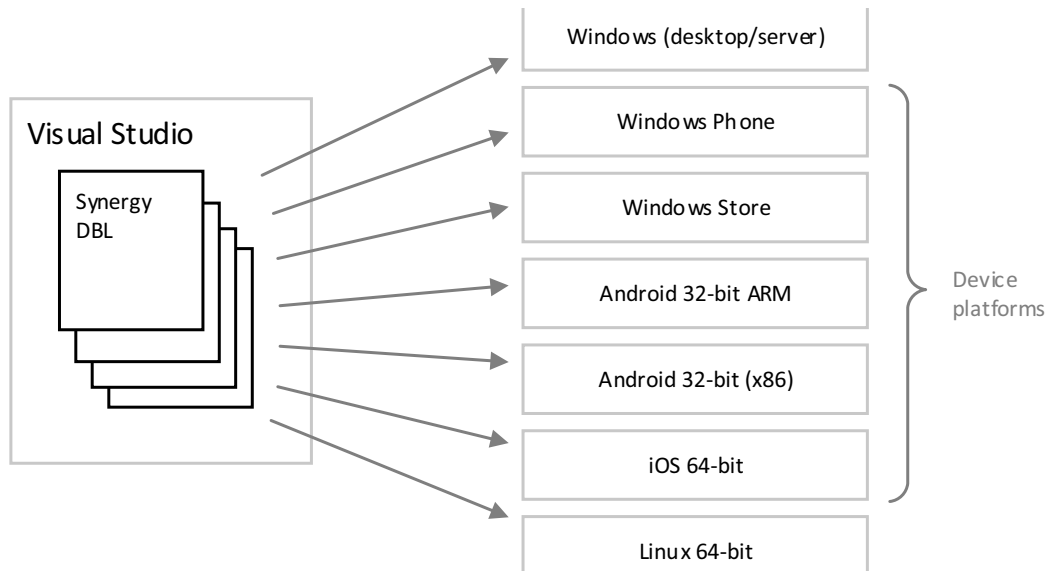


Figure 7-1. You can develop Synergy applications for a number of .NET platforms.

With the exception of portable class libraries (PCLs), every Synergy .NET assembly targets only one platform. (For information on PCLs, which can target multiple platforms, see [“Using portable class libraries and targeting multiple platforms”](#) on page 7-16.)

There are a number of advantages to developing with Synergy .NET. In addition to the benefits of managed code and the Visual Studio IDE, Synergy .NET assemblies can use .NET Framework classes, and they can interoperate with assemblies written in other .NET languages, such as C# or VB.NET.

To develop Synergy .NET assemblies, you'll use

- ▶ a subset of the Synergy DBL statements, routines, and so forth, that you would use for traditional Synergy.
- ▶ the Visual Studio IDE and standard Visual Studio development procedures to create and debug Synergy solutions and projects.
- ▶ Visual Studio build features to compile and build executables and libraries.

For Android and iOS development you'll also use Xamarin within the Visual Studio environment, and for iOS you'll also use Xcode.

## Synergy .NET components

Synergy .NET is not a Synergy/DE product. Rather, it is a term for the use of Synergy DBL with .NET. The primary Synergy/DE components used for Synergy .NET development are the Synergy .NET libraries and Synergy DBL Integration for Visual Studio.

### Synergy .NET libraries

Even though Synergy .NET assemblies run under a common language runtime (rather than the Synergy Runtime), some Synergy-specific runtime functionality is required. This is supplied by runtime libraries, which are included in Synergy/DE and in the Synergex.SynergyDE.synrnt NuGet package (which is for device applications). See [“Synergy runtime libraries” on page 7-11](#) for more information.

There are also libraries that enable you to use the XML API and the Repository subroutine library. See [“XML API and Repository subroutine libraries” on page 7-9](#).

### Synergy DBL Integration for Visual Studio

Synergy DBL Integration for Visual Studio (SDI) is a Synergy/DE product that enables you to use Visual Studio to develop Synergy applications and libraries. For Synergy .NET development, it includes the Synergy .NET compiler, which is invoked by Visual Studio build features (**MSBuild**), and it integrates with Xamarin tools for Android and iOS support. It enables you to use Visual Studio features, such as IntelliSense, colorization, and regions as you develop Synergy applications, and it hooks into and provides project wizards and designers. It also enables you to use the Visual Studio debugger to debug your Synergy .NET code for Windows applications, and it enables you to use the Xamarin debugger (which runs in Visual Studio) for Android and iOS development. (Debugging is not currently supported for Linux.) If a Synergy .NET assembly interoperates with code from other languages, you can step seamlessly from one language to another.

See [http://www.synergex.com/synergy\\_net.aspx](http://www.synergex.com/synergy_net.aspx) for information on system requirements.

SDI also includes the following:

- ▶ **Synergy/DE help for Visual Studio.** Help topics for Synergy-specific features and issues are installed with Synergy DBL Integration. See “[Synergy/DE help for Visual Studio](#)” on [page 7-6](#).
- ▶ **Project and item templates.** Templates give you a starting point for Visual Studio projects and items in projects. See the “[Synergy/DE Project Templates](#)” and “[Synergy/DE Item Templates](#)” topics in Synergy/DE WebDocs for more information.
- ▶ **Synergy-specific Visual Studio settings**, including project property settings, text editor settings, and a way to register file extensions other than the defaults (.dbl, .dbc, .def, and .rec). See the “[Setting Options for Synergy/DE Projects](#)” and “[Synergy/DE Project Properties](#)” topics in Synergy/DE WebDocs.
- ▶ **Synergy-specific Watch and QuickWatch commands** for debugging. See “[Debugging Synergy .NET Code](#)” on [page 7-46](#).
- ▶ The **C# to DBL Code Converter** utility, which converts C# code snippets into Synergy .NET code. To open this utility, select “C# to DBL Code Converter” from the Tools menu in Visual Studio.
- ▶ The **C# to DBL Solution Converter** utility, which converts C# solutions to Synergy DBL solutions. To open this utility, select “C# to DBL Solution Converter” from the Tools menu in Visual Studio.
- ▶ Synergy-specific **code snippets**, available in the Visual Studio Code Snippets Manager.
- ▶ The **Build > Stop Build on First Error** menu entry, which stops the build of a solution as soon as it encounters errors in a Synergy project.
- ▶ The **Tools > Command Prompt (x86)/(x64)** menu entries, which open the standard Visual Studio command prompt. This prompt automatically sets environment variables for .NET Framework tools. See Microsoft documentation for information.
- ▶ The **Tools > Synergy Repository** menu entry, which launches Synergy/DE Repository.
- ▶ The **Tools > Synergy Background Log File** menu entry, which displays logging for use by Synergy/DE Developer Support.
- ▶ The **Tools > Synergy Online Manuals** menu entry, which launches PDF versions of the Synergy documentation.
- ▶ Initial support for traditional Synergy. See the “[Traditional Synergy Development in Visual Studio](#)” topic in Synergy/DE WebDocs for information.

## For more information...

For more information on developing with Synergy .NET, see the following:

- ▶ Synergy help topics for Synergy-specific features. See “[Synergy/DE help for Visual Studio](#)” below, and note that many of these topics are available in the “[Visual Studio Integration](#)” section of Synergy/DE WebDocs.
- ▶ **REL\_SDI.TXT**, the release notes for Synergy DBL Integration for Visual Studio.
- ▶ The Synergy .NET requirements web page: [http://www.synergex.com/synergy\\_net.aspx](http://www.synergex.com/synergy_net.aspx).
- ▶ The “[.NET Development](#)” chapter in the *Professional Series Portability Guide* for information on differences between traditional Synergy and Synergy .NET, as well as a list of unsupported features.
- ▶ The *Synergy DBL Language Reference Manual* and the *Environment Variables & System Options* manual for information on Synergy DBL features (routines, data types, environment variables, and so forth).

For help with Visual Studio, see Microsoft documentation, including Visual Studio help and Microsoft Developer Network (MSDN). For help with Xamarin, see Xamarin documentation.

### Synergy/DE help for Visual Studio

Some help topics for Synergy-specific features are installed with Synergy DBL Integration. These topics are integrated with local Visual Studio help topics, so they are available in the Microsoft Help Viewer when viewing local help.

To access local help, select the following Visual Studio menu entry: Help > Set Help Preference > Launch in Help Viewer.

Synergy-specific topics are listed under the “Synergy/DE” node on the Contents tab of the Microsoft Help Viewer, but you can also access them from the index and search features in the Help Viewer and by

- ▶ pressing F1 in some project properties pages for Synergy/DE projects.
- ▶ pressing F1 in some options dialogs for Synergy DBL text editor options.
- ▶ pressing F1 or selecting View Help from the Help menu in the C# to DBL Code converter or in the C# to DBL Solution Converter.
- ▶ highlighting an error in the Visual Studio Error List and pressing F1.
- ▶ selecting Show Error Help from the context menu that displays when you right-click an error message in the Visual Studio Error List.

## Other options for .NET

Synergy .NET is the primary solution for Microsoft .NET Framework on Windows, and it makes UWP and Mono development possible. But there are other Synergy/DE options for .NET development for desktop and server applications on Windows:

- ▶ The **Gennet40** utility and the **Synergy .NET assembly API** enable existing Synergy code to take advantage of .NET features on Windows while still using the traditional Synergy compiler and runtime on Windows. See [“The Gennet40 Utility”](#) in the “General Utilities” chapter of *Synergy Tools* and the [“Synergy .NET Assembly API”](#) chapter of the *Synergy DBL Language Reference Manual* for information.
- ▶ **UI Toolkit .NET routines** enable you to embed .NET forms, .NET controls, and Windows Presentation Foundation (WPF) elements in Toolkit applications using the traditional Synergy compiler and runtime on Windows. See the [“.NET Routines”](#) chapter in the *UI Toolkit Reference Manual*.
- ▶ **xfNetLink .NET Edition** enables a .NET client to call Synergy routines residing on a remote server machine. Using the component generation tools, Visual Studio, and the .NET Framework, you can create an assembly that references Synergy routines. xfNetLink .NET is supported on Windows platforms only; however, you can create an assembly from Synergy routines that reside on UNIX or OpenVMS. See [“Part IV: xfNetLink .NET Edition”](#) in the *xfNetLink & xfServerPlus User’s Guide*.
- ▶ The **.NET Framework Data Provider for ODBC** (which is included with the .NET Framework) enables you to access Synergy data from .NET applications on Windows. See [“Accessing Synergy Data in a .NET Environment”](#) in the “Accessing a Database” chapter of the *xfODBC User’s Guide*.

## Compile-time defines

The following compile-time defines enable you to conditionally compile code for .NET:

- ▶ **\_DEBUG**—Debug mode only. The compiler ignores code marked with this define unless the project is compiled in debug mode.
- ▶ **DBLNET**—Synergy .NET development only. The traditional Synergy compiler ignores code marked with this define.
- ▶ **D\_MONO**—Mono development only. The traditional Synergy compiler ignores code marked with this define. The Synergy .NET compiler also ignores this code unless the project is for Mono (i.e., Android, iOS, or Linux).
- ▶ **D\_PORTABLE**—Portable class library development only. The traditional Synergy compiler ignores code marked with this define. The Synergy .NET compiler also ignores this code unless the project is for a portable class library.

For more information, see [“Built-in compiler definitions”](#) in the “Building and Running Synergy Applications” chapter in *Synergy Tools*.

# Environment variables

Environment variables can be used for

- ▶ Synergy .NET development (e.g., for build-time settings)
- ▶ runtime settings for Synergy .NET desktop/server applications on Windows

Environment variable settings are not used at runtime for applications on device platforms (UWP, Android, and iOS), except when set with the SETLOG routine or translated with the GETLOG routine. With any type of Synergy .NET application (including device and Linux applications), SETLOG and GETLOG can be used for internal program communication and for opening files.

The location of an environment variable setting determines when it will be used (for development tools, at build time, or runtime). For Synergy.NET, you can set environment variables

- ▶ in **synergy.ini** or **synuser.ini** (Windows only). Environment variables set in these files are available to Synergy/DE development tools on Windows and are available at runtime for Windows desktop/server executables (but not UWP). If an environment variable is shared by multiple executables, we recommend setting it in one shared **synergy.ini** file and then setting the SFWINIPATH environment variable in the application configuration (**App.Config**) files to point to the **synergy.ini** file.
- ▶ on the Runtime Settings page of Project Designer and in the application configuration file, **App.Config** (which is renamed to **ApplicationName.exe.config** when the project is built). Environment variables set in application configuration files are available for Windows desktop/server applications (but not UWP) and override settings in **synergy.ini** and **synuser.ini**. You can edit **App.Config** files directly, or you can use the Runtime Settings page of Project Designer. Environment variable settings on the Runtime Settings page are written to the application configuration file. See the [“Runtime Settings Page”](#) topic in Synergy/DE WebDocs for more information.
- ▶ on the Environment Variables page of Project Designer. Settings on this page are used when the project is built and when a Windows desktop/server (not UWP) application is run from Visual Studio. Environment variable settings on this page are written to the MSBuild project file (**ProjectName.synproj**), and they overwrite settings in **synergy.ini** and **synuser.ini**.

Note that although settings on the Environment Variables page are specific to the project, if you build a solution that has multiple projects, these settings will remain in effect for subsequently-built projects in the solution. So if one of these settings overrides a global setting in **synergy.ini** or **synuser.ini**, be sure to set that environment variable individually in each project in the solution to make sure the setting is correct for all projects.

## XML API and Repository subroutine libraries

Synergy/DE includes libraries for the XML API and the Repository subroutine library (the DD\_ routines). These are not supported for device platforms.

- ▶ To use the XML API, add a reference to **Synergex.SynergyDE.synxml.dll**.
- ▶ To use the Repository subroutine library, add a reference to **Synergex.SynergyDE.ddlib.dll**.

# Synergy .NET Requirements

This section lists basic requirements for developing and deploying Synergy .NET assemblies. For details on versions and editions, as well as requirements for Synergy DBL Integration for Visual Studio, see [http://www.synergex.com/synergy\\_net.aspx](http://www.synergex.com/synergy_net.aspx).

## Development system requirements

To develop with Synergy .NET, you'll need a Windows development machine with the following:

- ▶ Visual Studio
- ▶ Synergy/DE
- ▶ Synergy DBL Integration for Visual Studio

This is basically all that is required for Windows development. For Android, iOS, or Linux development you will need a Windows development machine with the requirements listed above, and you will need the following:

- ▶ For Android development, the Windows machine must also have Xamarin tools. See [http://www.synergex.com/synergy\\_net.aspx#android\\_notes](http://www.synergex.com/synergy_net.aspx#android_notes) for details
- ▶ For iOS development, the Windows machine must have Xamarin tools, and you must have a Mac development machine with Xamarin tools and Xcode. See [http://www.synergex.com/synergy\\_net.aspx#ios\\_notes](http://www.synergex.com/synergy_net.aspx#ios_notes) for details.
- ▶ For Linux development, you will also need a Linux system for testing. See [http://www.synergex.com/synergy\\_net.aspx#linux\\_notes](http://www.synergex.com/synergy_net.aspx#linux_notes) for details.

## Application requirements

A Visual Studio solution that includes one or more Synergy assemblies must have a reference to Synergy runtime libraries and must use Synergy licensing. These requirements are discussed in this section (“[Synergy runtime libraries](#)” below and “[Licensing](#)” on page 7-12). For platform-specific application requirements, see

- ▶ “[Developing Windows Desktop and Server Applications](#)” on page 7-17
- ▶ “[Developing for Universal Windows Platform](#)” on page 7-19
- ▶ “[Developing for Android](#)” on page 7-24
- ▶ “[Developing for iOS](#)” on page 7-31
- ▶ “[Developing for .NET on Linux](#)” on page 7-42
- ▶ “[Developing Portable Class Libraries](#)” on page 7-44



## Synergy runtime libraries

Every Visual Studio solution that has a Synergy project must have a reference to Synergy runtime libraries. This reference must be in a project that is *not* for a portable class library.

### Runtime libraries for desktop and server applications

For desktop and server applications (Windows and Linux), this reference must be to **synrnt**. Most Synergy project templates for desktop and server applications automatically add this reference. The exception is Synergy portable class library projects. These do not include this reference, so if all Synergy projects in a solution are for portable class libraries, you must manually add this reference to a non-Synergy project.

Synergy runtime libraries are included in the Synergy/DE Professional Series distributions for Windows and Linux. But on Linux systems, you must manually add the **synrnt** runtime library (located in `dbl/bin`) to the global assembly cache or make sure it is in the same folder as your application binaries. To add **synrnt** to the global assembly cache, use the following command:

```
sudo GACUTIL -i synrnt.dll
```

### Runtime libraries for devices

For a device application (UWP, Android, or iOS), at least one Visual Studio project for the application must have a reference to the **Synergex.SynergyDE.synrnt** NuGet package. This contains the runtime libraries for devices. It is installed to a local NuGet repository when Synergy DBL Integration is installed, and it is available on the NuGet site:

[www.nuget.org/packages/Synergex.SynergyDE.synrnt](http://www.nuget.org/packages/Synergex.SynergyDE.synrnt). Note the following:

- ▶ The version installed with Synergy DBL Integration is used only for new projects created from Synergy templates for Android and iOS. These project templates automatically add a reference for this.
- ▶ The version available from the NuGet site is used in two cases: if you manually add a reference to a project or if you instruct Visual Studio to update the version for a project. You can install this by running the following command in the Visual Studio NuGet Package Manager console:

```
Install-Package Synergex.SynergyDE.synrnt -Pre
```

When you create a project from a Synergy UWP, Android, or iOS template, a reference is automatically added to the project. When this reference is added, the version of the NuGet package installed with Synergy DBL Integration is copied to a repository for the project. From that point on, the package installed with Synergy DBL Integration is completely separate from the package for the project. Note the following:

- ▶ Updating Synergy DBL Integration will *not* update the package for the project. Instead, Visual Studio checks the NuGet site for updates, and when the package on the NuGet site is updated, you can use the NuGet Package Manager to update the package for the project.
- ▶ If a Visual Studio solution for a device platform has a Synergy project, but not a Synergy UWP, Android, or iOS project, you must manually add a reference to the NuGet package, and this reference must be added to a project that is not for a portable class library. For example, if a C#

application has a Synergy portable class library, you must manually add this reference to some other project (e.g., the project for the executable). Use the Visual Studio NuGet Package Manager to install the package; then add the reference. When the package on the NuGet site is updated, you can then use NuGet Package Manager features to update the package for the project.

## Licensing

Synergy .NET assemblies (executables and class libraries) require either traditional Synergy licensing or Synergy device licensing.

- ▶ Device licensing is required for UWP, Android, and iOS development. (Though the values for public key and GUID values are not validated when running on an emulator/simulator.)
- ▶ For Windows desktop and server development, you can generally use either traditional Synergy licensing or device licensing. However, device licensing is required if all Synergy DBL code for an application is in portable class libraries.

Note that if your application uses traditional Synergy licensing and the target machine has not been configured for local Synergy licensing, you must specify a license server name in the **App.config** file. See the [“Runtime Settings Page”](#) topic in Synergy/DE WebDocs for information.

- ▶ Traditional Synergy licensing is required for Linux development.

To use device licensing, your application must have a device licensing implementation. Projects created from the following Synergy project templates include basic device licensing implementations, but you may need to modify these or create your own implementations to meet your licensing requirements:

- ▶ Blank App (Universal Windows)—To use the basic device licensing implementation, add public key and GUID values to the SynergyDeviceLicense code in the **LicenseClass.dbl** file. See [“UWP quick start \(Hello World\)”](#) on page 7-21.
- ▶ Android Application—To use the basic device licensing implementation, add public key and GUID values to the SynergyDeviceLicense code in the **Activity1.dbl** file. See [“Android quick start \(Hello World\)”](#) on page 7-28.
- ▶ iOS Application—To use the basic device licensing implementation, add public key and GUID values to the SynergyDeviceLicense code in the **Main.dbl** file. See [“iOS quick start \(Hello World\)”](#) on page 7-39.

In the project that includes the device licensing attribute (SynergyDeviceLicenseAttribute), select the “Enable Device Licensing” option on the Compile page of Project Designer. (See the [“Compile Page”](#) topic in Synergy/DE WebDocs for information.) Do not use this option for any other project in a solution.

For more information on licensing, see the [“Configuring License Manager”](#) chapter of the *Installation Configuration Guide* and [“Device licensing \(.NET\)”](#) in the “Welcome to Synergy DBL” chapter of the *Synergy DBL Language Reference Manual*.

## Deployment requirements

To deploy a Windows desktop or server application (not UWP), the target Windows system must have .NET Framework and Synergy/DE Professional series, which includes the Synergy .NET runtime libraries. (With ClickOnce deployment, it is possible to deploy to Windows machines that do not have Synergy/DE, but this is not supported. See the [“ClickOnce Deployment for Synergy .NET”](#) topic in Synergy/DE WebDocs for more information.)

To deploy a UWP application, the target system must have a Windows 10 operating system (e.g., Windows 10 Mobile).

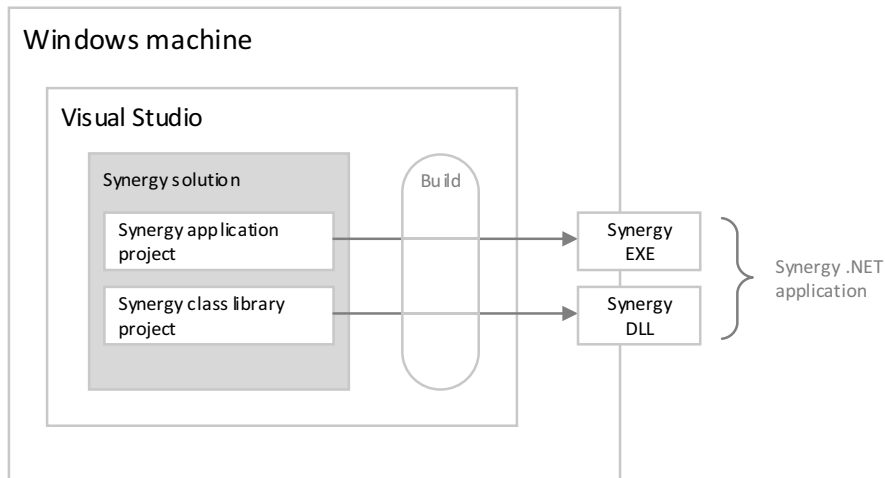
To deploy to an Android, iOS, or Linux application, the target system must have Mono. For Android, Xamarin includes a full or partial (linked) installation of Mono in deployment packages. Xamarin also includes Mono in iOS deployments. (See Xamarin documentation for information.) However, for Linux

- ▶ Mono must be installed separately
- ▶ the Linux system must have Synergy/DE Professional Series,
- ▶ you must manually add the **synrnt** runtime library to the global assembly cache (See [“Synergy runtime libraries” on page 7-11](#) for information.)

# Using Solutions, Projects, and Portable Class Libraries

.NET applications are made up of assemblies. An assembly can be an executable (.exe) or a class library (.dll), which is a collection of subroutines, functions, and/or classes that are invoked from other class libraries and executables.

To develop Synergy .NET assemblies, you'll use Visual Studio to create solutions and projects, and you'll use Visual Studio build features (which automatically invoke the Synergy .NET compiler) to build assemblies from these projects.

