



PeopleSoft Internet Architecture

*AN OPEN ARCHITECTURE FOR INTERNET ACCESS
AND INTEGRATION*

PEOPLESOFT POSITION PAPER
JANUARY 2000

PeopleSoft Internet Architecture—An Open Architecture for Internet Access and Integration



© 2000 by PeopleSoft, Inc.
All rights reserved. Published 2000.
Printed on recycled paper.

Restricted Rights

Printed in the United States of America.

The information contained in this document is proprietary and confidential to PeopleSoft, Inc.

No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of PeopleSoft, Inc.

This document is subject to change without notice, and PeopleSoft does not warrant that the material contained in this document is error-free. If you find any problems with this document, please report them to PeopleSoft in writing.

PeopleSoft, the PeopleSoft logo, PeopleTools, PS/nVision, PeopleCode, PeopleBooks, and Red Pepper are registered trademarks, and The Vantive Corporation, *PeopleTalk*, and "Applications for eBusiness" are trademarks of PeopleSoft, Inc. All other company and product names may be trademarks of their respective owners. The information contained herein is subject to change without notice. Copyright © 2000 PeopleSoft, Inc. All rights reserved.

This document contains or may contain statements of future direction concerning possible functionality for PeopleSoft's software products and technology. All functionality and software products will be available for license and shipment from PeopleSoft only if and when generally commercially available. PeopleSoft disclaims any express or implied commitment to deliver functionality or software unless or until actual shipment of the functionality or software occurs. The statements of possible future direction are for information purposes only and PeopleSoft makes no express or implied commitments or representations concerning the timing and content of any future functionality or releases.

Document Purpose and Scope

This document provides an overview of PeopleSoft Internet Architecture and describes the PeopleSoft approach to supporting internet access and integration for applications. It is written for a technical audience that is familiar with basic internet and enterprise architecture concepts and is intended to provide the reader with a general understanding of PeopleSoft’s technology architecture. This paper contains the following sections:

Introduction	1
PeopleSoft Internet Architecture Overview.....	3
Metadata-Driven Architecture.....	5
Internet Access	8
Internet Integration	12
Support for Standard Internet Technologies.....	16

Introduction

PeopleSoft Internet Architecture, introduced with PeopleTools 8, is completely focused on the internet to provide powerful new functionality for internet-based access and integration. This next generation architecture leverages a number of internet technologies and concepts to deliver simple, ubiquitous access to PeopleSoft applications and enable the open flow of information between systems. Using PeopleSoft Internet Architecture as the foundation, customers will be able to provide a wide range of end users with access to PeopleSoft applications over the web, as well as more easily integrate their PeopleSoft applications with existing internal systems and external trading partner systems.

Internet Access

PeopleSoft Internet Architecture is a server centric, component architecture that enables secure end user access to PeopleSoft applications. Any internet enabled device, such as a web browser running on a PC or a cell phone—which uses standard internet technologies such as HTML, XML, and HTTP—can access and execute PeopleSoft Internet Applications. This functionality is primarily supported through the following internet access technologies:

- ❖ Internet Application Server
- ❖ PeopleSoft Portal
- ❖ Directory Server Integration

