
Introducing AppDev Studio

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Welcome to AppDev Studio

Welcome to AppDev Studio, the first thin-client applications development solution that focuses specifically on information delivery. In today's competitive marketplace, organizations face the challenge of delivering information in a form that supports successful decision making. Web-enabled applications can increase users' access to strategic data and can provide other benefits such as a lower cost per user, reduced maintenance costs, and increased use of resources. But even with these benefits, organizations still have to convert large amounts of raw data into meaningful information before it can be useful to users. Data is just data, and today's knowledge workers demand more.

That's where AppDev Studio fits in. AppDev Studio is a complete, stand-alone development environment from SAS, the industry leader in information delivery. This integrated suite of development tools provides the power you need for building Web-based applications that use CGI and HTML, Java servlets and JavaServer Pages technology, or sophisticated Java applications and applets to access the information-delivery capabilities of SAS software. And that access enables you to take advantage of the SAS System for decision support, data visualization, data mining, statistical analysis, and reporting — all of which make it easier to turn those stores of data into knowledge for your organization.

About This Book

Just as AppDev Studio and SAS software combine to support successful decision making, the goal of this book is to help you make effective decisions about the most appropriate technology to use in your organization's environment. The book is designed to get you started with selecting a technological approach to information delivery and to help you understand the benefits and implications of that particular technology.

The remaining sections in this introductory chapter describe the front-end, communication, and back-end components that are part of AppDev Studio. This chapter also includes hardware and software requirements and a list of additional resources to help you learn more about what you can do with AppDev Studio.

Chapter 2 provides an overview of each technology that you can use to take advantage of SAS software in a thin-client or Web-enabled environment. Each section also includes a description of the development skills that are required for using the technology, scenarios where it makes the most sense to use the technology, and one or more short examples.

Chapter 3 describes the basic deployment issues that surround each technology. This chapter will answer many of your questions about implementing a particular technology, and it explains how that implementation might involve SAS software on a server.

The appendix provides a detailed guide to the AppDev Studio Middleware Server, a component that helps scale applications for enterprise-wide access to SAS servers.

Overview of AppDev Studio

AppDev Studio bundles all the software products that you need for developing client/server and *n*-tiered Web applications on your Windows PC. Each of these products can be categorized into one of three groups, depending on its purpose.

Category	Products	Purpose
Front-end Components	webAF, webEIS	Used to create Java-based thin-client applications that take advantage of the power of the SAS server on the back end.
Communication Components	SAS/IntrNet (including Application Dispatcher and htmSQL), SAS Integration Technologies, SAS/CONNECT and SAS/SHARE, Middleware Server	Used to establish and/or manage communication and data sharing between clients (such as a browser or a webAF or webEIS application) and servers.
Back-end Components	Base SAS, SAS/AF, SAS/EIS, SAS/FSP, SAS/MDDB Server, SAS/SHARE, SAS/GRAPH	Used to provide specific functionality in your client/server applications. Base SAS software and SAS/IntrNet software are required on the server, and the other products are dependent on the requirements of your application.

With AppDev Studio, your applications can take advantage of the following Web-enabled technologies:

- **Common Gateway Interface (CGI) Support.** The CGI support that is included with AppDev Studio enables your Web server to communicate with a SAS application or data server without requiring any base-level CGI programming. Your thin-client applications can use the Application Dispatcher to access SAS programs on the server and can send the results back to a Web browser. You can also use htmSQL to implement dynamic SQL queries for formatting data and displaying results in a browser.
- **Java Development.** With easy-to-use wizards and drag-and-drop interfaces, webAF provides a complete Java development environment in which you can build Java applets, applications, servlets, and JavaServer Pages that can instantly connect to a SAS server. You can add access to SAS/AF components, SAS tables, and OLAP engines by using a library of over 100 ready-to-use InformationBeans (JavaBeans that use the data access, computational, and analytical features of SAS software).
- **OLAP Reporting.** You can deliver robust applications for online analytical processing (OLAP) reporting without writing a single line of code. By using the drag-and-drop environment of webEIS, business analysts can build their own

Web-based Java reports quickly and easily. They can access data, drill down on areas of interest, and employ a variety of reporting styles. You can use webEIS software to deploy OLAP applications as applets or JavaServer Pages. Users can also take advantage of the MDDB Report Viewer, a pre-built application that enables CGI/HTML-based views of multidimensional databases (MDDBs).