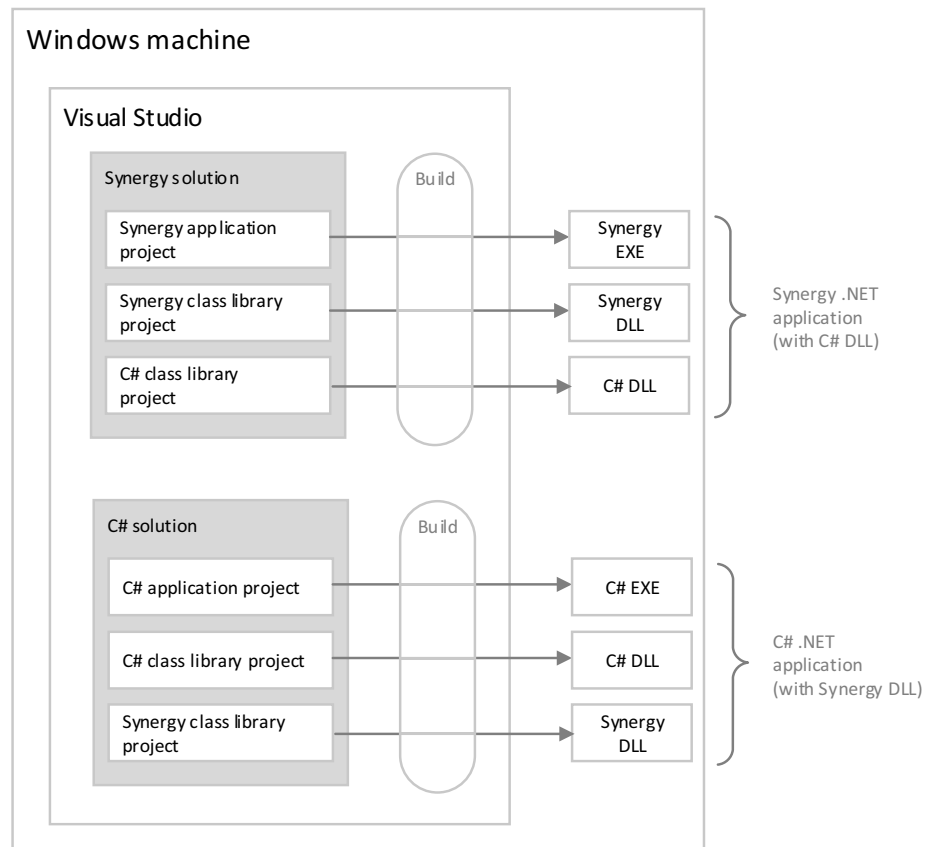


*Figure 7-2. Synergy .NET assemblies are built from Visual Studio projects.*

For each of the assemblies that will constitute your application, you'll need to create a Visual Studio project from one of the Synergy/DE project templates. You'll then add Synergy DBL code, references to other assemblies as necessary, and other items to your project. For details, see the following:

- ▶ [“Developing Windows Desktop and Server Applications” on page 7-17](#)
- ▶ [“Developing for Universal Windows Platform” on page 7-19](#)
- ▶ [“Developing for Android” on page 7-24](#)
- ▶ [“Developing for iOS” on page 7-31](#)
- ▶ [“Developing for .NET on Linux” on page 7-42](#)
- ▶ [“Developing Portable Class Libraries” on page 7-44](#)

One of the advantages to using .NET is that Synergy assemblies can use .NET Framework classes and can interoperate with assemblies written in other .NET languages (e.g., C#; see [figure 7-3](#) below). So in addition to invoking .NET Framework functionality in your code, you can include Synergy projects in solutions for other .NET languages, and you can include projects for other .NET languages in Synergy solutions.



*Figure 7-3. Synergy projects can be part of non-Synergy solutions and vice versa.*

For more information, see the following:

- ▶ [“Calling a routine in a Synergy assembly from another assembly” on page 7-60.](#)
- ▶ [“Performing Common Synergy .NET Coding Tasks” on page 7-55,](#) which includes information on instantiating and using a .NET class, inheriting and overriding a .NET class, and so forth.

### Using portable class libraries and targeting multiple platforms

With Synergy .NET, you can target multiple platforms by including projects for each type of platform in your Synergy solution. It's best to include common code in a portable class library and then put platform-specific code in platform-specific class libraries and executables. In [figure 7-4](#) below, projects for three target platforms are included in a single Synergy solution (with a portable class library project for common code):

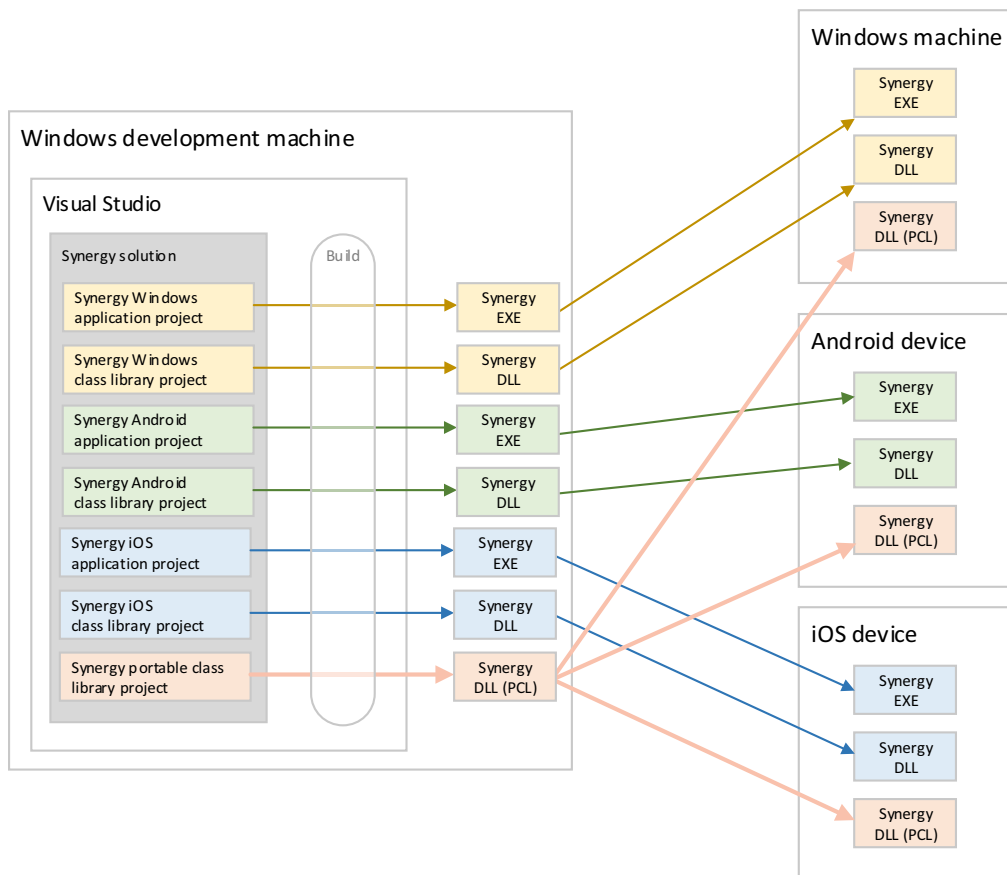


Figure 7-4. Projects for all targeted platforms in one solution.

For information on creating portable class libraries, see [“Developing Portable Class Libraries” on page 7-44](#).

# Developing Windows Desktop and Server Applications

The following are the basic Synergy .NET development steps for Windows desktop and server applications. Most of these steps outline Visual Studio procedures, so see Visual Studio documentation for full information.

This section does not discuss Universal Windows Platform (UWP) development. For information on UWP, see [“Developing for Universal Windows Platform” on page 7-19](#).

1. Start by reviewing [“Synergy .NET Requirements” on page 7-10](#). Your development machine and the Visual Studio projects you develop must meet the requirements listed in that section.
2. In Visual Studio, create a project for each assembly in your application. For example, to create a console application (an application that runs from the command line), select File > New Project, select Synergy/DE from the Installed Templates area of the New Project Dialog, and then select Console Application from the list of project types. You’ll then need to set a few options for the project (name, location, and so forth) in the New Project Dialog. Note the following:
  - ▶ All Synergy project templates are available for Windows desktop and server development for Synergy .NET except Android, iOS, UWP, and traditional Synergy templates. See the [“Synergy/DE Project Templates”](#) topic in Synergy/DE WebDocs for information on templates.
  - ▶ You can include Synergy projects in a solution for another .NET language (e.g., in a C# solution), and you can include projects for other .NET languages in a Synergy solution. See [“Using Solutions, Projects, and Portable Class Libraries” on page 7-14](#).
  - ▶ For portability, put as much logic as possible in portable class libraries. A portable class library can target the .NET Framework on Windows (including UWP), as well as Mono on iOS, Android, and Linux. See [“Developing Portable Class Libraries” on page 7-44](#).
3. Add DBL code, references to needed assemblies, and other items to your project.
  - ▶ For information on item templates, see the [“Synergy/DE Item Templates”](#) topic in Synergy/DE WebDocs.
  - ▶ For information on which Synergy features are supported see the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*. And note that for Interop projects Synergy global structures used as attribute arguments must be defined in an assembly outside of a namespace.
  - ▶ Synergy projects for desktop and server applications include a reference to **synrnt**. This is required.
  - ▶ To use device licensing, an assembly in your application must implement device licensing, and that assembly must be built with the “Enable device licensing” option on the Compile page of Project Designer.
  - ▶ To use the Repository subroutine library, add a reference to **Synergex.SynergyDE.ddllib.dll**. To use the XML API, you must add a reference to **Synergex.SynergyDE.synxml.dll**.

- ▶ You are not limited to the standard file extensions for Synergy DBL files (e.g., **.dbl** for code files). You can add files with other extensions if you specify those extensions in the Visual Studio IntelliSense dialog box for the Synergy DBL text editor. See the [“IntelliSense, Text Editor Options”](#) topic in Synergy/DE WebDocs.
  - ▶ To generate documentation from comments in code, use `;;;` to identify documentation comments in your code, and select the “XML documentation file” option on the Build page of Project Designer.
4. Set project properties, which include settings for licensing, deployment, and building/compiling. See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs. For information on setting environment variables for a project, see [“Environment variables” on page 7-8](#).
  5. Build and debug the project in Visual Studio. See Visual Studio documentation for information on build features and the debugger, and see [“Debugging Synergy .NET Code” on page 7-46](#).
  6. Deploy your application. See Microsoft documentation (and for information on ClickOnce deployment see the [“ClickOnce Deployment for Synergy .NET”](#) topic in Synergy/DE WebDocs).



# Developing for Universal Windows Platform

The following steps outline the basic procedure for creating a Universal Windows Platform (UWP) application from Synergy templates. Most of these steps outline Visual Studio procedures, so see Visual Studio documentation for full information.



You can use the “Synergy Blank App (Universal Windows)” project template to quickly get a simple application up and running on a mobile emulator in Visual Studio. See [“UWP quick start \(Hello World\)” on page 7-21](#)

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Note that Synergy .NET development for UWP is experimental and unsupported.

Developing for UWP is similar to developing Windows desktop and server applications (see [“Developing Windows Desktop and Server Applications” on page 7-17](#)), but there are different restrictions, special defines, templates, and so forth. Many of these are discussed below, but see in the [“.NET Development”](#) chapter in the *Professional Series Portability Guide* for more information.

Additionally, any UWP solution with a Synergy project must implement Synergy device licensing. See [“Licensing” on page 7-12](#).

1. Start by reviewing [“Synergy .NET Requirements” on page 7-10](#). Your Windows development machine and the Visual Studio projects you develop must meet requirements listed in that section.
2. In Visual Studio, create a project for each assembly in the UWP application. The following Synergy templates can be used for UWP projects:
  - ▶ Blank App (Universal Windows)
  - ▶ Class Library (Universal Windows)
  - ▶ Portable Class Library

For example, to create an executable assembly, select File > New Project, select Synergy/DE > Universal from the Installed Templates area of the New Project dialog, and then select “Blank App (Universal Windows)” from the list of project types. You’ll then need to set a few options for the project (name, location, and so forth) in the New Project dialog. Note the following:

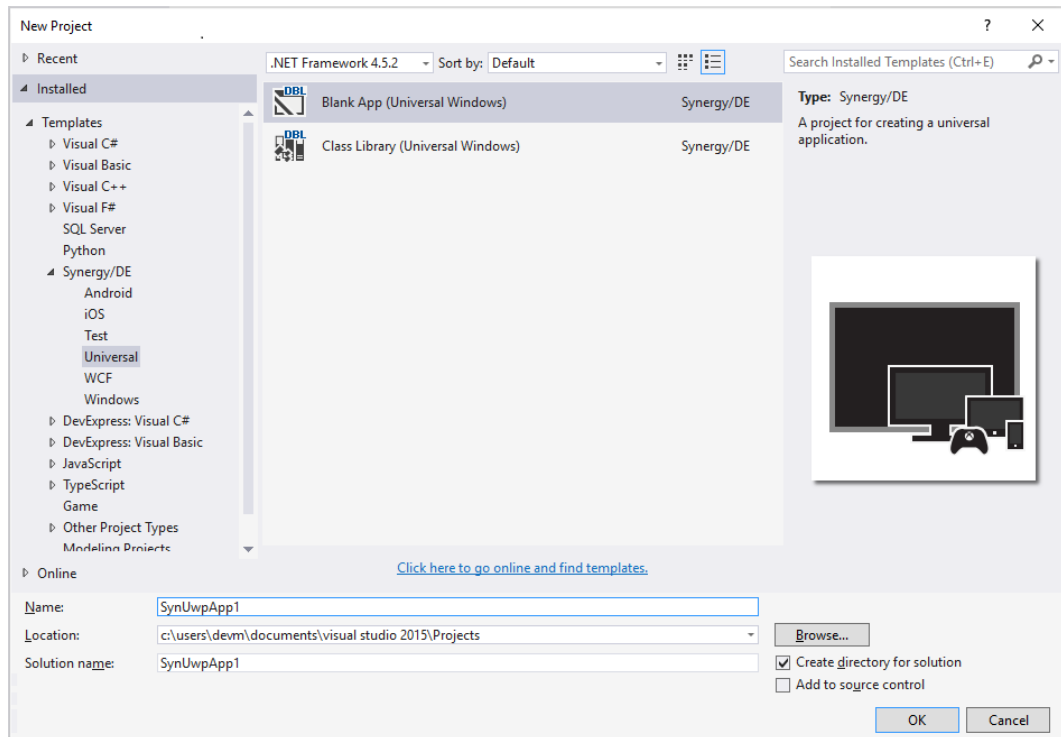
- ▶ You can include Synergy projects in a solution for another .NET language (e.g., in a C# solution), and you can include projects for other .NET languages in a Synergy solution. See [“Using Solutions, Projects, and Portable Class Libraries” on page 7-14](#).
- ▶ For portability, put as much logic as possible in portable class libraries. A portable class library can target the .NET Framework on Windows (including UWP), as well as Mono on iOS, Android, and Linux. See [“Developing Portable Class Libraries” on page 7-44](#).

3. Add DBL code, resource, controls, etc., to the Visual Studio projects, and make sure each project references needed assemblies. (For information on item templates, see the [“Synergy/DE Item Templates”](#) topic in Synergy/DE WebDocs.) Note the following:
  - ▶ The project for the executable must have a reference to the **Synergex.SynergyDE.synrnt** NuGet package (see [“Synergy runtime libraries”](#) on page 7-11).
  - ▶ An assembly in your application must implement device licensing. See [“Licensing”](#) on page 7-12.
  - ▶ For information on which Synergy features are supported see the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*. And note that for Interop projects Synergy global structures used as attribute arguments must be defined in an assembly outside of a namespace.
  - ▶ Use the MVVM pattern to reduce platform-specific code.
  - ▶ Use ASYNC routines for communication across networks and the Internet. See [“Asynchronous processing”](#) in the “Synergy DBL Statements” chapter of the *Synergy DBL Language Reference Manual* for more information.
  - ▶ For information on accessing data files, see [“Using data files for Universal Windows Platform”](#) on page 7-51.
  - ▶ You are not limited to the standard file extensions for Synergy DBL files (e.g., **.dbl** for code files). You can add files with other extensions if you specify those extensions in the Visual Studio IntelliSense dialog box for the Synergy DBL text editor. See the [“IntelliSense, Text Editor Options”](#) topic in Synergy/DE WebDocs.
  - ▶ To generate documentation from comments in code, use `;;;` to identify documentation comments in your code, and select the “XML documentation file” option on the Build page of Project Designer.
4. Set project properties. (See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs.)
  - ▶ In the project that includes the device licensing attribute (`SynergyDeviceLicenseAttribute`), make sure “Enable Device Licensing” is set on the Compile page of Project Designer. This option should not be set for any other project in the solution.
  - ▶ To minimize activation of device licensing during debugging and testing, go to the Debug page of Project Designer for the executable project and make sure the “Uninstall and then re-install my package...” option is *not* selected.
5. Build and debug the project in Visual Studio. See Visual Studio documentation for information on building and debugging, and see [“Debugging Synergy .NET Code”](#) on page 7-46. At build time, Visual Studio creates an **.appxupload** package, which is what you will deploy. When you are ready to release the application, you will submit this package to the Windows Store. Note that these steps are common to all UWP applications, so see Microsoft documentation for information.

## UWP quick start (Hello World)

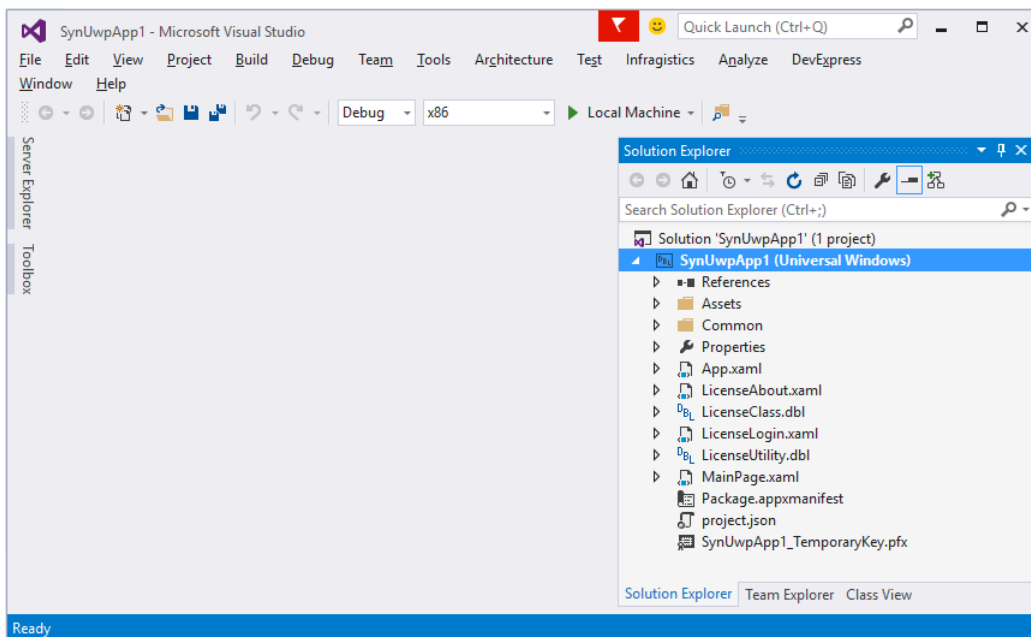
If your system meets the requirements for UWP development (see “[Synergy .NET Requirements](#)” on page 7-10) and you have a GUID and a public key from Synergex (see “[Device licensing \(.NET\)](#)” in the “Welcome to Synergy DBL” chapter of the *Synergy DBL Language Reference Manual*), you can have a simple UWP app running on a mobile emulator in Visual Studio in a matter of minutes.

1. Open Visual Studio and select File > New > Project. Then in the new Project Window, select “Blank App (Universal Windows)” in Installed > Synergy/DE > Universal:

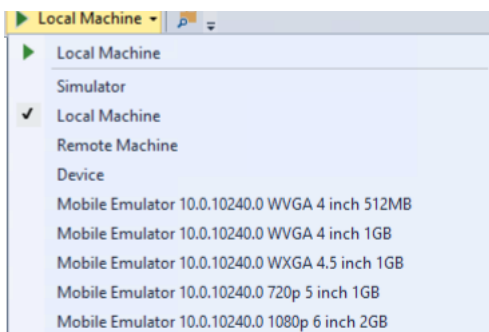


2. Set the options for the project (name, location, and so forth) in the New Project dialog, and then click OK.

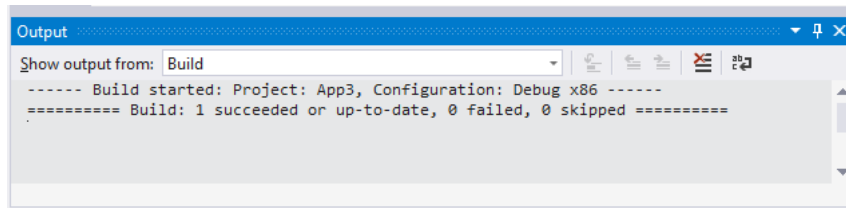
The new project opens in Visual Studio:



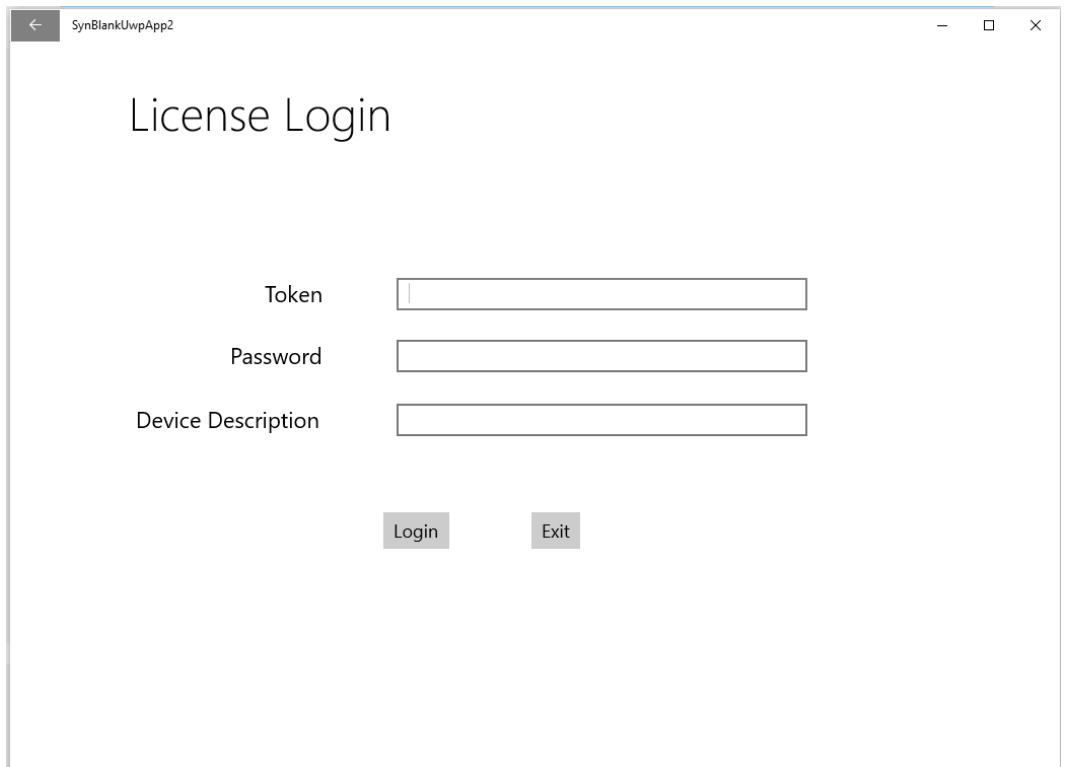
3. Open **LicenseClass.dbl** in the editor, find the `assembly:SynergyDeviceLicense...` line, and enter your public key and GUID values for device licensing. In other words, insert the public key and GUID values between the quotes that follow `PublicKey=` and `AppGUID=`.
4. In the toolbar dropdown for emulation, select Local Machine:



5. Select Build > Build Solution. The Output window should show that the build succeeded.



6. When the project has finished building, select Debug > Start Debugging.
7. Wait while Visual Studio deploys your application to the emulator, which may take a few minutes. When it's finished, your application should be running on the mobile emulator, and the application will display a License Login screen:



Congratulations! You have just created a Synergy UWP application.