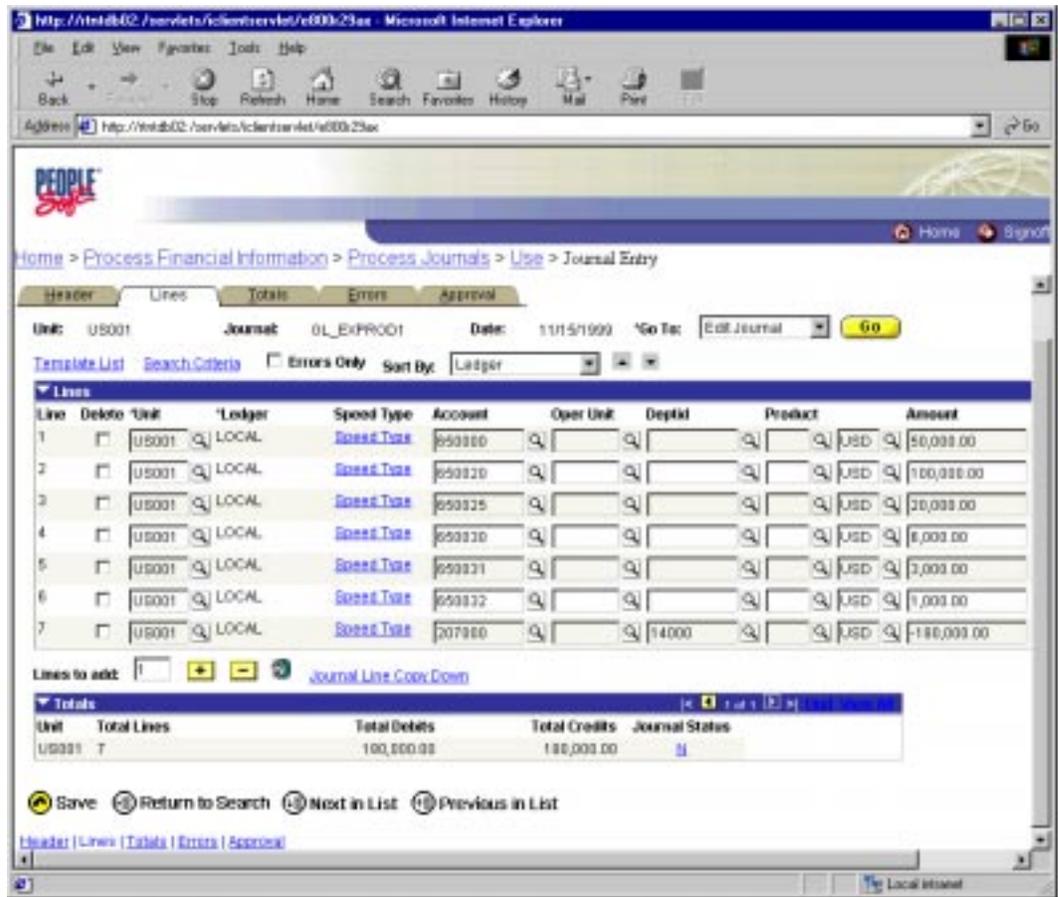


Figure 1 – Journal Entry deployed through the PeopleSoft Internet Architecture in PeopleSoft 8

Internet Integration

Discussions about internet technologies typically focus their attention on end-user access, however system-to-system integration is equally important and often considerably more complicated and costly. Fundamentally, internet computing is a platform that supports the open flow of information between systems. By leveraging ubiquitous internet technologies such as Extensible Markup Language (XML) and HyperText Transfer Protocol (HTTP), the PeopleSoft Internet Architecture delivers a set of server based technologies that supports true internet-based systems integration. These integration technologies streamline integration of PeopleSoft applications with other PeopleSoft applications, custom internal systems, eMerchants, and customer trading partner systems.

This functionality is supported through the following PeopleSoft internet technologies:

- ❖ Application Messaging
- ❖ Component Interfaces
- ❖ Business Interlinks
- ❖ Application Engine

PeopleSoft Internet Architecture Overview

PeopleSoft Internet Architecture is a completely server-based architecture. Clients to this architecture can be nearly any kind of internet access device:

- ❖ Web browser running on a PC, Macintosh, or Linux machine
- ❖ Wireless device or cell phone
- ❖ External or third-party system with XML/HTTP protocols