The advantages that AppDev Studio provides go beyond Web-enabled applications development. You can build applications quickly and easily without connecting to remote servers, tying up production resources, or moving files back and forth across your network. You can take advantage of code-free reporting and pre-built applications. Or you can develop sophisticated applications that use object-oriented development techniques on both the client and the server. Most importantly, you can develop what your users need to get the most out of SAS software.

Front-End Components

webAF Software

webAF software is an integrated visual programming environment that enables you to rapidly build Java applications, applets, servlets, and classes using a drag-and-drop object-oriented interface that helps reduce the amount of programming needed.

webAF software helps you build applications that are easy to manage, and which instantly connect to SAS software. Support for the creation and debugging of servlets and JavaServer Pages is also provided. webAF software's component-based visual development environment provides easy access to SAS software from Java classes, transparent access to SAS/AF objects, access to tables and MDDBs, and access to SAS computing power through procedure submissions. With webAF software, you have

- easy access to enterprise-wide information over the Web. Use webAF software to create user-friendly, Java-based applications that have simple access to the full capabilities of SAS software — from data warehousing to decision support. webAF also facilitates seamless access to a wide range of data sources, including major database management systems (Oracle, SYBASE, Informix, DB2) on all major operating systems, including HP-UX, Solaris, AIX/6000, COMPAQ Tru64 UNIX, Windows 95, Windows 98, Windows 2000, Windows NT, and (with SAS Version 8) OS/390.
- rapid application development and instant SAS connections. With webAF, you can avoid rewriting code for various platforms. Instead, you can drag the pre-packaged SAS components that are provided by webAF to your application to connect to the full capabilities of SAS software. You can also reuse existing code to create custom objects. Best of all, the objects that you create with webAF are functionally identical on any platform.
- centralized application management. webAF software's unique *n*-tiered environment sends requests to the most appropriate SAS server, eliminating unnecessary server sessions and the time-consuming tasks of managing applications across multiple platforms and networks. Java programs that are built

with webAF software are easily distributed, updated, and managed across the Web from one central location.

- the ability to build JavaBeans-compliant proxies to connect to remote SAS/AF objects running on a SAS server. The same ability enables you to build connections to remote objects through CORBA and Remote Method Invocation (RMI). You can use the Data Wizard to build access to remote data tables.
- integrated visual development with 100% Pure Java, and complete JDBC and JavaBean support.
- industry-standard GUIs, which reduce training costs and add consistency to your organization's information access.

webAF software creates 100% Pure Java applets and applications — without hidden tags or macros — so it is easy to integrate code from other applications development tools. webAF software also integrates Java-based applications that are not associated with SAS, all within a simple point-and-click visual development environment.

webAF also provides support for developing Java servlets and JavaServer Pages to build Java 2 Platform, Enterprise Edition-compliant Web applications.

webAF features include

- a visual drag-and-drop application builder
- 100% Pure Java source-code generation
- comprehensive support for JavaBeans
- a rich set of JavaBeans-compliant components
- a GUI-based class editor
- a source-code editor and debugger
- project, event, and data wizards to simplify the development process
- full support for standard Java layout managers
- support for integrated development and debugging of servlets and JavaServer Pages
- a visual page builder for JavaServer Pages
- the SAS Custom Tag Library that adds XML tag extensions for JavaServer Page (JSP) development
- intelligent, user-customizable packaging support that writes to JAR files
- access to remote SAS servers.

webEIS Software

webEIS software is an Online Analytical Processing (OLAP) application for the Web. It enables users to create interactive documents quickly and easily and then to publish those documents on the Web as Java applets or as JavaServer Pages. With webEIS, powerful decision-support capabilities are combined with a friendly, easy-to-use environment.