# Developing for Android

The following steps outline the basic procedure for using Visual Studio and Xamarin tools to develop for Mono on Android devices. Most of these steps describe Visual Studio and Xamarin features and procedures (some of which change often), so see Visual Studio and Xamarin documentation for full information.



You can use the Synergy Android Application project template to quickly get a simple application up and running on an Android emulator or device. See [“Android quick start \(Hello World\)” on page 7-28](#).

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Synergy .NET support for Android is similar to its support for Windows desktop and server applications (see [“Developing Windows Desktop and Server Applications” on page 7-17](#)), but there are differences. Windows-specific code won’t work with Android (for example, file paths for Android must have forward slashes) and there are different restrictions, special defines, templates, and so forth. Many of these are discussed below, but see in the [“.NET Development”](#) chapter in the *Professional Series Portability Guide* for more information.

Additionally, any Android solution with a Synergy project must implement Synergy device licensing, though licensing is not used when running on an emulator. See [“Licensing” on page 7-12](#).

1. Start by reviewing [“Synergy .NET Requirements” on page 7-10](#). Your Windows development machine and the Visual Studio projects you develop must meet the requirements listed in this section. For testing and debugging, you will need to use an Android emulator within Visual Studio or an Android device connected to the Windows development machine. (See [step 2](#) in [“Building, debugging, and deploying Android applications” on page 7-27](#).)
2. In Visual Studio, create a project for each assembly in the Android application. The following Synergy templates can be used for Android projects:
  - ▶ Android Application
  - ▶ Android Class Library
  - ▶ Portable Class Library

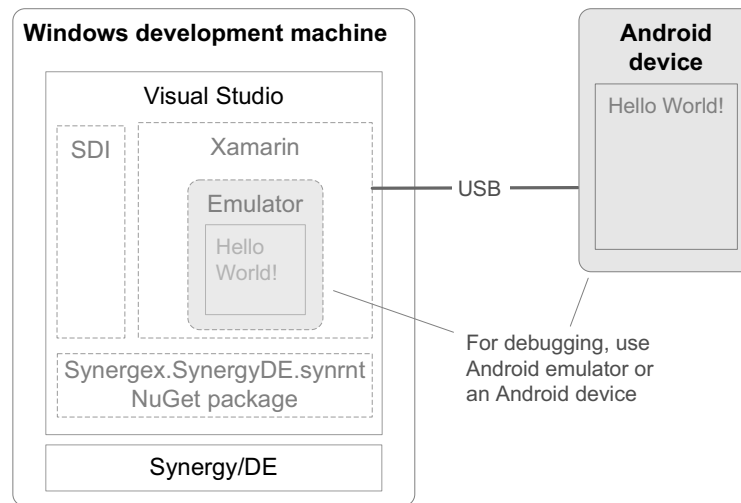


Figure 7-5. Components for Android development.

For example, to create an executable assembly, select File > New Project, select Synergy/DE > Android from the Installed Templates area of the New Project dialog, and then select Android Application from the list of project types. You'll then need to set a few options for the project (name, location, and so forth) in the New Project Dialog. Note the following:

- ▶ You can include Synergy projects in a solution for another .NET language (e.g., in a C# solution), and you can include projects for other languages in a Synergy solution. See [“Using Solutions, Projects, and Portable Class Libraries”](#) on page 7-14.
  - ▶ For portability, put as much logic as possible in portable class libraries. A portable class library can target the .NET Framework on Windows (including UWP), as well as Mono on iOS, Android, and Linux. See [“Developing Portable Class Libraries”](#) on page 7-44.
3. Add DBL code, resources, assets, controls, etc., to the Visual Studio projects, and make sure each project references all needed assemblies.
- ▶ For information on item templates, see the [“Synergy/DE Item Templates”](#) topic in Synergy/DE WebDocs.
  - ▶ For information on which Synergy features are supported see the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*. And note that for Interop projects Synergy global structures used as attribute arguments must be defined in an assembly outside of a namespace.
  - ▶ For user interface development, use AXML (XML user interface layout files for Android) or Xamarin.Forms.
  - ▶ Use the MVVM pattern to reduce platform-specific code.
  - ▶ The project for the executable must have a reference to the **Synergex.SynergyDE.synrnt** NuGet package (see [“Synergy runtime libraries”](#) on page 7-11).

- ▶ Use ASYNC routines for communication across networks and the Internet. See [“Asynchronous processing”](#) in the “Synergy DBL Statements” chapter of the *Synergy DBL Language Reference Manual* for more information.
- ▶ If your application accesses data files, you must use SETDFN to define the path to those files unless you explicitly specify the path in code. And if your application will access existing data files locally, you must add them as assets to the project. See [“Using data files on Android” on page 7-52](#).
- ▶ Make sure Xamarin types have finished initializing before using Xamarin properties and methods. Attempting to use a Xamarin property or method before it is initialized will cause a fatal error (e.g., a null reference exception). For example, **ActivationDialog.dbl**, a file included in the Synergy iOS Application template, includes code to ensure that the Xamarin UIApplication.SharedApplication property is initialized:

```
while (UIApplication.SharedApplication==^null)
    await Task.Delay(100)
```

- ▶ To generate documentation from comments in code, use ;;; to identify documentation comments in your code, and select the “XML documentation file” option on the Build page of Project Designer.
  - ▶ The Add Service Reference dialog is not available in Synergy Android Application projects or Synergy Android Class Library projects. This is, however, supported for Portable Class Library projects, so use a Portable Class Library project for references to WCF services.
4. Set project properties. See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs, and note the following:
- ▶ In the project for the executable, go to the Application page of Project Designer and set Android version options to at least API level 14. To use the Intel x86 Emulator Accelerator (HAXM), set them to level 15.
  - ▶ For a Synergy Android Application project, use the Android Options page in Visual Studio Project Designer to set the project to include all of Mono, include only needed parts of Mono (by using the Mono Linker), or rely on a shared Mono installation.
  - ▶ In the project that includes the device licensing attribute (SynergyDeviceLicenseAttribute), select “Enable Device Licensing” on the Compile page of Project Designer. Do not use this option for any other project in the solution.



To minimize activation of device licenses during debugging and testing, in the project for the executable, select the Xamarin option “Preserve application data/cache on device between deploys”. This option is available in Tools > Options > Xamarin > Android Settings.

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## Building, debugging, and deploying Android applications

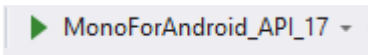
For Android debugging, use one of the following:

- ▶ An ARM device
- ▶ The Visual Studio Emulator for Android
- ▶ The Intel Atom (x86) emulator (may not work on virtual machines)
- ▶ The Intel HAXM Android emulator (works only with specific Intel, non-AMD, processors)

Note that the Google ARM emulator, which comes with Xamarin, is very slow to start (it generally takes several minutes).

Before you start, make sure debugging files are set up. See [http://www.synergex.com/synergy\\_net.aspx](http://www.synergex.com/synergy_net.aspx).

1. Build the Visual Studio projects. For an Android Application, Xamarin creates an Android package (**.apk**) at build time. This package is what you deploy to devices.
2. For debugging and deployment testing, use an Android emulator or an Android device that's configured for development (i.e., set to developer mode with USB debugging enabled) and connected to the Windows development machine. You can select the emulator (which must be API level 14 or higher) or the device in the Target Android Device toolbar dropdown.



▶ MonoForAndroid\_API\_17 ▾

For information on connecting to an Android device, see Synergex KnowledgeBase article [100002189](#).

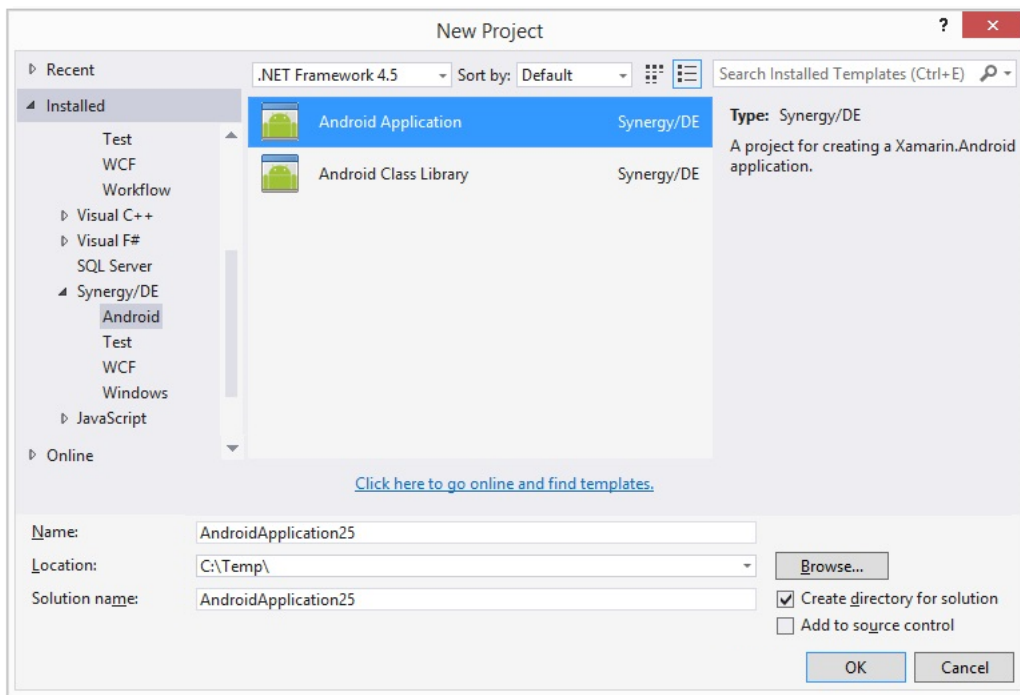
For more information on debugging, see “[Debugging Synergy .NET Code](#)” on page 7-46.

3. When testing is complete, follow Xamarin instructions for preparing an application for deployment: disable debugging, specify an application icon, version the application, configure the linker so that the shared runtime is not used, compile in Release mode, and so forth.
4. Deploy the application via a website, an email, or an Android deployment site (e.g., Google Play or the Amazon App store for Android), or just install it on target devices.

## Android quick start (Hello World)

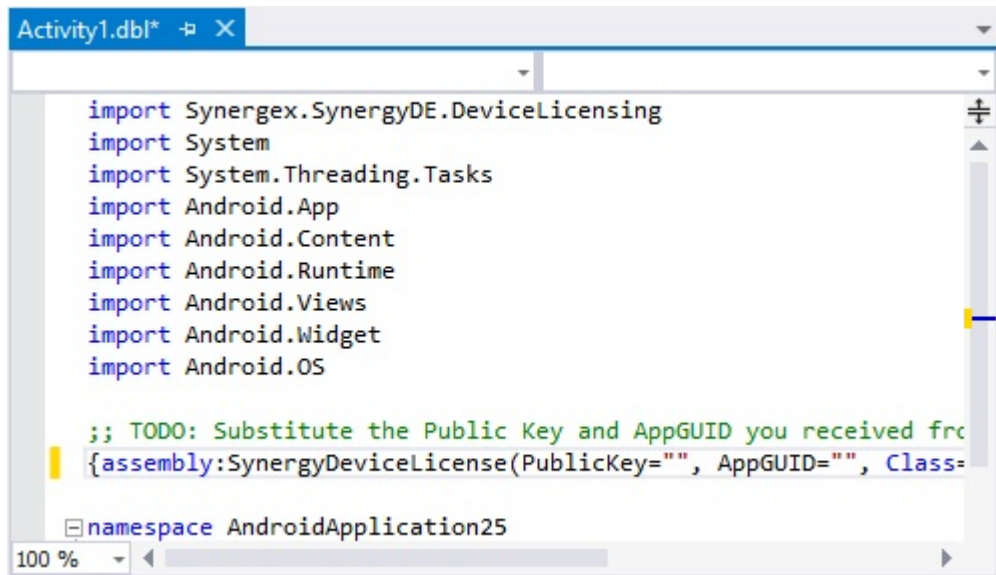
If your system meets the requirements for Android development (see “[Synergy .NET Requirements](#)” on page 7-10), you can have a simple Synergy application running on an Android emulator in a matter of minutes.

1. Open Visual Studio and select File > New > Project. Then, in the New Project window, select Android Application (in Installed > Templates > Synergy/DE > Android):



2. Set options for the project (name, location, and so forth), and then click OK.

The new project will open in Visual Studio with the **Activity1.dbl** file open in the editor.



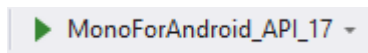
- Find the `assembly:SynergyDeviceLicense...` line in **Activity1.dbl**, and enter dummy public key and GUID values for device licensing. In other words, add some characters between the quotes that follow `PublicKey=` and `AppGUID=`. In the following, for example, both are set to "abc":

```

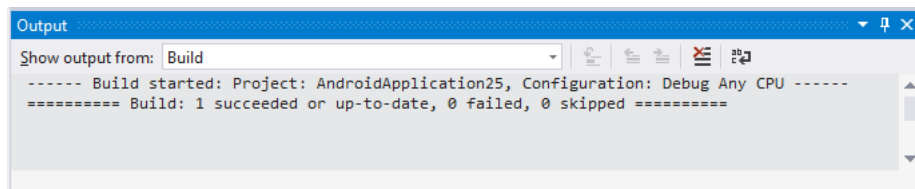
;; TODO: Substitute the Public Key and AppGUID you received from Synergy in
{assembly:SynergyDeviceLicense(PublicKey="abc", AppGUID="abc", Class=^typeo
  
```

Although device licensing is not required when running on an Android emulator, the Android Application project template includes a full device licensing implementation, which requires `PublicKey` and `AppGUID` values. The application will not build without them.

- In the Target Android Device toolbar dropdown, select `MonoForAndroid_API_15`.

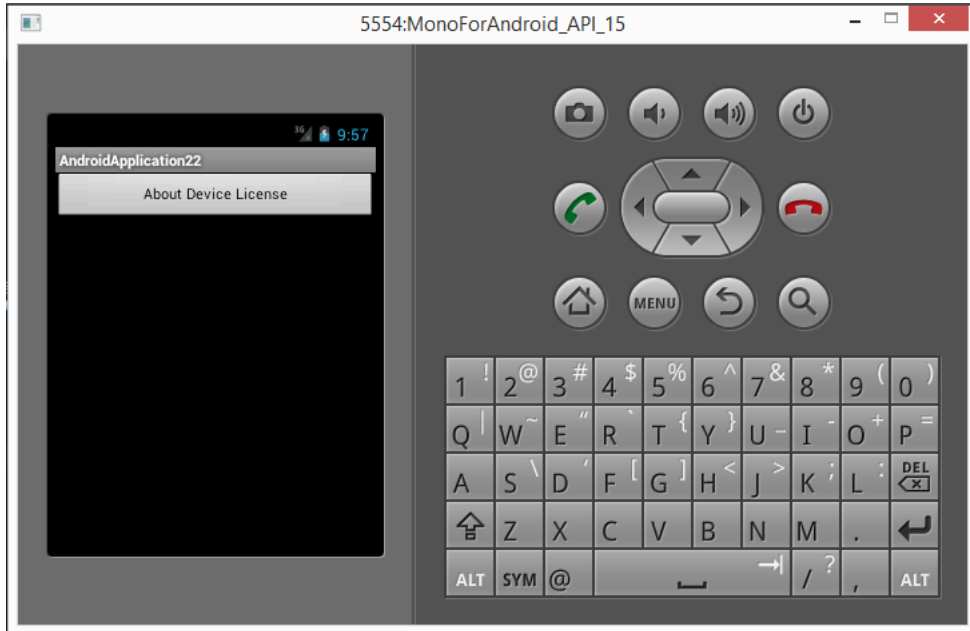


- Select **Build > Build Solution**. The Output window should show that the build succeeded.



- When the project has finished building, select **Debug > Start Debugging**. If a Launching Emulator window opens, click **Yes**.

7. Wait while the emulator opens and installs your application. This may take a few minutes. When it's finished, your application should be running on the Android emulator (though you may have to unlock the device):



Congratulations! You have just created a Synergy .NET Android application. On an emulator, clicking the About Device License button will open a window with licensing information. (On a device, it prompts you for a user, a password, and a description.)

# Developing for iOS

The following steps outline the basic procedure for using Visual Studio, Xamarin tools, and Xcode to develop for Mono on iOS devices. Most of these steps outline Visual Studio and Xamarin procedures (some of which change often), so see Visual Studio and Xamarin documentation for full information.



You can use the Synergy iOS Application project template to quickly get a simple application up and running on the iOS Simulator. See [“iOS quick start \(Hello World\)”](#) on page 7-39.

In general, Synergy/DE’s support for Mono on iOS is similar to its support for Windows desktop and server development (see [“Developing Windows Desktop and Server Applications”](#) on page 7-17), but there are differences. Windows-specific code won’t work with iOS (for example, file paths for iOS must have forward slashes), and there are different restrictions. Many of these are discussed below, but see in the [“.NET Development”](#) chapter in the *Professional Series Portability Guide* for more information. And note that any iOS solution with a Synergy project must implement Synergy device licensing, though licensing is not used when running on the iOS Simulator. See [“Licensing”](#) on page 7-12.

To develop a Synergy application for iOS, you must have an Apple developer account, and you must have Windows and Mac development machines that meet the requirements listed in [“Synergy .NET Requirements”](#) on page 7-10. For testing and debugging, you can use either the iOS Simulator or a provisioned iOS device connected to the Mac (see [figure 7-6](#)).

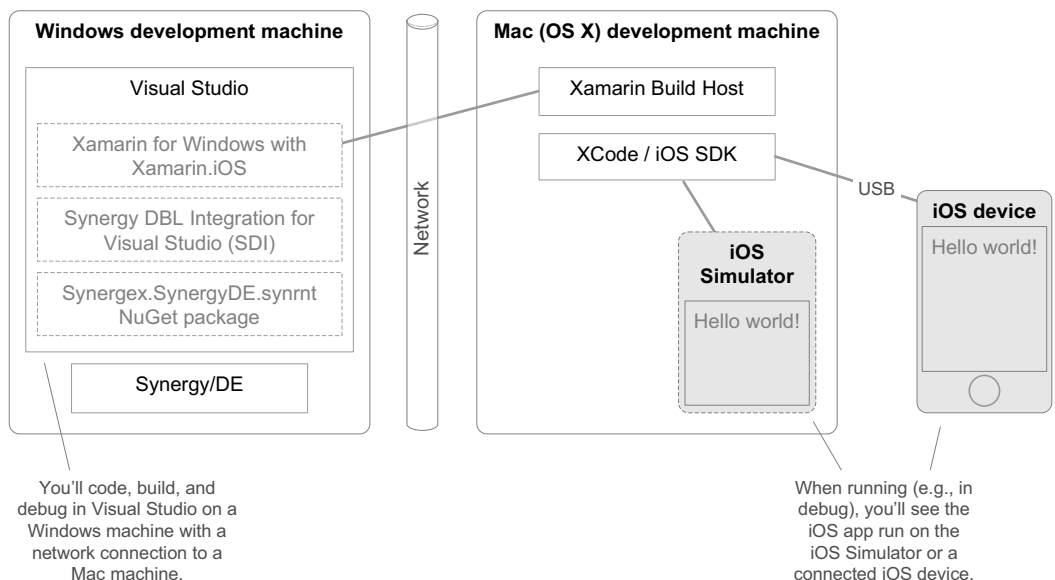


Figure 7-6. Components for iOS development.

### Step 1: Pairing

Before you can build an iOS project, you must pair your Windows development machine to the Xamarin Build Host on your Mac. Initially, this must be done manually using the following procedure. Subsequently, Visual Studio will automatically attempt this whenever you open the iOS project.

1. On the Windows development machine, select Tools > iOS > Xamarin Mac Agent from the Visual Studio menu. The Remote Login window for Xamarin Mac Agent opens.

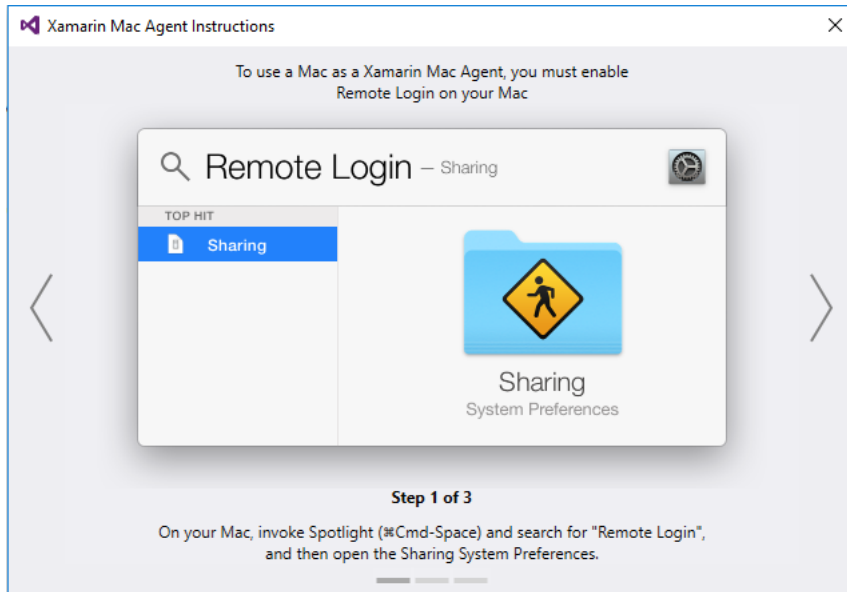


Figure 7-7. The Remote Login window for Xamarin Mac Agent (Windows development machine).

2. On the Mac, click the Spotlight icon (the magnifying glass) on the menu bar for the desktop and search for Remote Login. The “remote login – sharing” window opens.

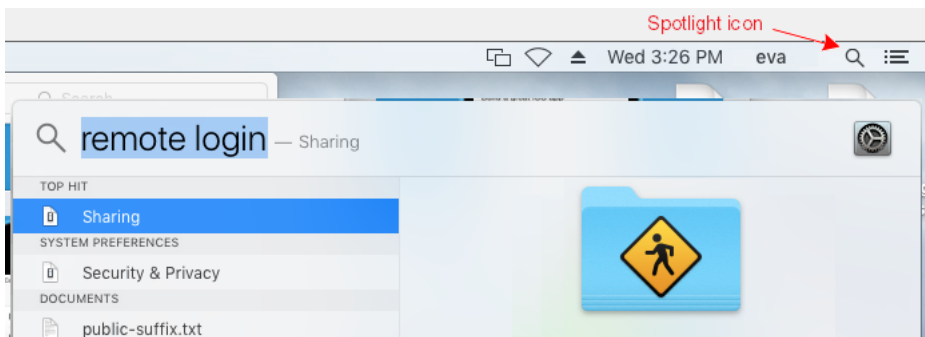


Figure 7-8. The “remote login – sharing” window (Mac).