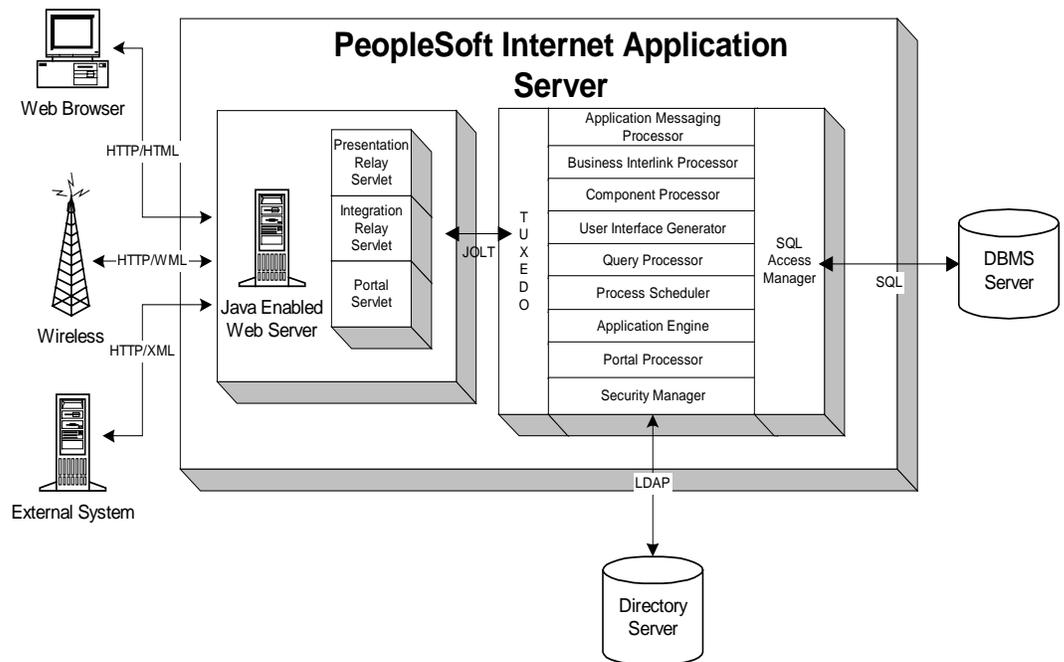


Figure 2 – PeopleSoft Internet Architecture

The remainder of this section describes the high-level functionality and interaction between the various internet architecture components in more detail.

Client Access

PeopleSoft Internet Architecture is really an architecture without a client. There are no PeopleSoft executables on the client. Thus, the client can be any internet device that uses standard internet technologies such as HTTP, HyperText Markup Language (HTML), and XML to communicate with the PeopleSoft Internet Application Server.

A web browser running on a PC is the most common internet client. The PeopleSoft Internet Application Server simply serves HTML and JavaScript to the web browser and the end user navigates through the PeopleSoft application just like navigating any other website.

A cell phone is a wireless example of an internet client that can interact with the PeopleSoft Internet Architecture. In this case, the PeopleSoft Internet Application Server serves Wireless Markup Language (WML) and WMLScript—Wireless Application Protocol (WAP) standards—to the cell phone, rendering the user interface to the end user.

An external or third-party system communicating with the PeopleSoft Internet Application Server over XML and HTTP is another example of an internet client—but this type of access falls more under system-to-system integration and is covered in a later section.

A key concept of the Internet Architecture is that there is no complex, expensive client software installation. The internet client device accessing the internet architecture already has all the software and configuration it needs. No additional software must be installed on the client for interaction with PeopleSoft applications. No Java applets, Windows .DLLs, or browser plug-ins are needed. Simple, open architecture creates easy, inexpensive access and is a big reason why the internet has been such an enormous, fast-growing success.

Internet Application Server

The Internet Application Server tier is the heart of PeopleSoft Internet Architecture. It leverages several technologies from BEA Systems (Tuxedo transaction monitor and JOLT), but the vast majority of components are delivered by PeopleTools development to support internet access and integration.

1. **Java Enabled Web Server**—Commercially available web servers that support Java Servlet execution can be used to provide the execution environment for the PeopleSoft Presentation Relay Servlet, Integration Relay Servlet, and Portal Servlet.
2. **Presentation Relay Servlet**—A PeopleTools Java Servlet that handles all inbound and outbound HTTP requests for PeopleSoft transactions and queries. This very thin servlet acts as a relay between the client device and the core back-end services. It receives and serves HTML, XML, and WML requests over HTTP and maps the data in these requests to the Component Processor and Query Processor application services that execute under Tuxedo. It communicates with these back-end services via BEA Systems JOLT.
3. **Integration Relay Servlet**—A PeopleTools Java Servlet that handles all inbound and outbound HTTP/XML requests for the third-party system integration. This is also a very thin servlet that acts as a relay between the external or third-party system and the core back-end integration services. It receives and serves XML requests over HTTP and maps the data in these requests to the integration services—Application Messaging Processor, Business Interlinks Processor, Component Processor—that executes under Tuxedo. This component communicates with these back-end services via BEA Systems JOLT.
4. **Portal Servlet**—A PeopleTools Java Servlet that handles all inbound markup language and outbound requests for the Portal. It receives and serves HTML, XML, and WML requests over HTTP. It also manages all aspects of the PeopleSoft Portal such as search, content management, and home page personalization. It communicates with this back-end service via BEA Systems' JOLT.
5. **Tuxedo**— This industry-leading transaction monitor is used to manage these Internet Application Server services:

- ❖ **Component Processor**—A key piece of the Internet Application Server, this component executes PeopleSoft Components—the core PeopleSoft application business logic.
- ❖ **Business Interlink Processor**—Manages the execution of Business Interlink Plug-ins and their interactions with third-party systems.
- ❖ **Application Messaging Processor**—Manages the publishing, subscribing, and delivery of Application Messages in a PeopleSoft system.
- ❖ **User Interface Generator**—This component dynamically generates the user interface based on the Component or Query definition and generates the appropriate markup language (HTML, WML, or XML) and scripting language (JavaScript, WMLScript) based on the client accessing the application.
- ❖ **Security Manager**—Interfaces with the Directory Server using Lightweight Directory Access Protocol (LDAP) to authenticate end users and manage their system access privileges.
- ❖ **Query Processor**—Executes queries defined using the PeopleSoft Query tool.
- ❖ **Application Engine**—Executes PeopleSoft Application Engine processes.
- ❖ **Process Scheduler**—Executes reports and batch processes and registers the reports in the Portal's Content Registry.
- ❖ **SQL Access Manager**—Manages all interaction with the relational DBMS via SQL.

Database Server

The PeopleSoft Database is the repository for all information managed by PeopleSoft's enterprise applications. All PeopleSoft internet applications support industry-leading database management systems, including Oracle, Informix, IBM DB2, Sybase, and Microsoft SQL Server.

Not only is application data stored in the database, but PeopleSoft metadata is also maintained in the database. The PeopleTools Application Designer development tools maintain this metadata which is then used to drive the runtime architecture. The PeopleSoft Internet Application Server executes business logic based on this PeopleSoft metadata.

Metadata-Driven Architecture

PeopleSoft architectures have always been very driven by metadata. This is a key reason why we have been able to make the leap from client/server to pure internet based applications without a complete rewrite of our existing applications. This section gives an overview of how metadata drives the PeopleSoft Internet Architecture.

PeopleTools Application Designer is a tool set used by PeopleTools Application Development and customers to define PeopleSoft applications. Dozens of different types of application objects are

designed and defined using the Application Designer. Examples of common application objects are Fields, Records, Pages, Components, Application Messages, and Business Interlinks. When an application developer saves an application object, the Application Designer saves this definition to the PeopleTools Metadata Repository.

At execution time, the Internet Application Server fetches the most recent application object definitions from the Metadata Repository. It then compiles and caches in memory the application object definition and then executes the business rules based on the definition. A good example of this is a Page definition. In the Application Designer, the developer specifies the layout of a Page and the coordinates of the various widgets on the Page. This definition is stored in the Metadata Repository. When that Page is executed by the Internet Application Server, the metadata definition is fetched, compiled, and cached. The Page layout is generated based on this definition.

The following diagram illustrates this metadata architecture:

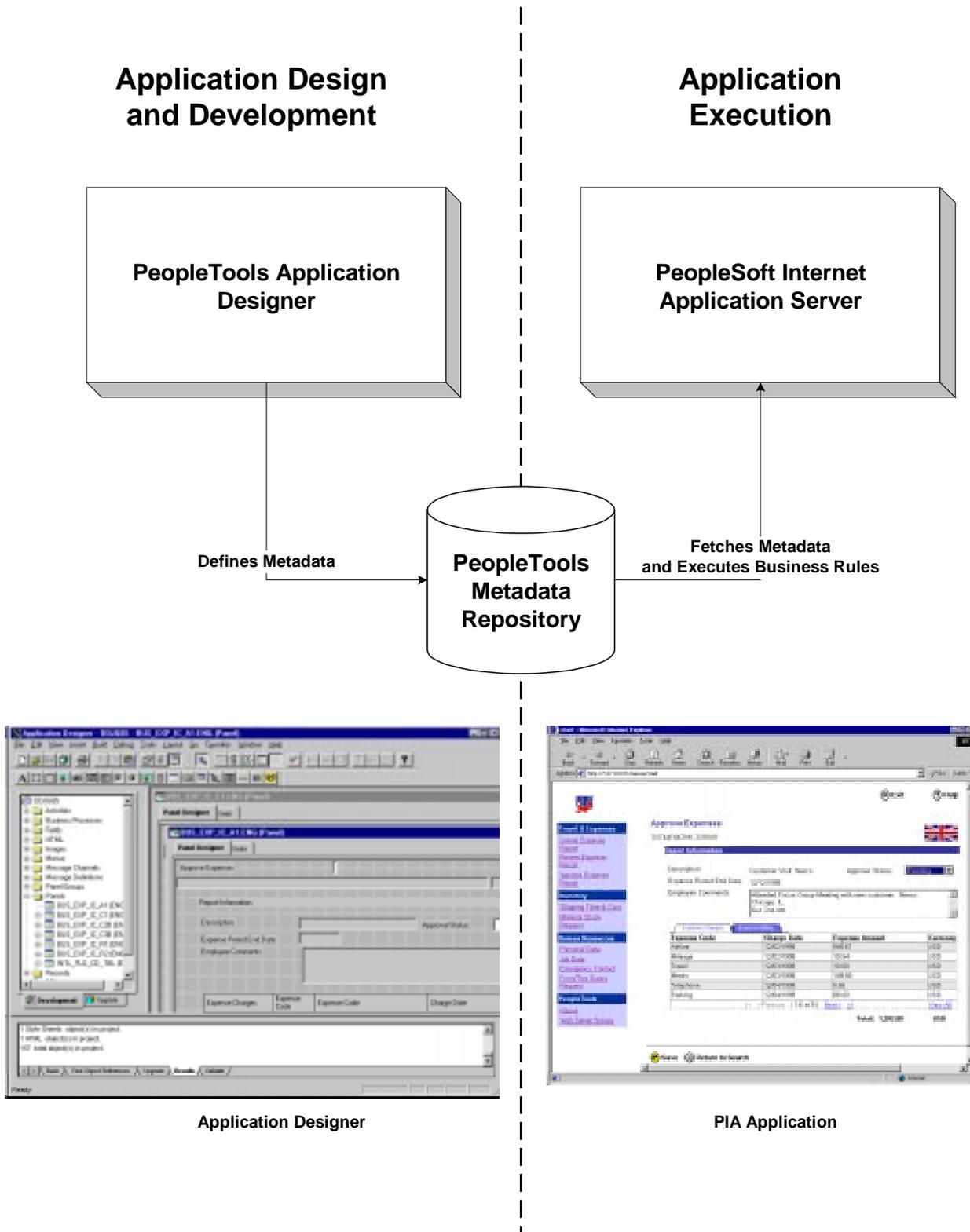


Figure 3 – The Metadata Driven PeopleSoft Internet Architecture

What are some advantages of having a metadata driven architecture?

1. **Low Cost of Deployment:** Internet Architecture has advanced caching mechanisms that automatically fetch and cache the most recent application definitions. Customers do not have to manage the deployment of changes they make to the PeopleSoft applications. The Internet Architecture automatically deploys the changes to the various Internet Application Server machines for them. Customers do not need to recompile code or manually manage the deployment of PeopleSoft applications to their various server machines.
2. **Easier Upgrades:** The metadata driven architecture makes upgrades much easier since the metadata is what is upgraded. You are not upgrading vast amounts of code. Instead, you are upgrading metadata definitions.
3. **Architecture Flexibility:** Because the development environment and execution environments are separate, PeopleSoft engineers can dramatically change the runtime execution architecture with relatively low impact on the existing applications. This has allowed PeopleSoft to move from a two-tier client/server architecture to a three-tier client/server architecture to a pure internet based architecture without a rewrite of our applications.

Internet Access

How is “Internet Access” defined in the context of a PeopleSoft system? Very simply, it means that if users are able to access, navigate, and interact with popular websites such as Yahoo! and Amazon.com, then they should be able to access and execute any PeopleSoft application with equal ease using the a web browser. The most critical attributes of internet access include:

- ❖ **Easy Access**—A user should be able to access PeopleSoft applications by simply entering a URL in the address bar or clicking on a hyperlink—all using a standard web browser without additional software installation requirements. Another example of easy access is from a cell phone or wireless device. A mobile end user could quickly and very simply interact with the application through the simplified mobile access user interface.
- ❖ **Platform Independence**—If a device can access the internet and be used to interact with leading websites, it should be able to interact with PeopleSoft applications just as easily. The end user should be able to use any modern web browser and client operating system without requiring installation of the latest version of Microsoft Windows, Netscape Navigator, a specific Java Virtual Machine, or other software components. The end user should not be limited by hardware or location. Any mobile internet access device, such as a cell phone or Personal Digital Assistant (PDA), should be able to interact with the PeopleSoft application.
- ❖ **Look and Feel of Leading WebSites**—Web-based PeopleSoft applications should look and feel like popular websites, providing an intuitive user interface that fully leverages the web paradigm with simplified integration and hyperlinking, effective use of graphics, and other standard web techniques and constructs.
- ❖ **Content Management**—The majority of content delivered over the web is unstructured data. PeopleSoft Portal technology—a key component of the Internet Architecture—manages the delivery of both structured (transactional) and unstructured data.
- ❖ **Low Bandwidth Access**—The majority of web access today occurs over dial-up phone lines. To accommodate this constraint, PeopleSoft designed internet access to support applications effectively over low bandwidth connections. This is accomplished through a server