OLAP documents are produced through an interface that provides a high level of user interaction. An easy-to-use, drag-and-drop environment enables business analysts to build their own Web-based documents for sharing and viewing information. They can access data, drill down on areas of interest, and enjoy a variety of reporting styles. Data that is stored in multidimensional data structures is viewed and navigated with a familiar browser interface such as Microsoft Internet Explorer or Netscape.

Developers can use webEIS to create customized OLAP viewer InformationBeans, which are JavaBeans that take advantage of the advanced data access and decision-support functionality of SAS software. In addition, developers can reuse InformationBeans that are created by webEIS in future Java applets or applications. This results in shorter development cycles and more time spent on strategic projects.

In short, webEIS provides

- rapid, code-free creation of Java OLAP documents
- easy access to enterprise-wide information over the Web
- a fully customizable document design
- an industry-standard GUI
- bookmarking to enable collaboration
- support for e-mail and printing from Java-based documents
- centralized data management and distributed data access
- the ability to save documents as JavaServer Pages for deployment in Web applications.

Communication Components

AppDev Studio communication components make it possible to access the computing power of the SAS System, share SAS sessions, and connect to SAS servers.

SAS/IntrNet software provides the underlying functionality that is necessary to connect to SAS servers. You must choose whether to connect to a SAS server using the spawner that is associated with either SAS/CONNECT software or SAS Integration Technologies software.

SAS/IntrNet Software

SAS/IntrNet software is a powerful set of CGI and Java tools that enable you to analyze and report on data, using the proven functionality of SAS software.

SAS/IntrNet software helps organizations

- share information with anyone who has a Web browser
- build and distribute applications via the Internet
- deploy sophisticated applications across the Web.

You might need to use different pieces of SAS/IntrNet software depending on the AppDev Studio technology that you use. For example, if you create CGI applications, then you might need to use the Application Dispatcher and to place the Application Dispatcher Broker on your Web server. You can also install htmSQL on your Web server to perform SQL queries that use a CGI tool. If you create Java applications, then you might need to use the SAS/SHARE driver for JDBC or the SAS/CONNECT driver for Java. You might also deploy one of the working applications that are

shipped with SAS/IntrNet, such as the MDDB Report Viewer, which is based on HTML and CGI.

SAS/CONNECT Software

SAS/CONNECT software is a SAS client/server tool set. SAS/CONNECT gives users and applications developers the ability to manage, access, and process data in a distributed client/server environment.

In SAS/IntrNet applications that provide remote access to the computing power of the SAS System, SAS/IntrNet software sometimes uses a SAS/CONNECT server to provide these services. A SAS/CONNECT server is a process that provides single-user access to a SAS session for the purpose of accessing, updating, and analyzing data through SQL statements and SAS procedures.

Java programs can use the SAS/CONNECT driver for Java classes to start a SAS/CONNECT session on the server machine and to establish a connection to that session. The applet or servlet can then submit SAS statements and retrieve the log lines and output that are generated by those statements.

Note: SAS/CONNECT software is required in order to connect to SAS in a production environment. If you plan to connect to SAS using the Integrated Object Model (IOM), then SAS/CONNECT software is not required, but SAS Integration Technologies software is required. △

IOM enables clients other than SAS to access and use SAS features programmatically. IOM is supplied with SAS Integration Technologies software.

SAS Integration Technologies Software

SAS Integration Technologies software enables you to leverage the power of SAS software within your portfolio of Web enterprise applications. Enterprise integration is accomplished when you leverage technology standards and business strategies to create smaller modules that are used and reused within your organization. These smaller, more flexible modules communicate with each other as well as with your existing applications in disparate operating environments.

AppDev Studio takes advantage of the SAS Integration Technologies infrastructure by providing access to Integrated Object Model (IOM) servers. IOM provides distributed object interfaces for conventional SAS features. This enables you to write applets, stand-alone applications, servlets, JavaServer Pages, and even Enterprise JavaBeans that interact with IOM servers. By supporting industry standards like CORBA and Java Database Connectivity (JDBC), SAS Integration Technologies software enables you to develop component-based applications that integrate SAS features into your enterprise applications.