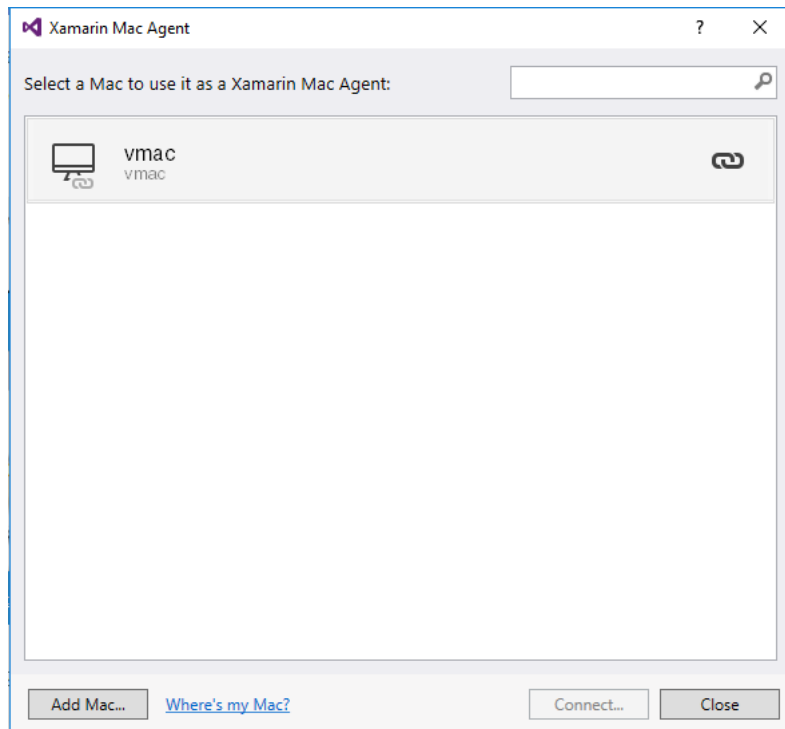
3. In the “remote login – sharing” window, double-click Sharing, which opens the Sharing window.
4. In the Sharing window, select the Remote Login option, and optionally select “Only these users” (under “Allow access for”) to limit users who can access your Mac remotely.



Figure 7-9. The Sharing window (on Mac).

5. On the Windows development machine, click OK in the Remote Login window (see [figure 7-7 on page 7-32](#)), which opens the Xamarin Mac Agent window.
6. In the Xamarin Mac Agent window, select the entry for your Mac and click Connect, and then, in the “Connect to Mac” window, enter the user name and password for the Mac and click Login.

The Xamarin Build Host on your Mac should now be paired with the Windows development machine. If you select Tools > iOS > Xamarin Mac Agent from the Visual Studio menu, the Xamarin Mac Agent window will display the name of the paired Mac machine (see [figure 7-10](#) below).



*Figure 7-10. Xamarin Mac Agent displaying the name of the paired Mac.*



## Step 2: Coding and configuring

To create and configure a Synergy iOS project, follow these steps:

1. In Visual Studio, create a project for each assembly in the iOS application. The following Synergy templates can be used for iOS projects:
  - ▶ iOS Application
  - ▶ iOS Class Library
  - ▶ Portable Class Library

For example, to create an executable assembly for an iOS application, select File > New Project, select Synergy/DE > iOS from the Installed Templates area of the new Project dialog, and then select iOS Application from the list of project types. You'll then need to set a few options for the project (name, location, and so forth). Note the following:

- ▶ You can include Synergy projects in a solution for another .NET language (e.g., in a C# solution), and you can include projects for other languages in a Synergy solution. See [“Using Solutions, Projects, and Portable Class Libraries” on page 7-14](#) for more information.
  - ▶ For portability, put as much logic as possible in portable class libraries. A portable class library can target the .NET Framework on Windows (including UWP), as well as Mono on iOS, Android, and Linux. See [“Developing Portable Class Libraries” on page 7-44](#).
2. Add DBL code, resources, assets, controls, etc., to the Visual Studio projects, and make sure each project references the assemblies it needs.
    - ▶ For information on item templates, see the [“Synergy/DE Item Templates”](#) topic in Synergy/DE WebDocs.
    - ▶ For information on which Synergy features are supported see in the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*. And note that for Interop projects Synergy global structures used as attribute arguments must be defined in an assembly outside of a namespace.
    - ▶ For information on adding data files, see [“Using data files on iOS” on page 7-54](#).
    - ▶ Use Interface Builder or Xamarin.Forms for interface development.
    - ▶ Use the MVVM pattern to reduce platform-specific code.
    - ▶ At least one project in an iOS solution must have a reference to the **Synergy.SynergyDE.syrnrt** NuGet package (see [“Synergy runtime libraries” on page 7-11](#)).
    - ▶ Use ASYNC routines for communication across networks and the Internet. See [“Asynchronous processing”](#) in the “Synergy DBL Statements” chapter of the *Synergy DBL Language Reference Manual* for more information.

- ▶ If your application accesses data files, you must add them to the Resources folder for the application project, copy them to the “Documents” folder, and then use SETDFN to specify the path and extensions, unless you explicitly specify the path in code. See [“Using data files on iOS” on page 7-54](#).
- ▶ Make sure Xamarin types have finished initializing before using Xamarin properties and methods. Attempting to use a Xamarin property or method before it is initialized will cause a fatal error (e.g., a null reference exception). For example, **ActivationDialog.dbl**, a file included in the Synergy iOS Application template, includes code to ensure that the Xamarin UIApplication.SharedApplication property is initialized:

```
while (UIApplication.SharedApplication==^null)
    await Task.Delay(100)
```

- ▶ To generate documentation from comments in code, use ;;; to identify documentation comments in your code, and select the “XML documentation file” option on the Build page of Project Designer.
  - ▶ The Add Service Reference dialog is not available in Synergy iOS Application projects or Synergy iOS Class Library projects. This is, however, supported for portable class library projects, so use a Portable Class Library project for references to WCF services.
3. Set project properties, See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs, and note the following:
- ▶ Set Xamarin options on iOS pages of Project Designer (e.g., the iOS Build page). See Xamarin documentation for information.
  - ▶ In the project that includes the device licensing attribute (SynergyDeviceLicenseAttribute), select “Enable Device Licensing” on the Compile page of Project Designer. Do not use this option for any other project in the solution.

## Step 3: Building and debugging

Before you start, make sure debugging files are set up. See [http://www.synergex.com/synergy\\_net.aspx](http://www.synergex.com/synergy_net.aspx).

Synergy licensing is not required when running a Synergy iOS application on the iOS Simulator.

1. Connect the Windows machine to the Xamarin Build Host on the Mac. See “[Step 1: Pairing](#)” on page 7-32.
2. Build the application in Visual Studio. Note the following:
  - ▶ If you are building for a physical device, build the application with the iPhone or iPad option. If you will use the iOS Simulator, use iPhoneSimulator or iPadSimulator. To access this setting, select Configuration Properties > Configuration in the property pages for the solution (not a project). See [figure 7-11](#) below.

Note that iPhoneSimulator and iPadSimulator cause the solution to be built for X86, not the actual target environment. iOS devices have ARM-based processors, but the Simulator requires applications to be built for a CPU that is not ARM-based.

  - ▶ If you get a “Connection to Xamarin.iOS Build Host failed” error, double-click the message in the Visual Studio Error List. This will open the Xamarin configuration wizard, which will enable you to select a Build Host. See “[Step 1: Pairing](#)” on page 7-32.

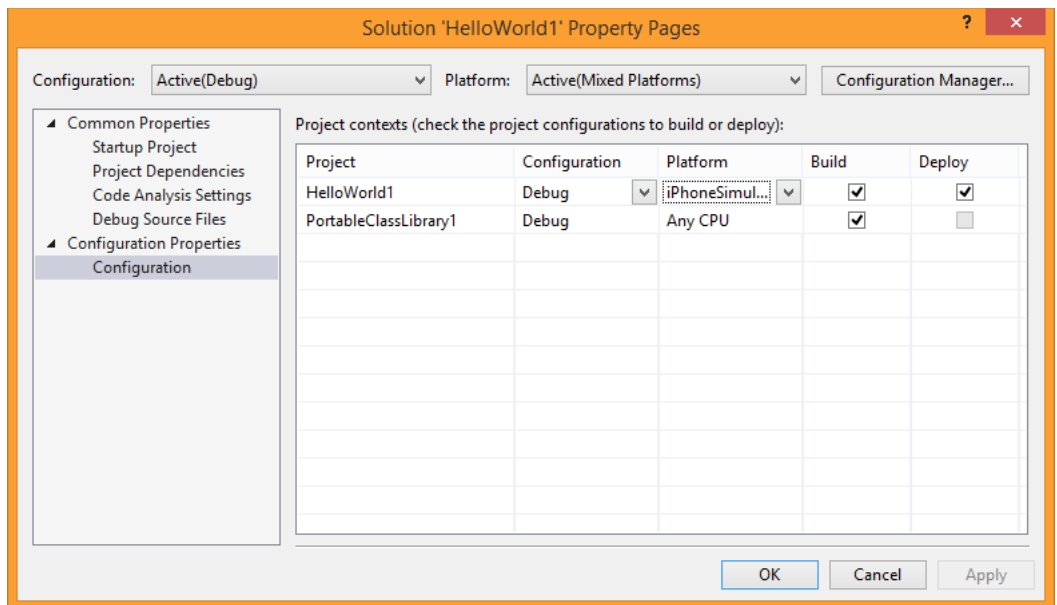


Figure 7-11. Specifying the device or simulator type.

You should now be able to run and debug. You can debug by using the iOS Simulator running on the Mac, or you can use a provisioned iOS device connected to the USB port on the Mac. Note that it is generally better to test on a physical iOS device since this is the actual environment in which the application will run.

- ▶ To debug using the iOS Simulator, make sure the simulator and Xcode are running on the Mac.
- ▶ To debug using a device, make sure the iOS device is provisioned, is turned on, and is connected to a USB port on the Mac. Make sure the Mac is running Xcode.

For more information on debugging, see [“Debugging Synergy .NET Code” on page 7-46](#).

## Step 4: Deploying an iOS application

The process for deployment depends on how you want to distribute the application. There are two methods: you can distribute the application package to users (e.g., to users in your enterprise), or you can make it available through the App Store.

### Deploying within an enterprise

To deploy an iOS application within an enterprise, you must sign the application with a distribution certificate obtained from Apple’s iOS Provisioning Portal (this is tied to the Enterprise Developer membership) and then package the application with a provisioning profile, which must also be obtained from the Provisioning Portal. (The Enterprise distribution provisioning profile allows the application to be deployed to an unlimited number of iOS devices.) You can then distribute the package to users who will do the following to install it:

1. Run the iTunes app on a Mac machine associated with the device. To connect the device, select it on the Devices list, click the Apps tab, select the app to be installed, and then click the Apply button.
2. Choose “Add File to Library...” from the menu, and then choose the distribution package containing the application to be installed.

For more information, see the *iOS Deployment Technical Reference*, which is available from Apple.

### Deploying through the App Store

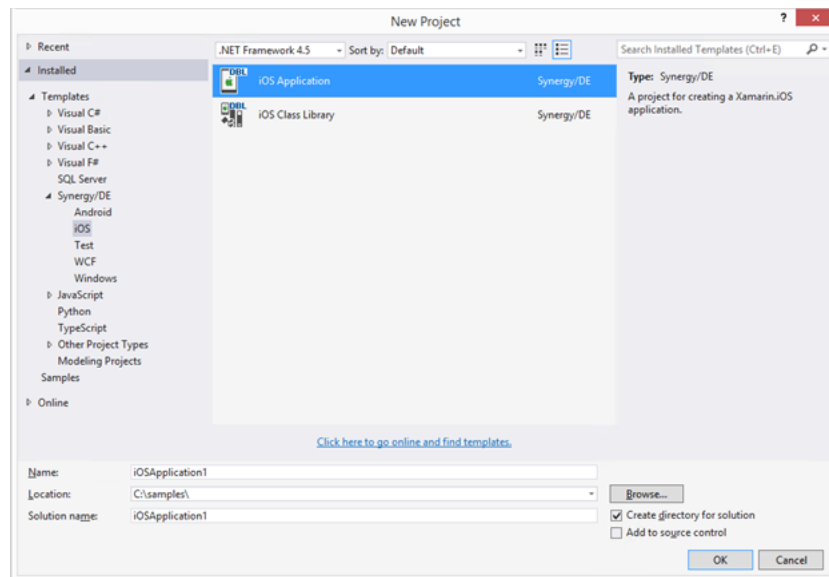
To deploy an application through the App Store, the application must be signed with a distribution certificate, and a store distribution provisioning profile must be created using the Apple iOS Provisioning Portal (as discussed in [“Deploying within an enterprise”](#) above). This profile indicates that the application uses certain technologies and services and confirms that it was submitted by the developer. These technologies and services can include iCloud, location data, keychain (passwords), background processing, encryption, etc. These are set in Xcode in the project data. You then archive and validate the application and create an application record on iTunes Connect at [itunesconnect.apple.com](https://itunesconnect.apple.com). Finally, you submit the application using Xcode. You can then check the approval status of the application on the iTunes Connect web site, and when it’s approved, it can be purchased from the App Store.

For more information, see the *App Distribution Guide*, which is available from Apple.

## iOS quick start (Hello World)

If you are set up for iOS development (see “[Synergy .NET Requirements](#)” on page 7-10), you can have a simple Synergy iOS application up and running in a matter of minutes.

1. Pair the Windows development machine to the Xamarin Build Host on the Mac development machine. See “[Step 1: Pairing](#)” on page 7-32.
2. Open Visual Studio and select File > New > Project. Expand the Installed > Templates > Synergy/DE category in the new Project window, and select iOS, and then select the iOS Application template.

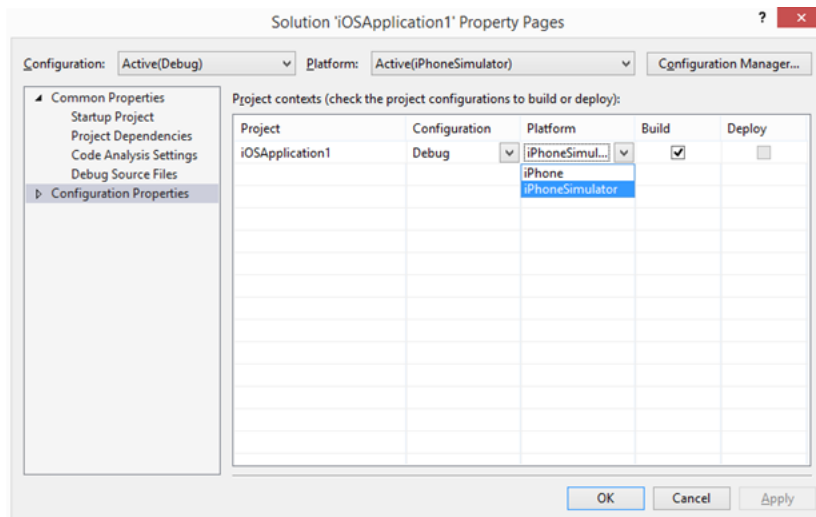


3. Set options for the project (name, location, and so forth), and then click OK. The new iOS application project will open in Visual Studio.
4. Find the {assembly:SynergyDeviceLicense... line in **Main.dbl**, and enter dummy public key and GUID values for device licensing. In other words, add some characters between the quotes that follow PublicKey= and AppGUID=. In the following, for example, both are set to “abc”:

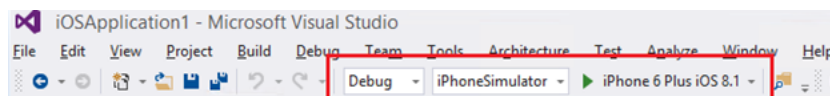
```
{assembly:SynergyDeviceLicense(PublicKey="abc", AppGUID="abc", Class=^typeof(LicenseClass))}
```

Although device licensing is not required when running on the iOS Simulator, the iOS Application project template includes a full device licensing implementation. This implementation requires PublicKey and AppGUID values. The application will not build without them.

5. Go to the property pages for the solution and set the Platform option to iPhoneSimulator.

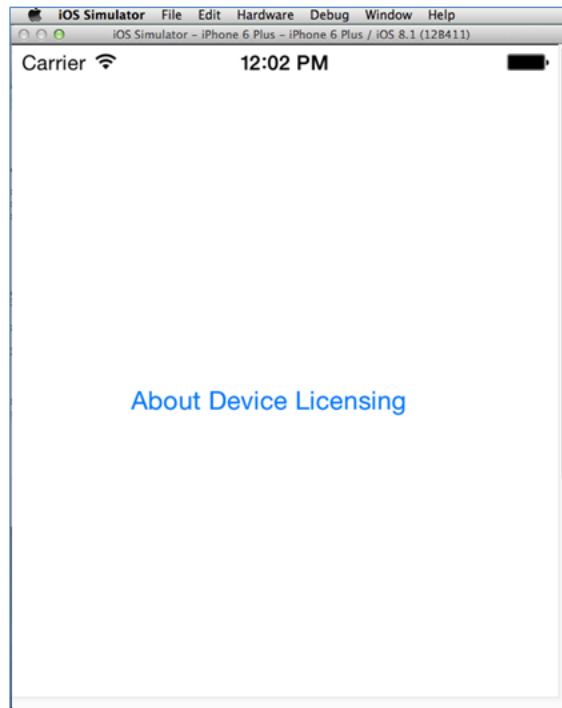


- On the Visual Studio toolbar, set the “Solution Configurations” dropdown to Debug, set the “Solution Platforms” dropdown to iPhoneSimulator, and set the next dropdown (to the right of “Solution Platforms”) to an iPhone version—e.g., “iPhone 6 Plus iOS 8.1”.



- Select Debug >Start Debugging. Starting a debug session while an iOS Simulator configuration is selected causes the application to be built, the iOS Simulator to start on the Mac machine, and the application to be deployed to the iOS Simulator.

8. Once the iOS Simulator is up and running, and the application has finished deploying, you should be greeted with a screen with the text “About Device License.”



Congratulations! You have just created a Synergy .NET iOS application. Clicking “About Device Licensing” will open a window with licensing information. (On a device, it prompts you for a user, a password, and a description.)

# Developing for .NET on Linux

The following steps outline the basic procedure for creating an application for Mono on Linux. Most of these steps outline Visual Studio procedures, so see Visual Studio documentation for full information.

Note that Synergy .NET development for Linux is currently experimental and unsupported, and debugging is not available.

In general, Synergy/DE's support for Mono on Linux is the same as its support for Windows desktop and server development, but there are some differences. Windows-specific code won't work with Linux (for example, file paths for Linux must have forward slashes), there are different restrictions, and you must use traditional Synergy licensing. (Synergy device licensing is not supported for Linux.) See the [“.NET Development”](#) chapter in the *Professional Series Portability Guide* for more information.

1. Start by reviewing [“Synergy .NET Requirements” on page 7-10](#). Your Windows development machine and the Synergy projects you create in Visual Studio must meet the requirements listed in this section.
2. For each assembly in your application, create a Visual Studio project from one of the following Synergy project templates:

- Class Library
- Console Application
- Empty Project
- Interop
- Portable Class Library
- WCF Service Library
- Windows Forms Application
- Windows Forms Control Library

For example, to create a console application, select File > New Project, select Synergy/DE from the Installed Templates area of the New Project dialog, and then select Console Application from the list of project types. You'll then need to set a few options for the project (name, location, and so forth) in the New Project Dialog. Note the following:

- ▶ WPF is not supported.
- ▶ For Linux server development, use Service Stack or WCF.
- ▶ For Linux desktop client development, use GTK#, WinForms, or Xamarin.Forms.
- ▶ You can include a Synergy project in a solution for another .NET language (e.g., in a C# solution), and you can include projects for other languages in a Synergy solution. See [“Using Solutions, Projects, and Portable Class Libraries” on page 7-14](#).



- ▶ For portability, put as much logic as possible in portable class libraries. A portable class library can target some or all platforms supported by Synergy .NET. For Linux, select .NET Framework 4.5 (or higher) as a target, and optionally select one or both of the following:

Xamarin.Android

Xamarin.iOS

Although you can select target options that are not available for Synergy .NET portable class libraries, keep in mind that every target you select limits framework resources available to the project, so select only necessary targets.

3. Add DBL code, resources, etc., to the Visual Studio projects, and make sure each project references needed assemblies. For information on which Synergy features are supported see in the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*.
4. Set project properties and then build the solution.
  - ▶ Set each project to target .NET Framework 4.5 or higher.
  - ▶ Make sure every Synergy project targets “Any CPU”.

See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs.

5. For testing and deployment, set up a Samba share and do the following:
  - ▶ Use XCOPY, GAC, etc., to deploy executables and libraries to the Linux test system. See Mono documentation for details.
  - ▶ Manually add the **synrnt** runtime library to the global assembly cache, or make sure it is in the same folder as your application binaries. See [“Synergy runtime libraries” on page 7-11](#).

# Developing Portable Class Libraries

The Synergy Portable Class Library project template enables you to create portable class libraries that can be added to .NET applications for multiple platforms. Note that Synergy device licensing is required for Android, iOS, Universal Windows Platform (UWP), and is optional for Microsoft .NET Framework on Windows. So if you include a Synergy portable class library (or any other Synergy .NET library) in an application (even a non-Synergy application) for one of these platforms, you'll need to implement Synergy device licensing.

To add a portable class library to an application, follow these steps. And note that these steps outline Visual Studio procedures, so see Visual Studio documentation for full information.

1. In Visual Studio, open the solution for the application and select File > New > Project.
2. In the New Project window, select Installed > Templates > Synergy/DE > Portable Class Library. Then, in the Solution field, select "Add to solution". Set options in this window as necessary (e.g., set the .NET Framework version and select "Add to solution" in the Solution field), and then click OK. The Add Portable Class Library window opens.
3. In the Add Portable Class Library window, select the target platforms. The following are supported for Synergy .NET:
  - ▶ .NET Framework *x.x*—This must be selected. For Windows and Linux desktop and server development, this is the only option on this window you need to select. For device licensing, you must select .NET Framework 4.5 or higher.
  - ▶ Windows Phone 8.1—Select this for UWP.
  - ▶ Xamarin.Android—Select this for Android.
  - ▶ Xamarin.iOS—Select this for iOS.

Note that this window includes some target options that are not available for Synergy .NET development. Every target you select limits framework resources available to the project, so select only necessary targets.

4. Add DBL code, resources, etc., to the portable class library project, and make sure it references needed assemblies.
  - ▶ For information on item templates see the [“Synergy/DE Item Templates”](#) topic in Synergy/DE WebDocs.
  - ▶ For information on which Synergy features are supported see the [“.NET Development”](#) chapter in the *Professional Series Portability Guide*. And note that for Interop projects Synergy global structures used as attribute arguments must be defined in an assembly outside of a namespace.
  - ▶ Use ASYNC routines for communication across networks and the Internet. See [“Asynchronous processing”](#) in the “Synergy DBL Statements” chapter of the *Synergy DBL Language Reference Manual* for more information.

- ▶ To use the Repository subroutine library, add a reference to **Synergex.SynergyDE.ddlib.dll**, and to use the XML API, add a reference to **Synergex.SynergyDE.synxml.dll**. Note that these are not supported for devices.
  - ▶ For information on deploying and accessing data files on device platforms, see [“Using Data Files on Devices” on page 7-51](#).
  - ▶ To generate documentation from comments in code, use ;;; to identify documentation comments in your code, and select the “XML documentation file” option on the Build page of Project Designer.
5. Set project properties (see the [“Setting Synergy Project Properties”](#) topic in Synergy/DE WebDocs).
- ▶ In the project for the executable for an Android application, set Android versions options to at least API level 14 on the Application page of Project Designer. To use the Intel x86 Emulator Accelerator (HAXM), set them to level 15.
  - ▶ If the application uses device licensing, in the project that includes the device licensing attribute (SynergyDeviceLicenseAttribute), select “Enable Device Licensing” on the Compile page of Project Designer. Do not use this option for any other project in the solution.



To minimize activation of device licenses during debugging and testing for UWP, or Android, do the following in the project for the executable:

- ▶ For UWP, make sure the “Uninstall and then re-install my package...” option on the Debug page is *not* selected.
- ▶ For Android, select the Xamarin option “Preserve application data/cache on device between deploys”. This option is available in Tools > Options > Xamarin > Android Settings.