architecture that uses HTML and JavaScript, and does not require the installation of Java plug-ins, proprietary components, or other heavy footprint client software. In addition, the network impact of deploying internet-enabled PeopleSoft applications is minimal, allowing companies to leverage their existing information technology infrastructure for providing wide-scale client access.

- ❖ ***Low Cost of Maintenance and Deployment***—One of the biggest issues with client/server implementations is the cost involved in deploying applications to a large end-user base. The PeopleSoft Internet Architecture allows customers to deploy applications at the lowest possible cost. In addition, it provides customers with the flexibility to customize their applications without the deployment and maintenance issues associated with a client/server implementation.
- ❖ ***Secure Access with Easy Administration***—Robust security is a crucial requirement for internet applications. However, the administrative cost and effort to create and maintain security profiles for thousands of end users is often ignored by application vendors. Directory Server integration in the PeopleSoft Internet Architecture addresses this issue by allowing customers to manage all of their end-user security profiles in a centralized repository. This enables simplified access and administration for PeopleSoft internet applications along with other directory services third-party systems.
- ❖ ***Robust Server Architecture***—Providing a large number of end users with access to applications should not require an inordinate number of servers. The robust, scalable, high-performance PeopleSoft Internet Architecture scales to support access for not only full-time users, but large populations of occasional and external users as well.

The following sections explain how PeopleSoft Internet Architecture technologies provide internet access support.

Internet Application Server

The PeopleSoft Internet Application Server serves the application interface down to the client machine via HTML and JavaScript—or WML and WMLScript in the case of wireless access—and the web browser renders the application user interface. This browser/server approach results in a zero-installation, zero-footprint client architecture that greatly simplifies application deployment and administration for internet applications.