AppDev Studio Middleware Server

The AppDev Studio Middleware Server (MWS) is a middle-tier Java application that enhances the functionality of applets and applications that are developed with webAF. MWS functionality is sometimes referred to as *funneling* because it enables multiple

clients to share the same SAS session. MWS is also completely configurable, which enables you to balance server loads, to use connection caching, and to daisy-chain multiple middleware servers.

For more information about the AppDev Studio Middleware Server, see the appendix.

Back-End Components

Base SAS Software

Base SAS software provides the common functionality that is required by all other SAS software products. You can use existing DATA step programs or SAS macro programs as part of your client/server or Web-enabled application. You can also create new DATA step programs that use HTML formatting macros to speed the delivery of SAS output to other front-end components.

Additionally, base SAS software provides access to the SAS Output Delivery System (ODS), which is an easy way to produce SAS output in HTML format.

Base SAS software is also required if the server needs to execute SAS Component Language (SCL) elements.

SAS/AF Software

SAS/AF software provides the back-end strength that enables you to implement object-oriented server components. By using SAS Component Language (SCL) to take advantage of the full features of SAS software, you can build models that execute on the server.

You can then use these SAS/AF models in AppDev Studio by associating them with appropriate InformationBeans, or you can use them in conjunction with an application that sends its output through the Application Dispatcher.

You can also use SAS/AF software to develop stand-alone, full-client applications that are portable across many host platforms.

SAS/EIS Software

SAS/EIS software is a code-free, object-oriented application development facility that is used to create custom, interactive, extendable, full-client graphical user interfaces. It provides a wide variety of business reporting, data access, management, and analysis objects. EIS and OLAP applications that are developed with SAS/EIS software can be customized to individual users' needs.

If you are using AppDev Studio in conjunction with Version 6 of the SAS System, and if you want your AppDev Studio clients to use EIS objects or to read multidimensional databases (MDDBs), then SAS/EIS software is required. For example, webEIS applications commonly read MDDBs and therefore require SAS/EIS software.

With SAS Version 8, AppDev Studio applications can read MDDBs without a SAS/EIS license. However, you must have SAS/EIS software licensed on the server to read EIS objects.

SAS/FSP Software

SAS/FSP software provides server-side interactive facilities for editing and browsing SAS tables.

If you are using SAS Version 6, then some of the applications that you can build with AppDev Studio might require SAS/FSP on the SAS server for editing or modifying SAS tables.

SAS/GRAPH Software

SAS/GRAPH software, the information and presentation graphics component of the SAS System, provides graphics capabilities to produce a wide variety of business and scientific charts, plots, and maps in many colors and patterns.

The licensing of SAS/GRAPH software is optional; however, you must license SAS/GRAPH software if you want to use specific HTML formatting tools. For more information, see “HTML Formatting Tools” on page 17.

You should consider licensing SAS/GRAPH if your applications have specific graphic needs. For example, you can use SAS/GRAPH to increase the functionality that you can provide with the Application Dispatcher.

Licensing SAS/GRAPH software is also desirable if you need to perform graphical processing on the server when you build thin-client applications. For example, you can use one of the many graphical procedures to generate a GIF file that can be deployed via a Web browser, or you can stream the graphics output directly back to the Web client.

SAS/MDDB Server Software

SAS/MDDB Server software enables you to build multidimensional databases (MDDBs) without writing a single line of code. MDDBs, which are ideal for online analytical processing (OLAP), enable you to make better decisions by giving you quick, unlimited views of multiple relationships in large quantities of summarized data.

Essentially, SAS/MDDB Server software provides a pre-built application that you can use in webAF or webEIS software to provide thin-client views of MDDBs.

SAS/SHARE Software

SAS/SHARE software was created for multi-user environments such as sales management or purchasing, in which users need to update information concurrently. With SAS/SHARE, two or more users can gain concurrent access to a SAS data library, to data sets (tables) in the library, or to observations (records) in the data set.

The SAS server, a control program, coordinates all requests to ensure maximum concurrency and security.