(iOS automatically preserves application data between deploys, so there is no option to select for this.)

---

- 6. In the project for the executable assembly, add a reference to the Synergy runtime libraries. See [“Synergy runtime libraries” on page 7-11](#).
- 7. You can now call routines in the Synergy portable class library from the non-Synergy code in the solution. See [“Calling a routine in a Synergy assembly from another assembly” on page 7-60](#).

## Debugging Synergy .NET Code

The Visual Studio .NET debugger is used for debugging applications for .NET Framework on Windows (including Universal Windows Platform), and the Xamarin debugger in Visual Studio is used for debugging applications for Android and iOS. (Debugging for Linux is not currently supported.) See Visual Studio and Xamarin documentation for assistance with these debuggers, and note the following:

- ▶ Local fields are not initialized until you step past the PROC statement.
- ▶ If the debugger is running slowly, it may be that too many variables are displayed in the Locals window (rather than being hidden in collapsed nodes of the Locals window). The debugger continually evaluates displayed variables, but doesn't evaluate variables in collapsed nodes. For example, if the Globals node is expanded, the debugger may need to evaluate scores of variables, especially if there are a large number of unnamed common variables. (These are displayed directly under the Globals node rather than in subnodes, which could be collapsed.) To prevent this, keep Locals window nodes collapsed, and instead use the Watch or QuickWatch window or hover over a variable to get information about it.
- ▶ When an assembly is built, the compiler creates a program database file, which is a **.pdb** file for .NET Framework development on Windows, or a **.mdb** file for Mono development. These files store debugging and project state information. If you want to obtain traceback information for a distributed assembly, you must distribute the program database file for the assembly. Only module traceback information is provided unless the assembly is compiled with the "Debug" or "Debug (full)" option set for "Debug/Optimize code" on the Build page of Project Designer.
- ▶ The `_DEBUG` system define enables you to include code based on whether a program is compiled in debug mode. See ["Compile-time defines" on page 7-7](#) for more information.
- ▶ Synergy types have different names in the Visual Studio 2015 Memory Usage Tool. See ["Synergy types in the Visual Studio Memory Usage Tool" on page 7-48](#).
- ▶ Remote debugging is supported for Visual Studio 2015. This means you can run and debug a Synergy .NET program on a remote Windows desktop system or server. To use remote debugging, your Windows development system must have Visual Studio 2015, and the remote system must have Remote Tools for Visual Studio 2015. To be able to examine Synergy variables as you debug remotely, you must also install the Synergy .NET Remote Debugger on the remote system. Synergy .NET Remote Debugger is not something you run. It is a set of libraries that enable the Visual Studio Remote Debugger to work with Synergy types. See Microsoft documentation for more information on remote debugging.
- ▶ If you set conditional breakpoints in a Watch window, only the `==` operator and value comparisons (not reference comparisons) are supported.
- ▶ If a breakpoint doesn't work, use Visual Studio's Modules window to load necessary symbols, or at least find out why the symbols weren't loaded. Select Debug > Windows > Modules from the Visual Studio menu (which opens the Modules window), and then find the entry for the missing symbols. If the path and filename are correct, but the status column indicates that the symbols aren't loaded, you can instruct Visual Studio to load them by right-clicking the entry

and selecting Load Symbols from the context menu. If the Modules window indicates that the path or file isn't correct, you'll need to figure out why the file couldn't be located and resolve the issue.

- ▶ Make sure both of the following Visual Studio debugging options (Tools > Options > Debugging > General) are selected: "Enable property evaluation and other implicit function calls" and "Call string-conversion function on objects in variables windows." If either is unselected, local variables will be displayed with internal names.
- ▶ If the "Unwind the call stack on unhandled exceptions debugging" option is cleared (Tools > Options > Debugging), the pseudovvariable \$exception is displayed in the Locals window for an uncaught exception. Expand \$exception to see more information.
- ▶ If a path to a static type contains a mix of imported and specified (manually entered) namespaces, it might not be evaluated in the Watch and QuickWatch windows. It may not be evaluated if a namespace is defined in a file, for example, because the namespace is assumed to be imported for the entire file.
- ▶ If you use the unsupported **Synergy.SynergyDE.tklb.dll** library, note that you cannot directly examine UI Toolkit globals such as **g\_select** in the debugger. Instead, find the property name for the .define in **tools.def**, and enter that property name (case-sensitive) in the Watch or QuickWatch window. For example, the property name entry in **tools.def** for **g\_select** is

```
.define g_select Synergex.SynergyDE.UIToolkit.GlobalState.t_selection
```

So, to examine **g\_select** you would enter the following in the Watch or QuickWatch window: Synergex.SynergyDE.UIToolkit.GlobalState.t\_selection.

For information on the **Synergy.SynergyDE.tklb.dll** library, see ["Using UI Toolkit with the .NET Framework"](#) in the "Welcome to UI Toolkit" chapter in the *UI Toolkit Reference Manual*.

- ▶ No information displays for a define when you hover over it. (Note that this is true for any language that supports defines—for example, C++.)
- ▶ C# literal suffixes are supported for Visual Studio 2015, which means that if you click on a local variable in the Locals window and its value is one of the following types, you'll see the suffix (e.g., .m). Do not remove these suffixes.

Literal	Suffix
float	.f
double	.d
decimal	.m
unsigned	.u
long	.l

Synergy DBL Integration includes several Synergy-specific commands for use in the Visual Studio Watch and QuickWatch windows:

Command	Information displayed
<code>^ADDR(<i>expression</i>)</code>	The address for a descriptor type variable specified by <i>expression</i> . This works only for .NET types in Synergy records and <b>i</b> , <b>d</b> , and <b>a</b> Synergy types. It is used in a procedure that determines what changed a variable. See <a href="#">“SET WATCH functionality in Visual Studio”</a> below.
<code>^M([<i>struct_field</i>,] <i>handle</i>)</code> (not supported for Mono or Visual Studio 2015)	The value of the specified location in the memory handle. If the field is typed as <b>a</b> , <b>d</b> , <b>i</b> , or <b>id</b> , it is displayed as that type. If it's an array, it is displayed as an array of appropriate types.
Show channels	Channel information
Show handles	Handle information

## Synergy types in the Visual Studio Memory Usage Tool

The Visual Studio 2015 Memory Usage Tool displays information on Synergy types, but it uses different names for these types:

- ▶ A Synergy alpha, integer, decimal, or implied decimal will be have a name with one of the following formats (where *Type* is Alpha, Integer, Decimal, or ImpliedDecimal):  
`Synergex.SynergyDE.TypeDesc`  
`Synergex.SynergyDE.PinTypeDesc`  
`Synergex.SynergyDE.RefTypeDesc`  
 For example, a decimal will appear as either `Synergex.SynergyDE.DecimalDesc`, `Synergex.SynergyDE.PinDecimalDesc`, or `Synergex.SynergyDE.RefDecimalDesc`.
- ▶ Structures appear as `GenBox<string1,string2>` or `GenCouple<string1,string2>`, where *string1* and *string2* are strings that include the structure name. For example, the following is for a boxed structure named `struct1` in namespace `ns1`:  
`Synergex.SynergyDE.Gen_Box<ns1.$$_struct1, ns1.$$_wrap_struct1>`  
 The next example is for a boxed structure named `struct2` in namespace `ns1`:  
`Synergex.SynergyDE.Gen_Couple<ns1.$$_struct2, ns1.$$_wrap_struct2>`

## SET WATCH functionality in Visual Studio

In traditional Synergy, if a variable's value changes, you can find out what changed it by using WATCH variable or SET WATCH variable. But with the Visual Studio debugger, this functionality is not available as the default. Instead you must use the SOS debugging extension (which is installed with Visual Studio) as outlined in the following procedure. The SOS command !CLRStack dumps current stack traces for all threads at the point the variable changes. By examining these stack traces, you can find out which routine is writing to the variable.

1. Open your Synergy project in Visual Studio, and locate or create a programmatic break or pause in execution (e.g., a point where the program waits for user input) that happens before the variable's value is changed. You'll need a programmatic break or pause to give you time to select Break All in [step 7](#).
2. Set a Visual Studio breakpoint at or before the programmatic break.
3. Start debugging the program (Debug > Start Debugging).
4. When the program breaks, use the ^ADDR() command in a Watch or QuickWatch window to get the address of the variable. For example, if the name of your variable is my\_alpha, enter the following in a Watch or QuickWatch window:

```
^ADDR(my_alpha)
```

Note (or copy) the address in the Value column of the Watch or QuickWatch window. You will use the hexadecimal form of this address to set a data breakpoint in [step 8](#). (If a decimal value is displayed in the Value column, you can right-click on the value and select Hexadecimal Display from the context menu.)

5. Detach from the process (Debug > Detach All).
6. Reattach to the process in native mode: Select Debug > Attach to Process, select the process for your program in the Available Processes area of the Attach to Process window, and then click Select. In the Select Code Type window, select Native and clear all other options. Then click OK to close the Select Code Type window, and click Attach in the Attach to Process window.

Detaching and reattaching is necessary because the debugger runs in managed mode by default but must run in native mode for the data breakpoint set in [step 8](#) to work correctly.

7. Select Debug > Break All. You may get an error (e.g., "The process appears to be deadlocked...") and a "No Source Available" window. Ignore these; just click OK in the error message and close the "No Source Available" window.
8. Set a data breakpoint (Debug > New Breakpoint > New Data Breakpoint) using the hexadecimal address you got in [step 4](#). For example, if the hexadecimal address from that step is 0x0288F0C0, enter this in the Address field of the New Breakpoint window.
9. When the breakpoint is set, continue program execution (Debug > Continue).
10. When the debugger breaks at the breakpoint, you'll see the message "The following breakpoint was hit...." Click OK in this message box.

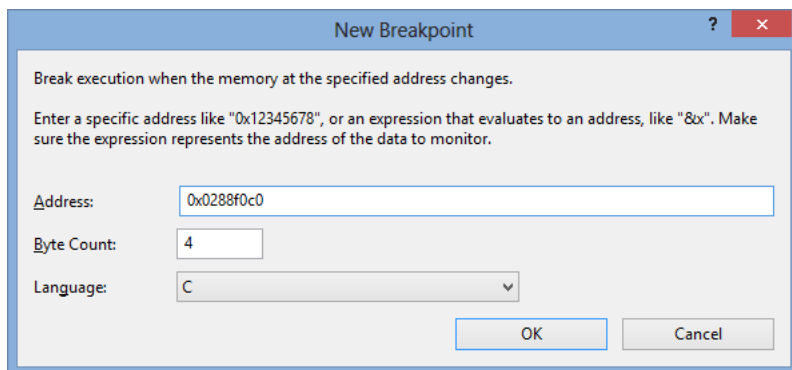


Figure 7-12. Set a breakpoint using the hexadecimal address for the variable.

11. Select Debug > Save Dump As, and then use the Save Dump As window to save a **.dmp** file.
12. Stop the debugging session (Debug > Stop Debugging).
13. In Visual Studio, select File > Open > File, and then in the Open File window, select the file you saved in the previous step and click Open.
14. A window opens with the title of the **.dmp** file. In the Actions section of this window, select Debug with Mixed.
15. Enter the following in the Immediate Window:  

```
.load sos
```

This loads the SOS debugger extension.
16. Enter the following case-sensitive SOS command in the Immediate Window:  

```
!CLRStack
```

This writes the stack traces to the Immediate Window.

Note that the program's debugging session is over, so you won't be able to continue debugging it.



## Using Data Files on Devices

With device platforms, there is no “current directory.” Whether you create files on a device or copy them to a device, files must be in a location on the system that allows read/write access. You can then use SETDFN to specify this as the default location and to specify an extension for data files used by your device application.

Terabyte files are not supported on devices. In addition to files created with the TBYTE option, the following are created as terabyte files:

- ▶ ISAM files created with the TRACK\_CHANGES option
- ▶ ISAM files that support variable-length records larger than 64K

If you want to use one of these types of file on a device, you must explicitly define the file as a non-terabyte file—e.g., by using NOTBYTE with **bldism** or no48 with the address keyword for XDL.

## Using data files for Universal Windows Platform

For Universal Windows Platform (UWP) applications, there are several data locations you can use for files—for example, the Roaming data store, the Local data store, and the Temporary data store. See Microsoft documentation on user and app data stores for more information, and note that for data files deployed with the application, you must put the files in a folder in the application project and then copy the files to the Local app data store.

1. In Solution Explorer, create a folder for the data files in the application project.
2. Copy the data files (e.g., **.ism** and **.isl**) to the folder you just created.
3. Set the Build Action property for each data file to Content.
4. Add code to the application project to copy the data files from the Dat folder to the Local app data store. For example:

```
; **The next three lines should be one long line of code**
data datFolder, @StorageFolder, await
Windows.ApplicationModel.Package.Current.InstalledLocation.GetFolderAsync
("Assets\Dat")
data localFolder, @StorageFolder, ApplicationData.Current.LocalFolder
await CopyAsync(datFolder, localFolder) ;See CopyAsync code below.
.
.
.
public static async method CopyAsync, @Task
source, @StorageFolder
destination, @StorageFolder
endparams
```

```
proc
    data targetFolder, @Windows.Storage.StorageFolder
    ; The next two lines are really one long line of code:
    targetFolder = await destination.CreateFolderAsync(source.DisplayName,
CreationCollisionOption.ReplaceExisting)
    data files, @IReadOnlyList<StorageFile>
    files = await source.GetFilesAsync(CommonFileQuery.DefaultQuery)
    data storageFile, @StorageFile
    foreach storageFile in files
    begin
        ; The next two lines are really one long line of code:
        await storageFile.CopyAsync((@StorageFolder)targetFolder,
storageFile.Name, NameCollisionOption.ReplaceExisting)
    end
endmethod
```

5. You can then use SETDFN to set a default location and extension for data files. For example:

```
xcall setdfn((A)(localFolder+".ism"),1)
open(1, "i:i", "syntxt")
close 1
```

## Using data files on Android

For Android applications, you'll put the data files in the Assets folder for the project, get the location of internal storage or the primary external storage directory for the device, and then copy the files to this directory.

1. Add the data files (e.g., **.ism** and **.is1** files) to the Assets folder for the project that accesses the files, unless the files will be accessed over a network or created by the application.
2. Select the files in Solution Explorer (under Assets), view file properties, and check the Build Action for the files. This should be set to AndroidAsset.
3. Add code to copy the files from the deployed package (**.apk**) to internal storage or to the primary external storage directory for the device. Use the `BaseContext` property for the Activity to get the location of internal storage, or use the `Xamarin.Android Framework` property `Android.OS.Environment.ExternalStorageDirectory` to get the primary external storage directory. You must have read/write access to the directory you use. (The application may crash if the directory is read-only.)

For example:

```
; Copy the ism file to internal storage. Note that dbIs1 and dbIs1 are
; the names of the ism files, and "this" indicates that this code is
; inside an Activity class.
```

```

data ismPath,    String
; "import System.IO" is required for Path.Combine.
ismPath = Path.Combine(this.BaseContext.FilesDir.AbsolutePath, dbIsm)
data is1Path,    String
is1Path = Path.Combine(this.BaseContext.FilesDir.AbsolutePath, dbIs1)
data br = new BinaryReader(Assets.Open(dbIsm))
data bw = new BinaryWriter(new FileStream(ismPath, FileMode.Create))

data myBuffer,  [#]byte,    new Byte [100]
data len,       int

if (File.Exists(ismPath))
begin
    while ((len = br.Read(myBuffer, 0, myBuffer.Length)) > 0)
    begin
        bw.Write(myBuffer, 0, len)
    end
end

bw.Flush()
br.Close()
bw.Close()

; Copy the is1 file to internal storage
br = new BinaryReader(Assets.Open(dbIs1))
bw = new BinaryWriter(new FileStream(is1Path, FileMode.Create))

if (File.Exists(is1Path))
begin
    while ((len = br.Read(mybuffer, 0, myBuffer.Length)) > 0)
    begin
        bw.Write(mybuffer, 0, len)
    end
end

bw.Flush()
br.Close()
bw.Close()

```


4. You can then use SETDFN to set a default location and extension for data files. For example:

```

xcall setdfn((A) (ismPath+".ism"),1)
open(1, "i:i", "syntxt")
close 1

```

As an alternative, you can use the Android Device Monitor to deploy files to an Android emulator or an Android device that's configured for development and connected to the Windows development machine (see [“Building, debugging, and deploying Android applications” on page 7-27](#) for information).

1. Open the Android Device Monitor, which is included in the Android SDK tools.
2. On the Devices tab of the Android Device Monitor, and select the Android emulator or device.
3. On the File Explorer tab, select the data files (or a folder with the data files) you want to deploy. Then click the “Push file onto device” toolbar button: 

## Using data files on iOS

For iOS, put the data files in the Resources folder for the application project, copy the files to the Documents folder on the device, and then set SETDFN to this directory and the file extension(s):

1. Create a Resources folder in the application project, if one doesn't already exist.
2. Put the data files (e.g., **.ism** and **.isl**) in the Resources folder.
3. Make sure the Build Action property for each data file is set to BundleResource.
4. Add code to copy the files to the “Documents” folder where the application has read/write access. (Without this code, the data files will be placed in the application's root directory, which is restricted to read-only operations.) For example, to deploy a file named **syntxt.ism** with your application, you could use the following:

```
;Copy syntxt.ism from application's root directory to "Documents"
DATA doc=Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments)
DATA ismPath = System.IO.Path.Combine(doc, "syntxt.ism")
File.Copy("./syntxt.ism", ismPath, true)
```

```
;Copy syntxt.isl from application's root directory to "Documents"
var islPath = Path.Combine(doc, "syntxt.isl")
File.Copy("./syntxt.isl", islPath, true)
```

5. You can then use SETDFN to set a default location and extension for data files. For example:

```
xcall setdfn((A)(ismPath+".ism"),1)
open(1, "i:i", "syntxt")
close 1
```

# Performing Common Synergy .NET Coding Tasks

The following sections briefly describe how to perform coding tasks that are common when creating Synergy .NET applications and when enhancing traditional Synergy code for Synergy .NET.

## Instantiating and using a .NET class

To use functionality from a .NET Framework or Synergy .NET class in a Synergy .NET method,

1. In your source file, add an **IMPORT** statement to import the namespace that contains the .NET class to be used.

```
import SomeNamespace
```

2. Declare a local variable of that class type using the following syntax within a method:

```
record  
    var, @SomeClass
```

3. Instantiate the class by calling its constructor and assigning it to a local variable. For example,

```
var = new SomeClass(SomeParams)
```

4. Call an accessible method from the .NET class using the local variable. For example,

```
var.SomeMethod(SomeParams)
```

## Inheriting and overriding a .NET class

To override a method in a .NET Framework or Synergy .NET class with different functionality,

1. In your source file, add an **IMPORT** statement to import the namespace that contains the .NET base class definition.

```
import SomeNameSpace
```

2. Add the .NET base class name to the class declaration using the **EXTENDS** keyword.

```
class MyClass extends System.Object
```

3. Add a method declaration and implementation to the class for any base class method to be overridden. The signature of the method must match the base class method signature.

## Creating a Synergy .NET interface

To create a new Synergy .NET interface and compile it into a Synergy application for use by .NET applications,

1. In your source file, declare an interface within a namespace declaration using the **INTERFACE** statement. For example,

```
interface IMyInterface          ;Put interface members here
endinterface
```

2. Add one or more method prototype declarations within the class declaration. Each method prototype declaration specifies the method's name, return type, and parameter signature. For example,

```
interface IMyInterface
    method mymethod, i4
        p1, i4
    end
endinterface
```

## Writing an implementation for a .NET interface

To write an implementation for an interface described in a .NET assembly,

1. In your source file, add an **IMPORT** statement to import the namespace that contains the .NET interface to be implemented. For example,
2. Add the .NET interface to a Synergy .NET class declaration using the **IMPLEMENTS** keyword in the **CLASS** statement. For example,

```
class MyClass implements IDisposable, IDisposable2
```

3. Add methods to the Synergy .NET class to implement all methods of the .NET interface. The Synergy .NET method signature must match the signature as defined in the interface. For example,

```
class MyClass implements IDisposable, IDisposable2
    public method IDisposable.Dispose, void
    proc
        ;Add logic to release resources here
    mreturn
    endmethod
    public method IDisposable2.Dispose, void
    proc
        ;Add logic to release resources here
    mreturn
    endmethod
endclass
```

## Creating a Synergy .NET class that uses generics

Generics enable you to substitute types dynamically into parameters, fields, or anywhere else a type is used in a class. To add a new generic Synergy .NET class and compile it into a Synergy .NET assembly,

1. Create a new file, and add a generic class declaration. (Generic types are added as type parameters. In the example below, <T> is the type parameter.)

```
class MyClass<T>
```

2. Add a method declaration that uses the generic type into the class declaration. The generic type can be used as a method's return type, parameter type, or local variable type.

```
class MyClass<T>
    public mymethod, T
        p1, T
    proc
        mreturn p1
    endmethod
endclass
```

3. Add member fields that use the generic type to the class declaration.

```
class MyClass<T>
    public myfield, T
endclass
```

## Using a generic .NET class

To use a generic .NET class in a Synergy .NET application,

1. In your source file, add code to use the generic class by first instantiating the generic class and providing another type as a substitute for the type parameter. This substitute type must meet all of the type parameter constraints declared in the generic class.

```
c1, @MyClass
c1 = new MyClass<SomeOtherClass> ()
```

2. Write code to use the instantiated class just like any other normal Synergy .NET class.

## Declaring and using a delegate

A delegate enables you to pass a method as a parameter value. To add a delegate to a Synergy .NET class and use it in an application,

1. Create a Synergy .NET class.
2. Add a delegate to the class by defining a delegate class member that defines a method prototype.

```
class class1
  public delegate mydelegate, i4
    p1, i4
  enddelegate
endclass
```

3. Define a method that uses the delegate as a parameter value. (See the [Examples](#) section for the DELEGATE statement for an example of steps 3, 4, and 5).

```
class class1
  public method mymethod, i4
    p1, @mydelegate
  record
    v1, i4
  proc
    v1 = p1(5) ;call the delegate passing in a 5
    mreturn v1
  endmethod
endclass
```

4. Define a method that will be passed as the parameter value in place of the delegate when calling the above method. The signature of this routine must match the delegate. For example,

```
class class1
  public method subthis, i4
    p1, i4
  proc
    mreturn p1 * 2
  endmethod
endclass
```

5. Call the routine in step 3, passing in the method as a parameter value to substitute for the delegate.

```
c1, @class1
md, @class1.mydelegate
v1, i4
c1 = new class1()
md = new class1.mydelegate(c1.subthis)
v1 = c1.mymethod(md)
```



## Declaring and using an event

Events are usually used to provide notifications and are used heavily in forms. To add an event to a Synergy .NET class and use it in an application,

1. Create a Synergy .NET class.
2. Add a delegate declaration to the class.

```
class class1
  public delegate mydelegate, void
    msg, a
  enddelegate
endclass
```

3. Add an event to the class by defining an event class member and using the previously defined delegate. For example,

```
class class1
  public event myevent, @mydelegate
endclass
```

4. Add a method to register for the event. The signature of this method must match the delegate.

```
class class1
  public method mymethod, void
    msg, a
  proc
    open(2,o,"tt:")
    writes(2,"in mymethod "+msg)
    close(2)
    mreturn
  endmethod
endclass
```

5. Register the method as an event handler for the event by adding a call to ADDHANDLER.

```
c1, @class1
c1 = new class1()
addhandler(c1.myevent, c1.mymethod)
```

6. Add a call to RAISEEVENT to raise the event, which causes all registered event handlers to be executed. Note that parameter values to be passed to RAISEEVENT are passed on to the registered event handlers.

```
raiseevent(c1.myevent, "pass this message")
```

## Calling a routine in a Synergy assembly from another assembly

A Synergy routine in a .NET assembly can be called from another Synergy .NET assembly or from a .NET assembly created with another language. Requirements vary depending on the types of passed data and whether the calling assembly was created with Synergy.