SAS/SHARE software might be required depending on what type of thin-client applications you create with AppDev Studio. For example, SAS/SHARE software is required anytime a Java class from the SAS/SHARE driver for JDBC is used.

SAS/IntrNet software might also use a SAS/SHARE server to provide remote data services for your thin clients. A SAS/SHARE server is a process that provides multi-user access to a single SAS session for the purpose of accessing and updating data through SQL statements.

Requirements and Recommendations

Development Environment

The minimum requirements for developing enterprise applications with AppDev Studio follow:

Operating System Choices

Windows 2000 Professional Edition
 Windows NT Workstation (SP5 or later)
 Windows 98 Second Edition
 Windows 95 (with Winsock 2.0)

SAS Software Choices

SAS Version 6.12 TS065
 SAS Version 6.12 TS070
 SAS Release 8.1
 SAS Release 8.2

Hardware

Pentium II processor (200 MHz or faster)
 VGA monitor (SVGA recommended)
 CD-ROM drive
 128 MB RAM (256 MB recommended)
 500 MB hard disk space

Deployment/Production Server Environment

Web Server/Application Server

To deploy and run applications that you create with AppDev Studio, you must apply server-side updates to SAS software. The necessary SAS Release 6.12 and SAS Version 8 updates are included on the AppDev Studio installation media.

New server-side updates might become available in-between releases of AppDev Studio software. These updates, often referred to as *hot fixes*, can be downloaded from www.sas.com/products/appdev/.

The minimum Web Server/Application Server requirements follow:

Web Server	any Web server on any standard operating system that provides network access to the machine running your SAS server.
Application Server/Servlet Engine	any product that provides full support for the Servlet 2.2/JSP 1.1 standard using JRE 1.2.2 or later (required for servlets/JSPs only).
Hardware	50 MB available hard disk space.

SAS Server

SAS Software Choices	Release 6.12 (TSO65 or TSO70) Release 8.1 Release 8.2 (recommended)
Operating System Choices	Release 6.12: Windows NT, Windows 98, Windows 95, Solaris, HP-UX, Compaq Tru64, UNIX, AIX, OS/2 Release 8.1 or 8.2: any platform/operating system that is supported by SAS.
Hardware	5 MB available hard disk space (in addition to the standard hard disk space required by SAS software).

If you plan to connect to SAS using SAS/CONNECT for Java, then you must install SAS/IntrNet and SAS/CONNECT on your SAS server.

If you plan to connect to SAS using the Integrated Object Model (IOM) or any other open standard supported by SAS Integration Technologies, then you must install SAS Integration Technologies on your SAS server.

If you would like to connect to SAS using either SAS/CONNECT or SAS Integration Technologies, then you must install SAS Enterprise Integration Technologies on your SAS server.

Note: SAS Integration Technologies and SAS Enterprise Integration technologies are only available for use with SAS Release 8.2 (or later). △

For more information about deploying specific types of AppDev Studio projects, see Chapter 3, “Deployment,” on page 63.

Client Environment

The end-user computing environment in the client tier requires the following minimum standards to run applications built with AppDev Studio.

To View Applets

Operating System	any operating system that has a Web browser capable of supporting the required Java version.
Windows Web Browsers	Microsoft Internet Explorer 5.01 (or later) with Java Plug-In 1.3.0_01, Netscape Communicator 4.76 or Netscape 6.0 with Java Plug-In 1.3.0_01.
UNIX Web Browsers	any browser capable of supporting the required Java version.
Java Runtime Environment	Java 1.3.0_01.

To View Servlets and JavaServer Pages

Operating System	any operating system that has a Web browser, including WAP-enabled devices.
Web Browser	any Web browser that supports HTML 3.2 or higher. For desktop use, Microsoft Internet Explorer 5.01 (or later), Netscape Communicator 4.76 (or later), or Netscape 6.0 browsers are recommended. Some TransformationBeans provide WML-compliant output which must be viewed using WAP-enabled devices.

Additional Considerations

If you would like to use the Integrated Object Model (IOM) connectivity that is supported with AppDev Studio Version 2.0, then you must run SAS Release 8.2 in your development environment. Previous SAS software versions are not supported when using the IOM access method. Instead, these previous versions require you to use SAS/IntrNet and SAS/CONNECT software.