### Calling from a Synergy assembly

The simplest case is to call a Synergy routine from another Synergy .NET assembly. To do this, do the following in the calling assembly:

1. Reference the assembly for the Synergy routine. See [“Synergy runtime libraries” on page 7-11](#).
2. If the Synergy routine is part of an explicitly declared namespace, import the namespace.
3. If the routine is a part of a class, call it as a class method. For example,

```
MyClass MyClassInstance = new MyClass()  
MyClassInstance.MySubroutine(arg1, arg2)
```

If the Synergy routine is not part of a class, call it as an external subroutine or function. For example,

```
xcall MySubroutine(arg1, arg2)  
var1 = MyFunction(arg3, arg4)  
MySubroutine2(arg5)
```

### Calling from a non-Synergy assembly and passing .NET types

When calling a Synergy routine from a non-Synergy .NET assembly, the method you'll use depends on the type of data passed. If only .NET types are passed, follow the steps below; otherwise see [“Calling from a non-Synergy assembly and passing structures or non-.NET types” on page 7-62](#). (.NET types are value types that correspond to .NET System.*type* types. For information, see [“Data Types”](#) in the *“Defining Data”* chapter of the *Synergy DBL Language Reference Manual*.)

In the calling assembly,

1. Reference the assembly for the Synergy routine. See [“Synergy runtime libraries” on page 7-11](#).
2. Import the namespace for the Synergy routine. (For example, use a “using” statement in C#.) If the Synergy routine is not in an explicitly defined namespace, it is assigned to the default namespace, `_NS_name`, where *name* is the name of the assembly.
3. Call the Synergy routine as a class method. If the Synergy routine is not part of a class, the routine is considered a static method of the default class, `_CL`.

For example, the Synergy code below includes a subroutine (MySubroutine) and a function (MyFunction) that are not part of a namespace or class:

```
import System
import System.Collections.Generic
import System.Text

subroutine MySubroutine
    required out int1      ,int      // .NET
    required in string1 ,string // types
proc
    open(1, o, "tt:")
    writes(1, string1)
    int1 = 1
    sleep Int1
    close(1)
    return
endsubroutine

function MyFunction
    required out int1      ,int      // .NET
    required in string1 ,string // types
record
    result      ,int      ,0
proc
    open(1, o, "tt:")
    writes(1, string1)
    int1 = 2
    sleep 1
    close(1)
    freturn (result)
endfunction
```

To call the routines in the Synergy code above, the following C# program imports the default namespace (for this example, `_NS_MyDll`) and calls the routines as methods of the default class `_CL`:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using _NS_MyDll; //Import namespace (in this case, the default
                // namespace).
```

```
namespace InteropConsoleApp
{
    class Program
    {
        static int      arg1;
        static string    arg2 = "A string";
        static int      freturn;

        static void Main(string[] args)
        {
            _CL.MySubroutine(out arg1, arg2); //Call subroutine as a method.
            Console.WriteLine(arg1);
            freturn = _CL.MyFunction(out arg1, arg2); //Call function as a
                                                    // method.

            Console.WriteLine(arg1);
            Console.WriteLine(freturn);
            Console.ReadLine();
        }
    }
}
```

## Calling from a non-Synergy assembly and passing structures or non-.NET types

If a Synergy routine has a parameter or return value that accepts or passes a structure or a data type that is not a .NET type, do one of the following to call it from a non-Synergy assembly:

- ▶ Use a Synergy/DE interop project to create the assembly for the Synergy routine. When you use an interop project, wrapper classes with data type mappings and classes for passed structures are generated when the project is built.
- ▶ Create your own mappings for types that are not .NET types and for passing Synergy structures.
- ▶ Use Synergy `PintypeDesc()` classes in the assembly that calls the Synergy routine. See [“Using Synergy data type classes in non-Synergy assemblies” on page 7-65](#).

We recommend the first method, using a Synergy/DE interop project, which will include code and generated classes that automate data type mapping and record-to-class mappings for structures. Note, however, that the interop project type was designed for converting `xfServerPlus` routines for native .NET access (see [“Converting `xfServerPlus` routines for native .NET access” on page 7-70](#)). Consequently, code that you write for use with an interop project must adhere to many of the same requirements as code written for use with `xfServerPlus`. For example, it must be written in the form of a subroutine or function (not a method) and must not be included in a class.

If you are not familiar with writing code for use with `xfServerPlus`, you may want to review the first chapter of the *xfNetLink & xfServerPlus User's Guide*, [“Preparing Your Synergy Server Code,”](#) particularly the information on passing data when using a .NET client. But bear in mind that some

of the information in that chapter (e.g., using ELBs) applies only if your routines are intended for use with xfServerPlus. These sections of the “Preparing Your Synergy Server Code” chapter may prove useful:

- ▶ [“Attributing Your Code”](#)
- ▶ [“Passing Structures as Parameters”](#)
- ▶ [“Handling Variable-Length and Large Data”](#)
- ▶ [“Passing Binary Data”](#)

To use an interop project to access a Synergy routine,

1. Create a Synergy/DE interop project by selecting Synergy/DE > Interop in the New Project window in Visual Studio.
2. Write and attribute the Synergy code. Generated classes that wrap the Synergy code are based on routine definitions in the code and on attributes when necessary. For example, the interface property of the xfMethod attribute is used for the name of the generated wrapper class, and the method name defaults from the routine name. See [“Using Attributes to Define Synergy Methods”](#) in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide*, and note the following:
  - ▶ The interop project will include the **SynergyRoutines.dbl** file, which has utility routines needed for date conversions and for compatibility with xfNetLink .NET clients. Do not make changes to this file or remove it from the project. Add your Synergy routines to a new DBL code file (Project > Add New Item > Code File).
  - ▶ Do not put the Synergy routine in a class. Other Synergy routines can be in classes, but code that you attribute (i.e., routines for which class wrappers will be generated) should not be in a class.
  - ▶ Structures passed as ordinary parameters or arrays must be INCLUDED from the repository and defined as a structfield in your code. Passed structures become classes in generated code, and fields in the structure become properties of these classes. In addition to [“Passing Structures as Parameters,”](#) listed above, for more information see [“Using Structures”](#) in the “Calling Synergy Routines from .NET” chapter of the *xfNetLink & xfServerPlus User’s Guide*, and note that the Original property is not supported for interop projects.
3. Set project properties as necessary. For information on these settings, press F1 while the Interop page is displayed.
4. Build the Synergy assembly. This generates wrapper classes and adds them to the project. A class will be generated for each interface defined in the project and for each structure.

5. In the calling assembly,
  - ▶ reference the Synergy Interop assembly.
  - ▶ import the namespace for the class that wraps the Synergy routine.
  - ▶ call the class method that corresponds to the Synergy routine you wrote in [step 2](#).



Along with the method that corresponds to your Synergy routine, the Object Browser and IntelliSense for Visual Studio will display several methods that you shouldn't use in your code: connect, disconnect, Equals, GetHashCode, GetType, getUserString, setCallTimeout, and setUserString. These items are for internal use by the generated classes and for compatibility with xfNetLink .NET clients.

---

The following example Synergy code includes an **i** argument (**arg1**), which is not a .NET type. If this code is added to a **.dbl** file in an interop project, the interop project will wrap the Synergy routine in a class that maps the **i** argument to a .NET type (**int**).

```
import System.Collections.Generic
import System.Texts

{xfMethod(interface="InteropTest")}      ;Attributing is required for
                                         ; interop project

subroutine MySubroutine
  required out arg1 ,i          ;Not a .NET type
  required in  arg2 ,String
proc
  open(1, o, "tt:")
  writes(1, arg2)
  sleep 3
  close(1)
  arg1 = 5
  return
endsubroutine
```

The following is a C# program that calls the Synergy routine above. The C# code imports the namespace (which for this example is InteropProjSynDll) and creates an instance of the InteropTest class (the generated wrapper class) to access the MySubroutine method:

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using InteropProjSynDll; //Namespace for generated class
```

```
namespace InteropProjConsoleApp
{
    class Program
    {
        static int      arg1;//Corresponds to i parameter in Synergy routine.
        static string    arg2 = "A string";

        static void Main(string[] args)
        {
            InteropTest tst = new InteropTest(); //Synergy routine
                                                    // (MySubroutine) called
            tst.MySubroutine(ref arg1,arg2);      // as method of InteropTest
                                                    // class wrapper

            Console.WriteLine(arg1);
            Console.ReadLine();
        }
    }
}
```

## Using Synergy data type classes in non-Synergy assemblies

If you import Synergex.SynergyDE and add a reference to Synergy runtime libraries (see [“Synergy runtime libraries” on page 7-11](#)), you can use the following classes in a non-Synergy assembly to pass Synergy alpha, decimal, implied decimal, and integer data when calling a Synergy routine. You can use these classes unless structures or other non-.NET types are passed (in which case, you will need to do the mappings yourself or use a Synergy/DE interop project).

- ▶ PinAlphaDesc(*size*)
- ▶ PinDecimalDesc(*size*)
- ▶ PinImpliedDecimalDesc(*size, precision*)
- ▶ PinIntegerDesc(*size*)



You can use these classes, but they are not supported. We recommend that you instead use a Synergy/DE interop project when passing non-.NET data types. See [“Calling from a non-Synergy assembly and passing structures or non-.NET types” on page 7-62](#).

---

## Preparing Existing Code for Synergy .NET

In addition to using Synergy DBL to create entirely new applications for Microsoft .NET Framework (on Windows) or Mono (on Android, iOS, or Linux), you may also be able to use existing traditional Synergy code to create .NET applications.

Whether you are planning to migrate an entire application, port frequently used functionality, or simply make some Synergy routines available to other .NET programs, you can begin with an existing traditional Synergy solution.

- ▶ If you use xfServerPlus and xfNetLink .NET, you can rebuild your Synergy methods to run under Microsoft .NET Framework on Windows and then call them natively (without going through xfNetLink .NET and xfServerPlus). See [“Converting xfServerPlus routines for native .NET access” on page 7-70](#).
- ▶ If you use the Synergy windowing API, you can use Synergy .NET’s support for this API as a starting point for your user interface. This results in “UNIX-like” non-mouse-controlled “W\_” windows in WinForms under the .NET Framework on Windows.

The following steps outline the basic procedure for a typical application. This is an iterative process; you start with global entities, move to common code, and then work up to code that’s specific to certain functionality. The goal is to organize code into useful projects and avoid circular dependencies and forward references, which are not allowed in DLLs (see [step 7 on page 7-68](#)), while making code compatible with .NET.

Unlike traditional Synergy,

- ▶ all global symbols must be resolved at the time an assembly (class library or executable) is compiled because all files in an application are compiled together. (With traditional Synergy, the same name can be used for different global entities in different **.dbl** files if the files are compiled separately.)
- ▶ it is not possible for a global record in an **.exe** file to be referenced by an external record in a class library.

To prepare existing traditional Synergy code for .NET,

1. Start by creating a Synergy class library project as a new solution (i.e., create the project when no solution is open in Visual Studio). Select File > New Project from the Visual Studio menu, and then select a class library project template (under Installed Templates > Synergy/DE in the New Project window).

For more information on project templates, see the [“Synergy/DE Project Templates”](#) topic in Synergy/DE WebDocs, and note that for portability, put as much logic as possible in portable class libraries. Portable class libraries can target some or all supported platforms (Microsoft .NET Framework on Windows and Mono on Android, iOS, and Linux).



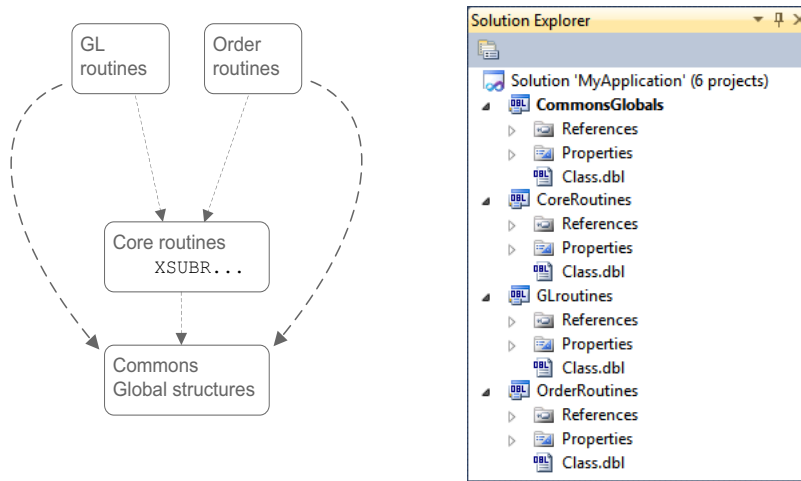
2. Once you've selected a template, specify a name, location, etc., for the project, and click OK to create it.
3. In the **.dbf** file for the project, create a subroutine and add all global entities for your application into the subroutine:
  - ▶ Add all global structures to the data division of the subroutine.
  - ▶ Add global commons, global literals, global data sections, and INIT statements to the procedure division of the subroutine.
4. Set project properties as necessary. See the [“Setting Synergy/DE Project Properties”](#) topic in Synergy/DE WebDocs.
5. Build the project. If you get errors, it is probably because the code includes something that is not supported in the .NET environment. (By double-clicking an error message in the Visual Studio Error List, you can go directly to the line of code that is causing the error.) Analyze the code causing the problem, and ask yourself the following questions:
  - ▶ Is it necessary to the .NET solution, or can it be removed?
  - ▶ Is it replaceable with code that functions in both Synergy .NET and traditional Synergy? If not, you can use the following compile-time defines to conditionally compile code of the program: DBLNET (for Synergy .NET only), D\_MONO (for mono development only), and D\_PORTABLE (for portable class libraries only).

Don't be alarmed if your initial compilations result in a number of errors and warnings. Most of the errors and warnings will involve only minor fixes, and solving one will most likely also resolve several others. Also keep in mind that many of these issues would result in runtime failures—and they may already be causing runtime errors in your current application.

See the [“.NET Development”](#) chapter in the *Professional Series Portability Guide* for information on Synergy features that are not supported in Synergy .NET.

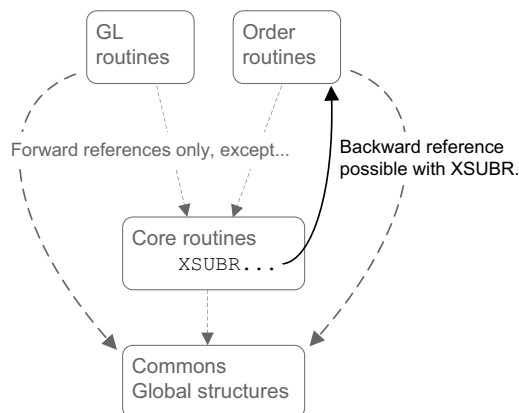
6. Repeat the process ([step 1](#) through [step 5](#)) for your application's core routines, and add a project reference to the project for global structures, commons, etc.

7. Repeat the process again, but for sets of routines that are specific to certain areas of your application, and this time add project references to the project for core routines and the project for globals. For example, if your application has general ledger (GL) functionality and order entry functionality, you could create a class library project for the GL routines and another class library project for the order entry routines, making sure they reference existing projects:



*Figure 7-13. Create class libraries for routines specific to certain areas of your application.*

With Synergy .NET, only forward references are supported (i.e., circular references are not allowed). For example, if you have core routines and order entry routines in separate projects and the order entry routines call the core routines, the core routines cannot reference anything in the order entry routines. There is an exception: you can use XSUBR for a “backward reference” if necessary, but this can adversely affect performance.



*Figure 7-14. Use only forward references with Synergy .NET (unless you use XSUBR).*

8. Create projects for the routines that make up the programs that call the routine libraries and add project reference to those libraries. These programs will be executable assemblies, so create application projects for these programs. Then repeat the process described in [step 4](#) for these projects.

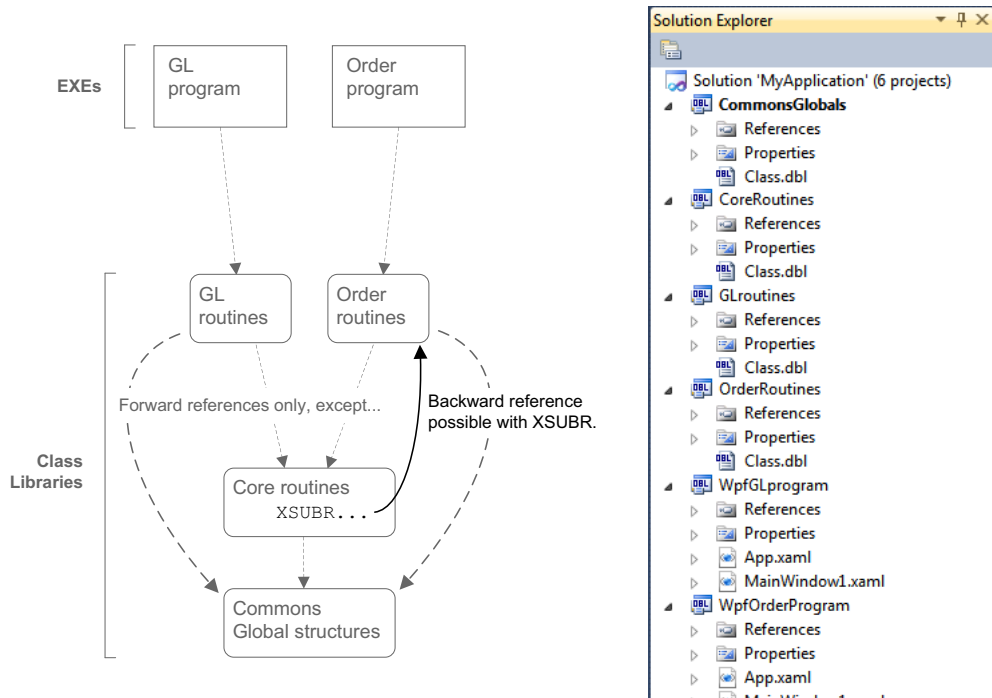


Figure 7-15. Create application projects for programs that call libraries.

9. Once compile errors have been corrected for the assemblies, you should be able to run and debug the application.

## Converting xfServerPlus routines for native .NET access

If you use xfNetLink .NET to access Synergy routines, you can access these routines natively in Microsoft .NET Framework on Windows by generating an assembly for the Synergy routines and then accessing that assembly (rather than the assembly generated by **gens**). Once you make this change to your application, it will no longer be a distributed application that accesses Synergy routines remotely. Rather, those routines will be built into a DLL, which will be referenced *locally* by the .NET application (the application that was the xfNetLink .NET client). Neither xfNetLink nor xfServerPlus will be involved.

This conversion can be of benefit if your xfNetLink client application is a Windows application (e.g., written in C# or VB.NET). It should improve performance and enable you to use seamless in-process debugging from your client code through to the Synergy .NET code. It should also help you prepare for future .NET development. For a web application, you can either continue to access Synergy routines remotely from your .NET client, or if your web server is Windows based, you can convert to run natively without xfServerPlus/xfNetLink .NET.



For web services (IIS and WCF), globals, channels, and server connections must be isolated by AppDomain. For more information, see [“Using Synergy .NET in Multi-Threaded Applications,”](#) available on the Synergy/DE PSG blog site, and see [SynNetAspAppDomainOnlyInterop.zip](#), available from Synergy CodeExchange in the Resource Center on the Synergex web site.

---

To convert xfServerPlus routines for native .NET access,

1. Create a Synergy/DE interop project in Visual Studio. (In the New Project window for Visual Studio, select Synergy/DE > Interop.) You can add this project directly to the client solution, or you can create a separate solution (and later add a reference to it from the client).

The project will include the file **SynergyRoutines.dbl**, which has stub routines for XFPL\_LOG and SET\_XFPL\_TIMEOUT so that if your Synergy code calls these two xfServerPlus API routines, it won't break. **SynergyRoutines.dbl** also includes some datetime conversion routines that are used by the generated classes. Do not alter these routines and do not remove this file from the project.



If your xfNetLink client program calls XFPL\_REGCLEANUP directly, you will need to find some other way to incorporate that functionality. For example, you could change your code to directly call the cleanup routine that was called by XFPL\_REGCLEANUP.

---

2. Add the source files that contain the Synergy routines currently accessed by your xfNetLink .NET application to the project.

3. If your Synergy routines have not yet been modified to use attributes, parameter modifiers, and (optionally) documentation comments, do so now. See [“Using Attributes to Define Synergy Methods”](#) in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide*.

- ▶ Add direction (IN, OUT, INOUT) and required/optional (REQ, OPT) modifiers to parameters. See [“Parameter definitions”](#) in the “Defining Data” chapter of the *Synergy DBL Language Reference Manual*.
- ▶ Add xfMethod attributes. For details, see [“xfMethod Attribute”](#) in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide*.

Only the interface property of the xfMethod attribute is required when attributing code in an interop project, but you may need other properties, such as method name, depending on your code. The elb, id, and encrypt properties are unnecessary. Pay special attention to how methods are named so that you do not break existing code. Note that if you’ve already attributed your code, adding properties such as elb and id, you can leave it as is; these are not necessary when using the interop project type, but they do no harm.

Pay special attention if you choose to rely on default sizes for return values when attributing code, as the data type conversion from Synergy to C# types sometimes depends on the defined size. See the xfNetLink .NET section of [Appendix B](#) in the *xfNetLink & xfServerPlus User’s Guide* for details on data type mapping.



If you used the alternate interface name feature, you will need to specify the *alternate* name for the interface property when you attribute your code. For example, if the interface for the login routine was Cust in the SMC and you always changed it to Customer when you generated classes, you would use Customer for the interface property in the xfMethod attribute. Or, if you generated classes once with Cust and a second time with Vendor, you’d create two xfMethod attributes for the login routine, one for each interface. See [“Attribute Examples”](#) in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide* for an example.

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- ▶ Add xfParameter attributes as needed. For details, see [“xfParameter Attribute”](#) in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide*.

If your Synergy routines pass structures as ordinary parameters or as arrays, redefine them as structfields.

As with return values, if you rely on default sizes for parameters when attributing code, you should pay special attention, as the data type conversion from Synergy to C# types sometimes depends on the defined size. See the xfNetLink .NET section of [Appendix B](#) in the *xfNetLink & xfServerPlus User’s Guide* for details on data type mapping.

- ▶ Add Select classes to access your remote (or even local) data instead of READ, READS, etc., and ensure xfServer is enabled. Using Select causes the database (rather than the program) to filter the returned records. See the “[System-Supplied Classes](#)” chapter of the *Synergy DBL Language Reference Manual* for more information about the Select classes. Note that the SparseRecord method and the Select.OrderBy class offer additional performance benefits to Select class implementations.
  - ▶ Add documentation comments, if desired. See “[Documentation Comments](#)” in the “Defining Your Synergy Methods” chapter of the *xfNetLink & xfServerPlus User’s Guide*.
4. Set project properties.
- ▶ On the Interop tab, you’ll find some of the options that you used to set in the Component Information dialog in Workbench (or specify on the command line). You should set these options the same way you did previously so as not to break code. For help with the fields on this tab, press F1 while the tab is displayed. Note the following:
    - ▶ Prior to version 9.5, output parameters were always generated as “out” in the C# classes. If you change to “ref”, you will need to update your client code.
    - ▶ If you previously used pooling, you should select the pooling option. This will ensure that any pooling support methods your application relied on are still called.
  - ▶ On the Application tab, verify that the value in the Default namespace field matches the namespace your application currently uses. It defaults to the project name; previously, it defaulted to the project (or assembly) name followed by “NS”.
  - ▶ If your application passes structures as parameters, be sure to specify the location of the repository files. You can do this on the Environment Variables tab or in the **synergy.ini** file (if SFWINIPATH is set). Also set any other environment variables used by the Synergy routines. You can use repository files that are not in the location specified by RPSMFIL and RPSTFIL (or RPSDAT) by setting DBLNET2XML\_RPS. See [DBLNET2XML\\_RPS](#) in the “Environment Variables” chapter of *Environment Variables & System Options*.
  - ▶ To generate an XML file for API documentation, select the option on the Build tab.
5. Build the interop project to generate the wrapper classes and the assembly. Fix any issues reported by the compiler (see [step 4 on page 7-67](#) for more information). The generated classes are added to the project. Note that the classes and assembly are generated in one step rather than two as they were in Workbench.