To run applications using SAS on a mainframe environment such as OS/390, AppDev Studio Version 2.0 requires you to run SAS Release 8.1 or 8.2 in your development environment.

Information Resources

This section describes several resources that you can use to access more information about AppDev Studio, as well as about other SAS products that are either included in the AppDev Studio suite or required by your application for server-side processing.

Online Help

You can refer to online Help for additional information about each of the main components of AppDev Studio. webAF and webEIS include detailed, task-oriented online Help. To access online Help, open the appropriate product, and then select the **Help** menu. The Help menu includes a list of commands that enable you to use online Help.

The Web tools that are included with SAS/IntrNet are also accompanied by complete online documentation. See the AppDev Studio Developer's Site that is installed with AppDev Studio for complete information.

The SAS System also provides comprehensive online Help that includes a syntax reference for base SAS procedures, functions, and statements, as well as SAS/AF class documentation and SCL syntax. To access this Help from within SAS software, select **SAS System Help** from the **Help** menu.

AppDev Studio Developer's Site

The AppDev Studio Developer's Site is designed to help you develop and implement enterprise applications that use the power of SAS software to support information delivery and decision making. The site is frequently updated with new information, including comprehensive tutorials, how-to topics, and technical papers. You can access the most current version of this site at www.sas.com/rnd/appdev/.

A snapshot of the AppDev Studio Developer's Site is installed on your local Web server when you install AppDev Studio.

Troubleshooting Information

You can find troubleshooting information on the AppDev Studio Developer's Site that is installed on your development machine. For the most up-to-date troubleshooting tips, visit www.sas.com/rnd/appdev/.

Publications

Many books that provide detailed reference information about SAS software are available through SAS, including

- SAS Component Language: Reference*
- SAS/EIS Software: Reference*
- SAS Guide to Applications Development*

- *SAS Language Reference: Dictionary*
- *SAS Macro Language: Reference*

Reference documentation for SAS Version 8 is also provided on a CD-ROM. The SAS OnlineDoc CD-ROM enables you to locate information quickly through its online table of contents, index, and full-text search facility.

See the SAS Publications Catalog for a complete listing of available documentation. This catalog is also available online at the SAS Publications Web site (www.sas.com/pubs).

Training

SAS offers a broad curriculum of instructor-based courses to help you use AppDev Studio and SAS software to meet your development goals. Instructor-based training gives you the flexibility of attending courses in training facilities across the United States and in other countries. Check with your local SAS office for availability. Courses cover a wide range of Web applications development, including

- *Developing JSP Applications Using webAF Software*
- *SAS Web Tools: Accessing MDDB Data Using webEIS Software*
- *SAS Web Tools: Advanced Dynamic Solutions Using SAS/IntrNet Software*
- *SAS Web Tools: Developing Java-Based Applications*
- *SAS Web Tools: Overview of SAS Web Technology*
- *SAS Web Tools: SAS/IntrNet Administration (V8 only)*
- *SAS Web Tools: Static and Dynamic Solutions Using SAS/IntrNet Software*
- *SAS Web Tools: Understanding Java in webAF Applications*

In addition, SAS staff can conduct on-site training. For more information about these and other courses, visit the SAS Training site at www.sas.com/training.

Consulting

SAS provides consulting services that enable your organization to get the most out of its investment in its information technology. Services include expertise in software, industry, and functional areas that are related to your immediate and future needs. Contact your local SAS office for details on the SAS consulting services that are available in your area, or visit the SAS Consulting site at www.sas.com/consulting.

Technical Support

SAS Technical Support provides a wide variety of services and resources to help you answer questions about AppDev Studio and SAS software. For detailed information, see www.sas.com/ts.

For phone support in North America, call 919-677-8008 between 9:00 a.m. and 6:00 p.m. Eastern Standard Time Monday through Friday. For e-mail support in North America, send e-mail to SAS Technical Support at support@sas.com.

For support outside of North America, contact your local sales office.