If you previously edited the generated classes, you will need to find some other way to include the added (or altered) functionality into your application. Because classes are generated and the assembly is built all in one step, any changes you make to the classes will be overwritten when you rebuild.

---

6. Update your client application:

- ▶ Open projects for assemblies that used xfServerPlus and remove the references to the previous assembly and to **xfnlnet.dll**.
- ▶ Add a reference to the new assembly.
- ▶ Rebuild the project and run the application. You may need to set environment variables needed at runtime that were previously set on the xfServerPlus machine.



Your files will include unnecessary code. For example, there may be calls to the connect() and disconnect() methods, which are no longer used. The DLL you built in the interop project has stub routines to handle these calls (by doing nothing), but you may want eventually to remove the unnecessary calls so that your code is easier to read.

---





# 8

## Accessing Data Remotely with xfServer

### **What Is a Client/Server System? 8-2**

Defines a client/server system and identifies its benefits.

### **What Is xfServer? 8-5**

Explains what you can expect from your xfServer system operation, the basic requirements for setting up your system, and the client and server components of your system.

# What Is a Client/Server System?

A client/server system is a computer network in which one or more computers act as *clients*, requesting services or access to data, and one or more computers act as *servers*, processing the clients' requests. The primary objective behind setting up a client/server system is to set up some computers on a network as user-interface specialists and some computers as shared-data specialists.

## A basic client/server model

In a basic two-tier client/server model, the bulk of the application, including the user interface and logic processing, resides on the client machine. (See [figure 8-1](#).) The client is usually a PC, but it can also be a workstation connected to a multiuser system. The data—as well as the logic that maintains the data's integrity—is centralized on the server. When a client application needs to access remote data, it sends the request over the network to the server.

The server can wait for client requests while processing requests from connected client applications. The computer selected to be the server must be capable of pre-emptive multitasking.

Any computer hosting a client application becomes a client. A client application is simply an application that uses client capabilities (such as the runtime included with Synergy DBL version 6.1 or greater or Synergy/DE xfODBC).

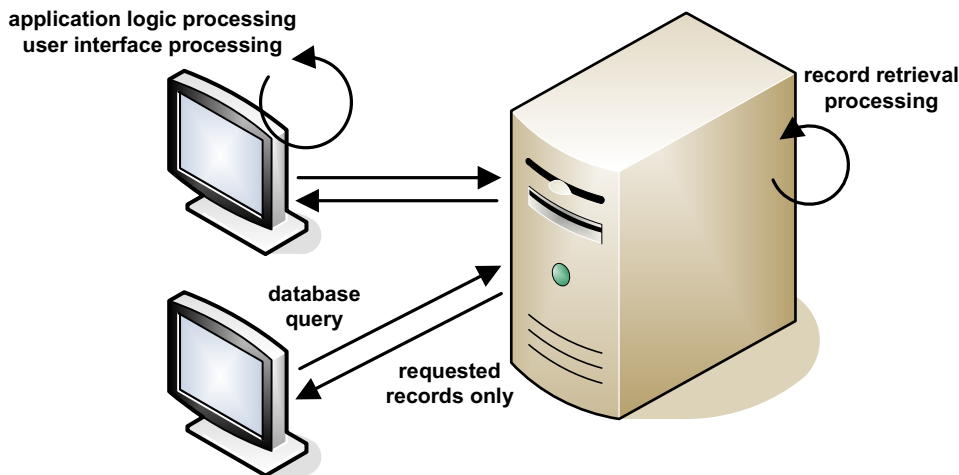
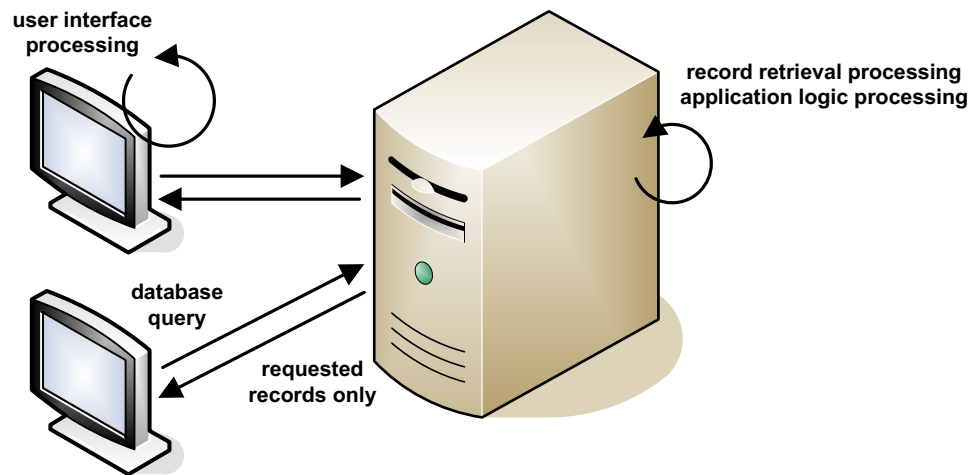


Figure 8-1. A two-tier client/server configuration.

## A multi-tier client/server model

The first multi-tier client/server architecture was the three-tier model (see [figure 8-2](#)), which divides processing into essentially three layers:

- ▶ User interface (collecting data from the user)
- ▶ Database serving (accessing data)
- ▶ Business logic (processing data)



*Figure 8-2. A three-tier client/server configuration.*

The three-tier architecture led to an  $n$ -tier architecture, in which many application servers can be created to perform parts of the processing involved in any of the three layers, but most commonly in the application logic processing area. An  $n$ -tier configuration uses a distributed network and has different layers of business presentation and database access logic, each running where it is most appropriate.

This chapter addresses only data access with xfServer. For information about logic processing and the other Synergy products that enable you to create true multi-tier software solutions, see [chapter 9, “Accessing Logic Remotely with xfServerPlus.”](#)

## Benefits of a client/server system

Client/server architectures are popular for several reasons:

- ▶ **Your users can share data.** This is the same benefit you get from traditional multiuser environments. Data requests and transfers between the client and the server can be concurrent and are transparent to the user. Supported file types include relative, stream, sequential, and ISAM. Any file I/O function supported by the server's "native file" system can be performed from the client application.
- ▶ **You can optimize existing systems.** When you network various types of computers in the same client/server system, you can set up each to execute the function(s) it performs best. Client/server tools enable you to use both the network connections and serial terminal connections at the same time, so you don't need a desktop system for every user. Furthermore, a client/server system allows both the client and the server to make the most efficient use of their power:
  - ▶ The client application manages the user interface.
  - ▶ The server system handles shared file or data access requests.

Freeing the server from interface tasks reduces processing time and memory usage.



Although you can access remote data with a mapped drive or on an NAS (network-attached storage) drive, we recommend that you use xfServer instead. Mapped and NAS drives are known to cause data corruption. With xfServer, there is less chance of data corruption because xfServer properly closes files when a network connection is lost. In addition, xfServer is more efficient than mapped drives for file I/O. For more information on using mapped or NAS drives to access remote data, see Synergex KnowledgeBase article [100002008](#).

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## What Is xfServer?

Synerdy/DE xfServer is the technology that enables Synergy developers to add client/server capabilities to their Synergy applications. It provides the connectivity layer for remote access to corporate data from Synergy client applications.

The basic xfServer system consists of a Windows and/or UNIX client application connected by a TCP/IP-based network to a Windows, UNIX, or OpenVMS server system. The client portion of xfServer is incorporated into the runtime of Synergy DBL for Windows and UNIX systems. The server portion of xfServer is a background process that can reside on any Windows, UNIX, or OpenVMS computer you select to be the server. Once started in the background, the server program continually accepts requests from any client computers. The server program's executable file is **rsynd.exe** (Windows), **rsynd** (UNIX), or **rsynd.exe** and **rsdmse.exe** (OpenVMS).

xfServer uses a fixed-port TCP/IP implementation. The default port is 2330, but it can be overridden, enabling users to resolve port conflicts and run multiple servers on a single host.

## How the xfServer system operates

Let's say we have a business contact application that is used by the account managers and support representatives in a large software company. The Synergy application is located on the PCs (the client systems) of the sales and support staff, while the data about customers, which needs to be shared, resides on a server in the MIS department. xfServer is what enables the server to accept client requests for data and send data back to the client PCs.

This section describes how the xfServer system works locally (at the client application level) and remotely (at the server level).

## How your application works locally

### Access files using a server "address"

To access remote files, you must specify the server name in your file specifications. You can do this directly or using a logical. The direct file specification method is to append the server "name" to the filename in your Synergy DBL statements and subroutines. The server name, in the form *@server*, can be either the host name of the server or the server's fully qualified domain name. An alternate form of a server file specification is *@address*, where *address* is the server's IP address on the network. For example, if your server's host name is "yubby" and the IP address is 234.52.47.128, you can specify the file using either of the following forms:

*file@yubby*  
or *file@234.52.47.128*

If you are accessing a file on a separate domain, you can specify the file in the following form:

*file@yubby.subdomain.com*



A remote file specification cannot reference another remote file specification when the first file specification is on Windows.

---

We recommend that you use a logical to specify the server address rather than using a direct specification. It is much easier to maintain your code and keep up with potential changes in the client/server system architecture if your application uses logicals. Ultimately, your system will translate your file specification to the direct form and use it to access the data, but under most circumstances, your program should not hard-code the file location. See “[Getting Started with xfServer](#)” in the “Configuring xfServer” chapter of the *Installation Configuration Guide* for more information about setting up logicals.

### I/O limitations

You are restricted to the I/O limitations of the xfServer system. See the *Professional Series Portability Guide* for more information on system-specific limitations.



We do not recommend using GET and PUT statements in a heterogeneous client/server environment. Remote fixed I/O (GET and PUT) is *not* transparent between client/server systems with different native line terminators (for example, Windows and UNIX). To allow for this, you may have to change client applications to support multiple operating system file types. Your client application must know where the file is located and account for either zero, one, or two line terminators when specifying the destination record size.

---

## How the server works remotely (Windows and UNIX)

The design for the Windows and UNIX xfServer platforms are similar, with only a few differences. Because Windows and UNIX servers can handle multiple clients’ requests quickly, and starting a new session server process is transparent to the user, “standby” session servers are not needed. Instead, a Windows or UNIX server starts a new session server only when it receives a new client request.

xfServer operates on Windows and UNIX as follows:

1. The server receives a request from a client application.
2. The server’s dispatcher starts a new session server process (server thread on Windows).
3. The new session server completes the connection to the client application.
4. The session server processes the client’s requests. After the process has completed all of the client’s requests, the session server process (server thread on Windows) terminates. See [figure 8-3](#).

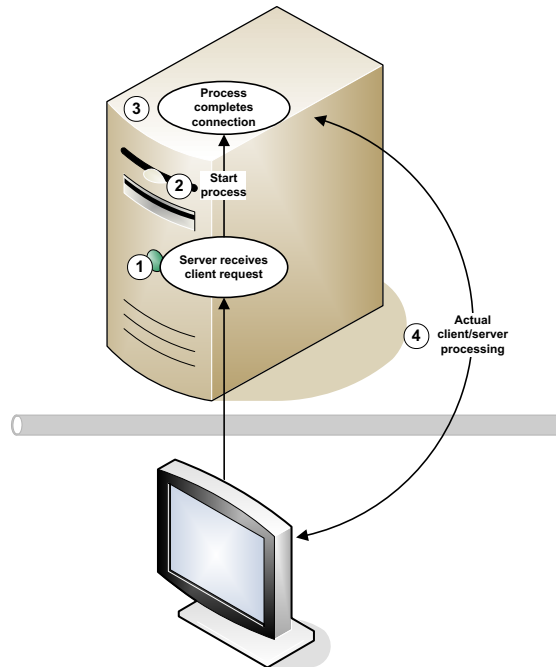


Figure 8-3. Windows and UNIX server processing.

## How the server works remotely (OpenVMS)

xfServer starts a pool of session server processes at server startup. These processes maintain and communicate their status (“I’m busy” or “I’m waiting for a client request”) to the server connection manager.

As the session server pool is depleted by client requests, connection manager starts additional servers in order to maintain the free pool. If there are a sufficient number of session servers in the free pool, these temporary processes are deleted after servicing the client’s request.

xfServer operates on OpenVMS as follows:

1. The connection manager receives a request from a client application.
2. The connection manager assigns a session server process (from the pool of processes).
3. The assigned process completes the connection to the client application.
4. The process services the client’s request. During processing, the connection manager won’t assign the process to another request. After the process has completed the client’s request, the process sends a message back to the connection manager and waits to be reassigned. See [figure 8-4](#).

## Accessing Data Remotely with xfServer

What Is xfServer?

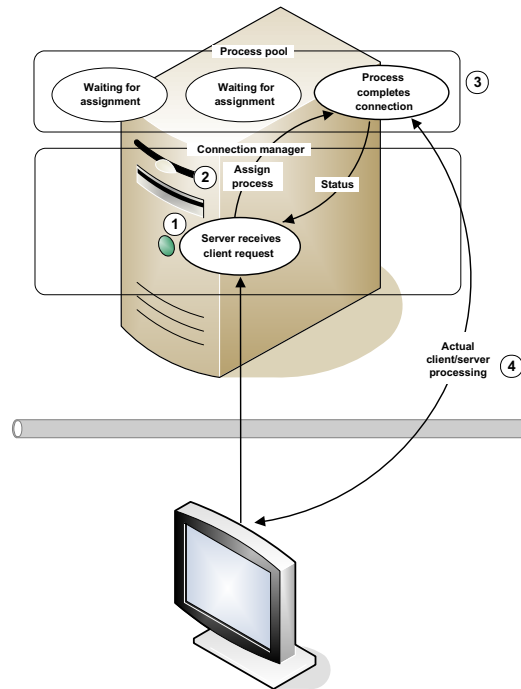


Figure 8-4. OpenVMS server processing.

### How the user sees the system

You may be asking yourself, “Will my users have to perform any extra steps to access the files on the server?” Your users will see the application operate exactly as it did before. Data requests and transfers between the client and the server will be completely transparent to the user.

### Basic requirements

To set up your xfServer system, you’ll need the following:

- ▶ Network hardware (network cards, cables, and connectors)
- ▶ Network software (TCP/IP) for all client and server hosts
- ▶ Your Synergy application
- ▶ Synergy DBL with client support (version 6.1 or higher) for your client machine
- ▶ xfServer for your server system
- ▶ Log-ins and home directories for each client on the server system



## Managing and monitoring your xfServer system

### On Windows

You can optionally log information related to xfServer. To view the log, choose Event Viewer from the Administrative Tools window. The log of events appears under the **rsynd** source.



The event log fills up quickly. Remember to clear your event logs.

---

You can also monitor which files are open, who opened them, and whether they are locked by using the Monitor utility. See [“The Monitor Utility for Windows”](#) in the “General Utilities” chapter of *Synergy Tools*.

### On UNIX

xfServer includes utilities you can use to manage your client/server system. To use these utilities, add the appropriate option specification when you invoke the **rsynd** command. For example, to start the Monitor function so you can track client/server activity, use the **-m** option when you execute the server command:

```
rsynd -m
```

The **rsynd** options **-m** and **-v** do *not* restart the existing **rsynd** daemon. They merely return the server version (**-v**) or enable monitoring (**-m**).

See [“The Monitor Utility for UNIX”](#) in the “General Utilities” chapter of *Synergy Tools* for additional information about monitoring the client/server system.

### On OpenVMS

xfServer includes a utility called **servstat** that you can use to manage your OpenVMS server system. See [“The servstat Program”](#) in the “General Utilities” chapter of *Synergy Tools* for more information.

## See also

- ▶ The [“Configuring xfServer”](#) chapter of your *Installation Configuration Guide* for additional information about setting up your xfServer system.
- ▶ [Chapter 9, “Accessing Logic Remotely with xfServerPlus,”](#) for information about logic access.



# 9

## Accessing Logic Remotely with xfServerPlus

### **Overview 9-2**

### **What Are xfServerPlus and xfNetLink? 9-3**

Describes xfServerPlus and the three xfNetLink editions.

### **Design Considerations 9-8**

Discusses some of the issues you will need to consider to create a successful distributed application.

## Overview

Synergy/DE enables you to create robust two-tier and multi-tier distributed applications—including web-enabled, thin-client solutions—using xfServerPlus, xfNetLink, and Professional Series Workbench. Using these tools, you can update your existing Synergy applications by adding a modern interface, without completely rewriting your Synergy code.

The user interface can be handled through applications written in Synergy, Java, or a .NET capable language such as C# or VB.NET. Or, you may choose to develop a web solution using ASP.NET, JavaServer Pages™ (JSP), or web services. The xfNetLink edition that your application requires depends on what type of user interface you want to provide.

The application logic can be written in Synergy DBL, and the database can be accessed by routines written in Synergy DBL. You can use Professional Series Workbench to edit your Synergy server code and to generate Synergy JAR files and assemblies. (See [chapter 2, “Developing Your Application in Workbench,”](#) for details about Workbench.)

See [chapter 8, “Accessing Data Remotely with xfServer,”](#) for an overview of basic distributed computing and a list of its benefits.

## What Are xfServerPlus and xfNetLink?

xfServerPlus and xfNetLink enable you to access Synergy routines and data remotely from a Synergy, Java, or .NET client. The three xfNetLink editions serve as clients to xfServerPlus and provide the ability to access Synergy logic from a variety of front-ends. Together, xfNetLink and xfServerPlus handle creating a connection and translating data between the client machine and your Synergy server machine.

### xfServerPlus

xfServerPlus is the Synergy business logic server that handles the remote execution of Synergy routines. The routines are made available for remote calling by including them in an ELB or shared image and defining them in the Synergy Method Catalog (SMC). (Routines that have been defined in the SMC are referred to as *Synergy methods*.) xfServerPlus receives a request to execute a Synergy routine from the remote client, translates the request, executes it, and returns the results to the client. xfServerPlus uses the **dbms** non-interactive runtime.

#### The Synergy Method Catalog

The Synergy Method Catalog identifies each Synergy subroutine or function that you want to be able to call remotely and the ELB or shared image in which it can be found. For Java and .NET clients, routines are assigned a method name that is used by the client application, and then grouped into interfaces. The SMC also provides detailed information on the type and length of the input and output parameters, as well as the type and length of the function results that are transmitted back to the client.

xfServerPlus uses the information in the SMC to allocate adequate memory for data that is passed to (and possibly updated by) the Synergy DBL routines; to ensure that data from xfNetLink clients is translated into the correct Synergy data types; and to ensure that function results are translated into the correct return types for the xfNetLink client. Data in the SMC is also used to create JAR files for use with xfNetLink Java and assemblies for use with xfNetLink .NET.

To populate the SMC with information about your routines, you will add attributes that describe the routines to your Synergy code. Then, you will run the **dbl2xml** utility using your Synergy source files as input. The **dbl2xml** utility outputs an XML file containing information about the routines, which can then be imported into the SMC. You can also populate the SMC manually using the Method Definition Utility. See the “[Defining Your Synergy Methods](#)” chapter of your *xfNetLink & xfServerPlus User’s Guide* for details on the SMC.

## xfNetLink Synergy Edition

xfNetLink Synergy is a set of routines distributed with Synergy/DE Professional Series. These routines work in conjunction with xfServerPlus to execute Synergy routines stored on a remote machine. Using xfNetLink Synergy, you can create a two-tier distributed application consisting of a Synergy user interface on the client accessing Synergy logic residing on a remote Synergy server. (See [figure 9-1](#).) A Synergy front-end provides your users with a familiar look. Because the client API is provided by Synergy DBL, you can use it on all supported Synergy platforms. The Synergy runtime must be deployed on the client.

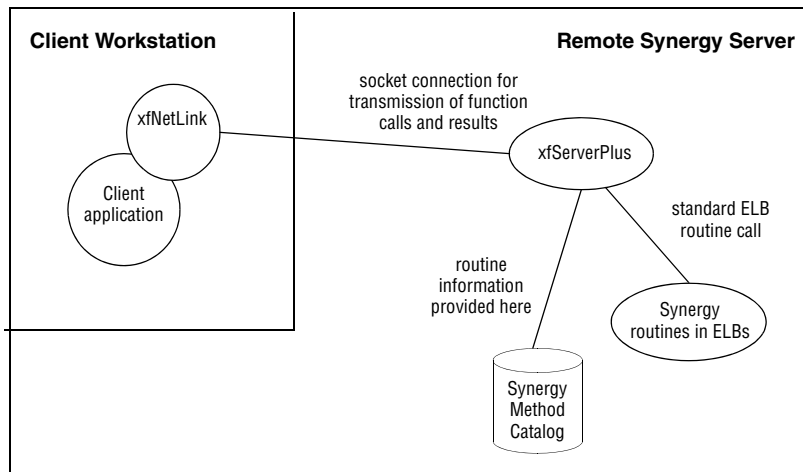


Figure 9-1. *xfNetLink and xfServerPlus in a two-tier configuration.*

There are two ways to use xfNetLink Synergy: %RXSUBR (and the xfNetLink Synergy API) and the routine call block API. You can use other Synergy/DE tools to develop your xfNetLink Synergy application: Composer provides drag-and-drop GUI development, as well as platform independence, and Workbench can be used to edit your Synergy code.

For more information see the “[xfNetLink Synergy Edition](#)” section of your *xfNetLink & xfServerPlus User’s Guide*. For details on making remote calls using a routine call block, see the “[Synergy Routine Call Block API](#)” chapter of the *Synergy DBL Language Reference Manual*.

## xfNetLink Java Edition

xfNetLink Java is a Java client for xfServerPlus that works in conjunction with the Java programming language. Java is an interpreted language and is supported on a wide variety of platforms, including Windows, UNIX, and OpenVMS. Using xfNetLink Java, Synergy business logic can be accessed from any Java-capable environment, including Java applications, JavaServer Pages, and Java applets in web pages. (We discuss two of these options below.) Together, xfNetLink Java and xfServerPlus handle the creation of a connection between the client machine and your Synergy machine, as well as the translation of data from Java to Synergy and back to Java.

The xfNetLink Java tools enable you to create a Java JAR file that references your Synergy methods in the SMC. If you're developing on Windows, you can create a JAR file from within Workbench. The JAR file presents a familiar interface for Java developers and can be used in a Java application, JSP application, or any other Java environment.

### Java application

Using a Java application, you can create a two-tiered solution that consists of a Java application running on the client and accessing Synergy logic on a remote Synergy server. (See [figure 9-1](#).) The Java runtime must be deployed on the client.

### JSP

JavaServer Pages are a combination of HTML and programming code written in JavaScript and Java. When a user's browser requests a JSP page, the web server executes the embedded program and returns a pure HTML page to the browser. Using JSP provides you with a three-tier distributed system, which includes an end-user machine running a web browser, a web server where xfNetLink and your JSP pages are located, and a Synergy server. (See [figure 9-2](#).) JSP works with many Windows and UNIX web servers. A servlet container for the web server is required.

Refer to the "[xfNetLink Java Edition](#)" section of your *xfNetLink & xfServerPlus User's Guide* for more information.

## xfNetLink .NET Edition

xfNetLink .NET, in conjunction with Microsoft's .NET Framework SDK, enables you to create a .NET client for xfServerPlus. .NET is a multi-faceted technology that provides numerous solutions. See the Microsoft website or one of the many third-party resources available for detailed information about .NET.

Using the component generation tools in xfNetLink .NET, you can create a Synergy .NET assembly that references Synergy methods defined in the SMC. (These tools can be accessed from within Workbench or from the command line.) The assembly can be used in any .NET environment to call routines residing on the Synergy server. For example, the client might be a Windows application written in a .NET-capable language such as C# or Visual Basic .NET, or a web application that uses ASP.NET, or a web service. We discuss a few of these options below. The

## Accessing Logic Remotely with xfServerPlus

### What Are xfServerPlus and xfNetLink?

.NET redistributable (i.e., the runtime, **dotnetredist.exe**) must always be deployed on the Windows client machine. Although .NET is a Microsoft solution, your Synergy routines can reside on any supported Synergy platform.

### Visual Basic .NET

Visual Basic .NET (VB.NET) is a Windows front-end development tool that enables you to write applications in the Visual Basic .NET language. While VB.NET is similar to Visual Basic, Microsoft has made significant changes. (See the Microsoft website for details.) Using VB.NET provides you with a two-tier solution: a VB.NET desktop application on a Windows client accessing Synergy logic residing on a remote Synergy server. (See [figure 9-1](#).)

### ASP.NET

Active Server Pages .NET are a combination of HTML coding and scripting language. For ASP.NET that language can be any Common Language Runtime-compliant language; the most commonly used languages are C# and VB.NET. Using ASP.NET enables you to create a three-tier distributed system, which includes an end-user machine running a web browser, a web server where xfNetLink and your ASP.NET pages are located, and a Synergy server. (See [figure 9-2](#).) ASP.NET requires a Windows web server running Microsoft IIS.

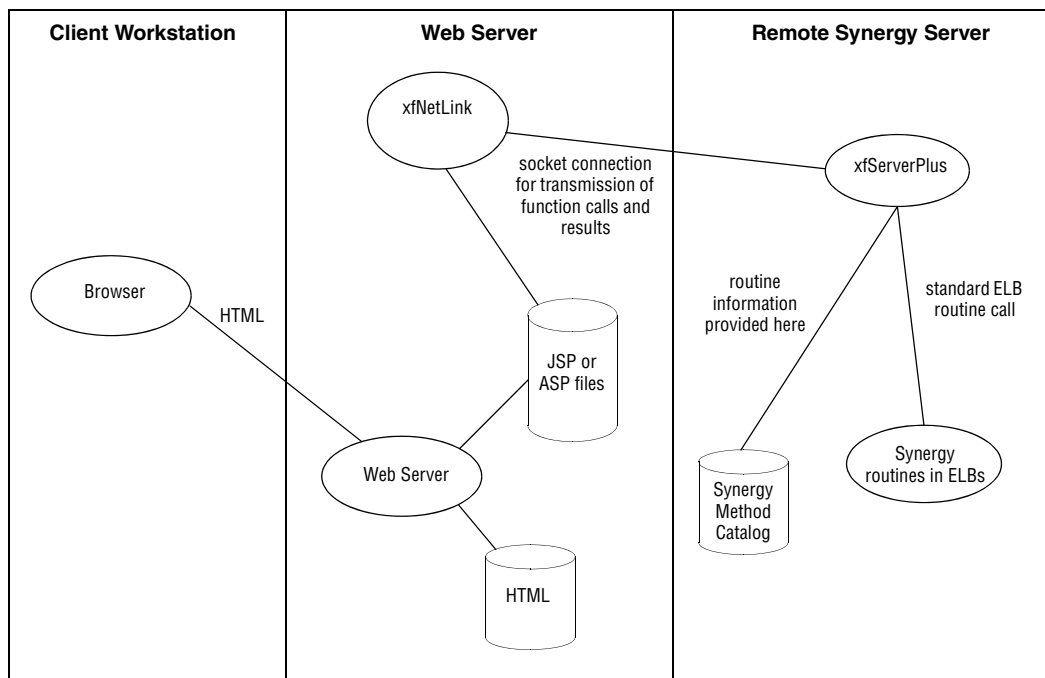


Figure 9-2. xfNetLink and xfServerPlus in a three-tier configuration.



#### Web services

Web services are business components that provide functionality to a web or desktop application. They serve as “black boxes”: callers use the API that you publish and don’t need to know anything about the inner workings of the component. Web services provide you with discreet, reusable components. They are easily upgraded and can be called by multiple applications. Because web services are a .NET solution, you can write them in any language that supports .NET; however, they can be deployed only on Windows servers running Microsoft IIS.

A web service is not a complete solution. It is simply a component that is called by another application. Web services must be published on the web so that anyone can use them, which requires that you establish and adhere to strict security protocols.

See the “[xfNetLink .NET Edition](#)” section of your *xfNetLink & xfServerPlus User’s Guide* for detailed instructions on using xfNetLink .NET.

## Design Considerations

Regardless of which edition of xfNetLink you are using, the only way to take advantage of a distributed processing environment is to use modular, encapsulated code that can be distributed independently in a software system. If you are designing an application from the ground up, it makes sense to think in terms of completely modularizing your entire system right from the start. However, in many cases, the goal is to improve an existing application or to make several routines accessible from the Web. This makes things more complex, and the task may seem overwhelming.

The first step is to think about where you most need the benefits of modularization. What pieces of functionality do you want to make available on an intranet or the Web? What routines can you centralize into a utilities library that can be used by many or all of your applications? Do you want to have multiple user interfaces—perhaps a desktop user interface and a web interface?

In a distributed application, processing is divided into three layers:

- ▶ User interface processing occurs on the end user's machine.
- ▶ Business logic processing occurs on the server system. When you're building a system with xfServerPlus and xfNetLink, this is the xfServerPlus machine.
- ▶ Database processing occurs on the database server—the machine (or machines) where the data resides.

Some routines control what the user sees (for example, forms, error messages, and prompts) and other routines handle data access, calculations, validations, report generation, and so forth. When you want to display the result of a piece of application logic in the user interface, the user interface logic can call a function that performs the required task and then display the result.

For example, if you wanted to perform a log-in operation in a distributed processing environment, you would probably separate the processing layers as follows:

User interface processing:

- ▶ Draw a log-in screen.
- ▶ Perform field input.
- ▶ Validate field contents and write error messages to the screen.

Business logic processing:

- ▶ Validate the username.
- ▶ Validate that the password is correct for the specified username.

Database processing:

- ▶ Read user information from the database.

You will likely need to modify your Synergy server code before it can work effectively in a distributed environment. Once you identify the areas where modularization is needed, you can start redesigning the required functionality with your objectives in mind.

- ▶ If supporting multiple user interfaces is your priority, the first step is separating the user interface from the application logic.
- ▶ If you want to support multiple databases, the first step is separating the file access from the other application logic.
- ▶ If you plan to make your application available to customers on the Web, you will first need to modularize the system's application logic so that it can be called remotely from the user's browser. Another option is to write a few modular routines that perform the functions you want customers to have access to, and then integrate them into your system at a later date.

As with any other significant code modification, you can handle the move to modularity in chunks, slowly moving your system to a more modular state. Keep in mind that you don't need to modularize *all* of your code—just what needs to be called remotely.

## Separating the user interface from application logic

UI Toolkit, which supports event-style programming, effectively separates much of the user interface from the data management. However, Toolkit event loops are candidates for revision if you are planning to support multiple user interfaces. When you process user events using `arrive` and `leave` methods or `break` processing, be sure to handle those events with a call to a function in an ELB. This function must return a result that your user interface logic processes.

Error messages are an often overlooked part of the user interface. Your routines should return a success or failure status, and the user interface code should handle the actual generation of the error message on the screen. See [“Handling errors” on page 9-10](#) for additional ideas on error handling.

## Separating data access from application logic

Separating the database from the application logic involves writing routines to handle all file I/O. This is probably the most commonly modularized area in existing applications because it hides the details of file organization, data access, and so on from the user of the routine. Since file structures change frequently, the benefits of writing routines to handle file I/O have been obvious for a long time. Again, be sure to check carefully for error messages, data validations, or other functionality that belongs in other layers of the distributed client/server system or web application model.

## Using ELBs or shared images

Executable libraries (ELBs) and shared images (on OpenVMS) provide a means of storing related routines in a common library that can be called by multiple Synergy programs. When you build a distributed system with xfServerPlus and xfNetLink, your Synergy routines *must* be contained in an ELB or shared image and placed on the xfServerPlus machine.

The ideal approach to modularizing your system is to create a set of routines with defined interfaces (formal argument lists) and then group related routines into ELBs. For example, you might group your utility routines (such as string handling and date calculations) into one ELB, your order entry application logic into another ELB, and your order entry data access into yet another ELB. These routines can be called by any application that can make use of them, particularly if you do not maintain global or common data inside the ELBs. With remote execution of ELBs, you can position each ELB where the application that uses it is located.

See the “[Preparing Your Synergy Server Code](#)” chapter of the *xfNetLink & xfServerPlus User’s Guide* for more information on using ELBs and shared images with xfServerPlus.

## Handling errors

Because a distributed computing system has multiple points of failure, it is more complex to debug. Therefore, you should design your application with failure in mind.

For robust server-side code,

- ▶ trap for all possible errors on the server side.
- ▶ test your logic locally before calling it remotely. After you have modularized your Synergy code, you can test it by using the test skeleton generator utility to generate test code from your SMC definitions. It is much easier to debug your code and find problems at this point than it will be when you are calling it remotely. For more information about the test skeleton generator utility, see “[Testing Your Synergy Code](#)” in the “Preparing Your Synergy Server Code” chapter of the *xfNetLink & xfServerPlus User’s Guide*.
- ▶ return status information, in the form of status codes, as well as results, rather than displaying an error message. If you are modifying existing routines, you may want to convert them to ^VAL functions to do this, which enables you to return a status value without altering your argument list. See “[^VAL functions](#)” in the “Understanding Routines” chapter of the *Synergy DBL Language Reference Manual*.

For robust client-side code, write your client-side code to check for errors (both xfServerPlus errors and errors from your client code).

## **Guidelines to improving performance and resilience**

- ▶ Minimize the number of trips to the server.
- ▶ Minimize expensive operations such as starting your xfServerPlus connection.
- ▶ Plan for multiple points of failure.
- ▶ When determining what to include in your client-side script, keep in mind that client-side script can be edited in a web browser or even disabled by the user. Avoid including business logic that you don't want the user to tweak.
- ▶ Favor client-side processing over server-side processing for simple field-level validations that don't require server-side data.
- ▶ Take into account that information must travel back and forth across the wire, especially for web applications. For example, you should limit the number of records displayed on the user's browser, or display them in reasonably-sized chunks, rather than sending hundreds of records.



# Glossary

<b>access key</b>	A true key in a database file, which is used to specify relationships between files.
<b>ActiveX</b>	A set of technologies developed by Microsoft that provides the ability to develop active, executable objects for Windows applications and websites.
<b>alias</b>	A name that represents a directory path or a section of code. A directory alias expands to a complete directory path, which means you don't have to type the entire path when prompted for a filename or a directory. An extension-specific alias expands to the syntax for a routine or to an entire method or processing loop.
<b>API</b>	Short for Application Programming Interface, which is a set of subroutines and functions used to communicate between different parts of a system. This is the level of the system that the application programmer uses. For example, UI Toolkit provides an API that can be called by a Synergy program; this API is the interface between the Synergy program and UI Toolkit.
<b>Application window</b>	An area in Composer in which you can design your user interface.
<b>arrive method</b>	A subroutine called to perform special processing before an input field is processed.
<b>assembly</b>	A collection of all files required for a .NET executable or class library. An assembly is what results when Synergy .NET source files are compiled, and it can have the extension <b>.exe</b> or <b>.dll</b> .
<b>attribute</b>	A characteristic of an object. For example, width is an attribute of a window.
<b>bounds checking</b>	A feature of the Synergy debugger that identifies situations in which data is being stored into structures that are referenced beyond the "bounds" of their normal definition.
<b>break field</b>	A sort field on which a report break and possibly a page break is set in ReportWriter.

<b>check box</b>	An input field displayed as a small box with accompanying text to its right. When a check box is selected, an “x” is displayed in the box.
<b>client</b>	A computer hosting a client application, which is an application that requests services or access to data from another computer.
<b>client/server system</b>	A computer network in which one or more computers act as “clients,” requesting services or access to data, and one or more computers act as “servers,” processing the clients’ requests.
<b>command button</b>	The rectangular button in a dialog box that carries out a command or initiates an action (for example, OK, Help, or Cancel).
<b>Common Intermediate Language (CIL)</b>	CIL is a processor- and platform-independent set of instructions that is executable in any environment that supports a CLR. During compilation, Synergy .NET source code is translated into CIL code. This was formerly known as Microsoft Intermediate Language (MSIL).
<b>Common Language Runtime (CLR)</b>	The CLR is the .NET Framework component that manages program execution for .NET. The Microsoft .NET Framework has a CLR for Windows platforms, and Mono has a CLR for a number of platforms, including Android and iOS.
<b>compile-time definition</b>	An expression that can be completely evaluated at compile time.
<b>compiler directive</b>	A statement that instructs the Synergy compiler and is evaluated only when a program is compiled.
<b>compiling</b>	The process of translating source files containing Synergy DBL statements into object files containing system-level information.
<b>component</b>	One or more related methods grouped together as a named entity.
<b>context</b>	The next input field to process OR whatever object your mouse pointer is over when you click to access the context menu in Composer.
<b>context-sensitive help</b>	“What is it?” and “What can I do with it?” information about the current context. For example, if the cursor is in an input field, context-sensitive help would provide information about what to enter in that field.
<b>Control Bar</b>	The Composer window that contains Composer’s menu bar and toolbars.



<b>cross-reference file</b>	A file that contains name link associations, which ReportWriter uses to provide access to related files and data structures.
<b>data division</b>	The part of a Synergy program in which you define the data structures that will be used in the program.
<b>display method</b>	A subroutine called whenever the associated field is about to be displayed by Toolkit.
<b>distributed application</b>	Software whose tasks are split (i.e., distributed) between client and server machines.
<b>DLL</b>	Short for Dynamic Link Library, which is a library file containing API routines. You can access these libraries at runtime without explicitly linking them to an application. Most (third-party) Windows applications provide and use their own DLLs.
<b>drill method</b>	A subroutine called when the user clicks a drilldown button (on Windows) or selects a drilldown menu entry (in non-Windows environments). A drill method is primarily used to look up additional information or display a dialog box.
<b>dynamic memory</b>	Memory that is allocated as the program requires it. The system allocates the memory and returns a pointer to the base of the memory segment.
<b>edit format method</b>	A subroutine called by Toolkit whenever the text in the field is being formatted for editing purposes.
<b>ELB</b>	See <a href="#">executable library</a> .
<b>environment</b>	A program state that consists of the current definition of the screen and any terminal settings.
<b>environment variable</b>	An abbreviation defined at the operating system level for a device, directory, or path name. Also called a logical.
<b>escape sequence</b>	The set of characters emitted by a keyboard when a key is pressed.
<b>executable library</b>	A group of subroutine executable modules in a single file created by the Synergy linker.
<b>file stack</b>	A temporary file management system consisting of a single physical file that contains multiple logical scratch files accessed in a stack manner.

<b>font</b>	A design for a set of characters, comprised of typeface, point size, width, and spacing. For example, within the Helvetica typeface there are many different fonts (10-point italic, 12-point bold, and so forth).
<b>format</b>	The way data will be displayed in an input field or the way a field will be displayed in a report.
<b>function code</b>	The internal value assigned by UI Toolkit that associates a keyboard's escape sequences with menu entries.
<b>function name</b>	The name of a function code. For example, on a PC, the default name of Function 1 is "F1."
<b>Global Assembly Cache (GAC)</b>	The GAC is a machine-wide central repository of .NET assemblies that are shared by multiple applications on a single machine.
<b>global format</b>	A repository format that can be used by a field definition in any structure.
<b>handle</b>	A pointer to the base of the memory segment.
<b>HTML</b>	HyperText Markup Language, the authoring language used to create documents on the World Wide Web.
<b>hyperlink method</b>	A subroutine that's called when the user clicks on an input field prompt.
<b>information line</b>	A single line at the bottom of the screen body that is used to display messages and general information.
<b>input field</b>	A window field associated with a set of characteristics that defines how terminal input and display are to occur.
<b>input information</b>	Determines how input must be entered and how it will be displayed and interpreted.
<b>input set</b>	A list of one or more fields in an input window. It defines the default order for processing fields.
<b>input window</b>	A window that contains one or more input fields.
<b>integer data</b>	A byte-oriented, binary representation of a signed whole number.
<b>Java</b>	An interpreted language used to write applications and applets.

<b>JavaServer Pages (JSP)</b>	A web page that combines HTML and programming code written in JavaScript. When a browser requests a JavaServer Page, the web server executes the embedded program, allowing the web page to interact with databases and other programs.
<b>key</b>	The portion of the data record that identifies the record and is used to access it.
<b>key map</b>	A record that defines the correspondence between the function keys or other special keys on the user's keyboard and the functions they perform.
<b>key map file</b>	A file that contains the escape sequences for each defined terminal type.
<b>leave method</b>	A subroutine called to perform additional processing after an input field is processed.
<b>License Manager</b>	A set of utilities that controls the installation and use of Synergy/DE products.
<b>linking</b>	The process that combines one or more routines into an executable program or library.
<b>list</b>	A collection of identically formatted items.
<b>list class</b>	A nonvisual entity that defines the characteristics for an entire list.
<b>load method</b>	A subroutine called by the list processor each time it needs a new item.
<b>menu entry name</b>	The internal name for a menu entry.
<b>method</b>	A program that you write and that UI Toolkit or ReportWriter calls when necessary.
<b>method information</b>	Specifies any arrive, leave, drill, or hyperlink method subroutine associated with a field.
<b>modularization</b>	A programming technique that requires code to be an isolated functional unit with a well-defined, published interface (i.e., an argument list).
<b>Mono</b>	An implementation of the .NET Framework that runs on a number of platforms, including Android devices, iOS devices, and Linux machines.
<b>name link</b>	An association between fields in different structures that is used by ReportWriter to access related files.

<b>.NET Framework</b>	A software framework that consists of a Common Language Runtime (CLR) and a base class library named Framework Class Library (FCL).
<b>.NET Native</b>	A build feature for Universal Windows Platform (UWP) that generates native binaries from managed IL binaries. If you build a UWP app with .NET Native, the build takes longer, but the final result is a native UWP binary, which performs better than a managed IL binary and has no dependencies on .NET runtimes installed on desktop systems. If you build without .NET Native, the result is a managed IL binary, which can be useful for development and initial testing because it takes less time to compile.
<b>object</b>	Any window, list class, menu column, window field, input field, selection window entry, menu entry, text, line, box, or button.
<b>object library</b>	A group of subroutine object modules in a single file created with the Synergy librarian. Object libraries are linked into an executable file by the Synergy linker.
<b>Object Manager</b>	The Composer window that displays a visual representation of the project file, script file(s), and user interface object hierarchy.
<b>OLB</b>	See <a href="#">object library</a> .
<b>palette entry</b>	One in a set of colors (or fonts) available to Synergy programs.
<b>portable class library (PCL)</b>	A type of library assembly that can target some or all platforms supported by Synergy .NET.
<b>procedure division</b>	The part of a routine that contains the executable statements and defines the processing algorithms.
<b>project</b>	A collection of one or more related files (for example, all of the files for a particular application) and the build parameters that operate on those files.
<b>Properties window</b>	The Composer window that contains a list of design object attributes, followed by the property, or value, for each attribute.
<b>property</b>	The value of an attribute of an object.
<b>quick-select character</b>	A single character that accesses a menu column, menu entry, or selection window entry, or a key that when pressed simultaneously with the ALT key accesses a command button in a dialog box. The quick-select character is underlined on a menu or list.

<b>radio button</b>	An input field displayed as a set of round buttons. The user selects one button to make a choice from among several items.
<b>relation</b>	An association between structures that enables you to link the keys of one structure with the keys of the other structure.
<b>relational operator</b>	An operator that compares two operands (equal to, not equal to, greater than, less than, greater than or equal to, or less than or equal to).
<b>rendition</b>	A set of attributes and color of a screen display item. Rendition attributes are boldface, blinking, reverse video, and underscore.
<b>rendition scheme</b>	A record that defines the display attributes and colors for your screen.
<b>Repository</b>	The Synergy/DE application that orders and defines your data structures, files, and attributes.
<b>repository</b>	The location where your data definitions are stored.
<b>reserved entry</b>	One of a class of menu entries that is handled automatically by UI Toolkit and that is used to activate many of the standard Toolkit functions.
<b>runtime terminal binding</b>	The process that binds the keyboard to the shortcuts at runtime instead of during script processing.
<b>script file</b>	An editable text file that contains special script commands to define and control user interface objects and their characteristics.
<b>selection list</b>	A pull-down list of options for an input field.
<b>server</b>	A computer that processes client requests.
<b>shared image</b>	The functionality of an executable library on OpenVMS.
<b>shortcut</b>	A key or key sequence that is associated with a specific menu column entry. A shortcut provides a quick way to access a menu item, bypassing the standard menu entry selection method.
<b>static handle</b>	A persistent memory handle that does not get released when the activation level of the generating routine is exited.
<b>string relational operator</b>	An operator (equal to, not equal to, greater than, less than, greater than or equal to, less than or equal to) that compares two alpha operands for the length of both.

<b>structure</b>	An entire record definition, or the combination of field and key characteristics.
<b>structure-specific format</b>	A repository format that is defined for a particular structure and can only be used by the fields in that structure.
<b>Synergy UI Toolkit Control Panel</b>	A visual tool that enables you to customize message text, screen renditions, and key mapping.
<b>Synergy Method Catalog (SMC)</b>	Identifies the Synergy routines that you have prepared for remote calling. The SMC includes information such as the function or subroutine name, the ELB or shared image it is stored in, and the type and length of its parameters.
<b>tab method</b>	A subroutine called to process a tab in a dialog box.
<b>tab set</b>	A set of toolbar buttons that is accessed by clicking on the tab that extends above the top of the toolbar OR a group of tabs that are placed simultaneously, in an organized stack, in a dialog box.
<b>tabbed dialog</b>	A dialog box that is organized into more than one screen of fields, prompts, and buttons. Each screen is accessed by clicking the tab at the top of the screen.
<b>tag file</b>	A database that stores the information displayed for a routine when the user requests function help.
<b>template</b>	In Workbench, a method of expanding syntax automatically by generating predefined code into the editor. In Repository, a set of field characteristics that can be assigned to one or more field definitions or templates.
<b>text window</b>	A special window that contains variable-length, editable text.
<b>token</b>	A keyword that represents and is replaced with a specific name.
<b>Universal Windows Platform (UWP)</b>	An application architecture that enables applications that target it to run as Metro-style apps on any system or device with Windows 10 or Windows 10 Mobile. UWP is built into these operating systems and is a further development of the Windows Runtime (WinRT) model.
<b>user-overloadable subroutine</b>	A subroutine that you write and register so that UI Toolkit calls it automatically at the appropriate time. If you do not register your routine, Toolkit will use its default implementation.
<b>validation information</b>	Defines what input is considered valid.

<b>volatile handle</b>	A dynamic memory handle that goes away along with the routine activation level.
<b>window library</b>	An ISAM file with a specific format to which Synergy/DE windows are saved.
<b>workspace</b>	A group of related projects in Workbench.





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