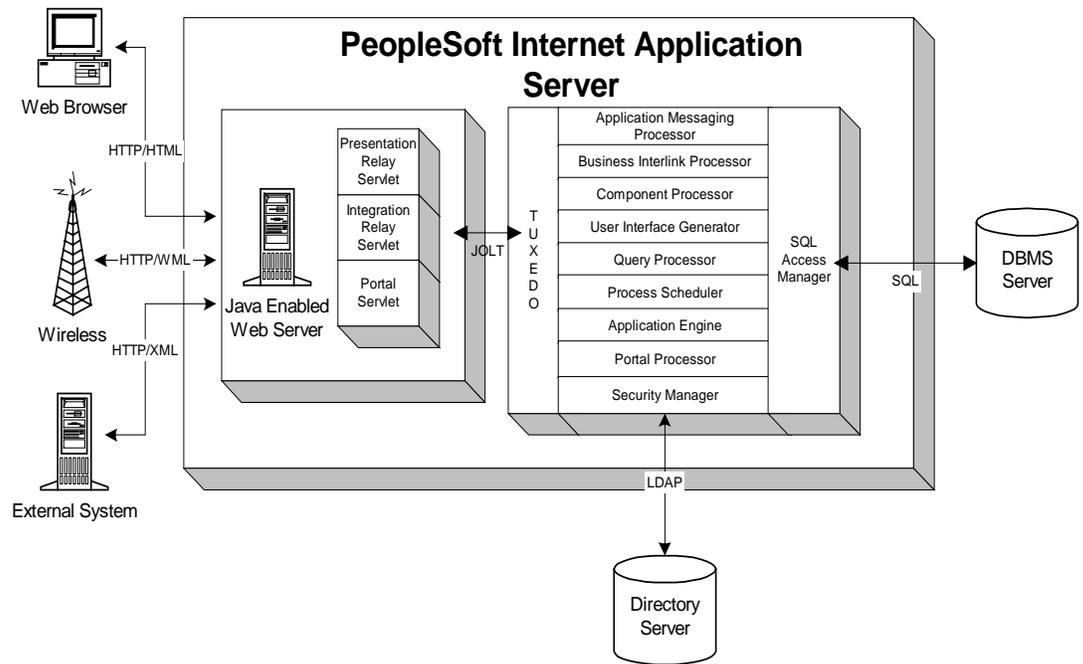


Figure 4 – PeopleSoft Internet Application Server

The web browser—or other internet enabled device—communicates with the web server over a secure HTTP connection, which invokes the Presentation Relay Servlet to serve the HTML and JavaScript to the web browser. This servlet is a very thin layer in the architecture that maps data in the HTTP requests to and from the core application Component Processor and User Interface Generator services. The Presentation Relay Servlet communicates with these back-end services using BEA Systems JOLT. The PeopleSoft Internet Application Server employs a number of application services to support end-user applications—with the Component Processor as the primary service for executing the application logic to build and save PeopleSoft Components.

All PeopleSoft application services use the PeopleSoft SQL Access Manager to communicate with the DBMS via native SQL. This service features a sophisticated database connection pooling facility for efficient access and a high degree of scalability.

PeopleSoft Portal

The PeopleSoft Portal technology consists mainly of the Portal Servlet and Portal Processor components which handle common portal processing such as page assembly, search, content management, navigation, and home page personalization.

Note that the portal technology can also be viewed as an important integration technology since it ties together content from a wide variety of data sources and delivers this content to end users in a central user interface.

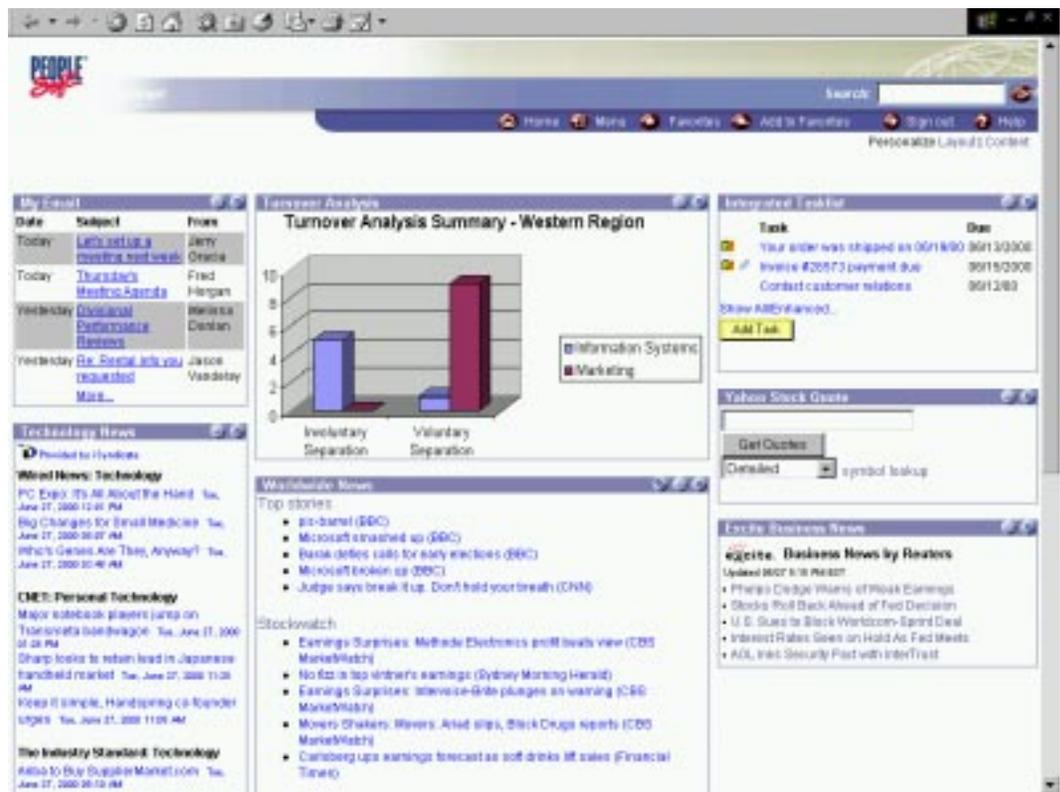


Figure 5 – Portal Personalized Home Page

Directory Server Integration

Directory Server Integration is a key function of the Security Manager service that is used for end user authentication.

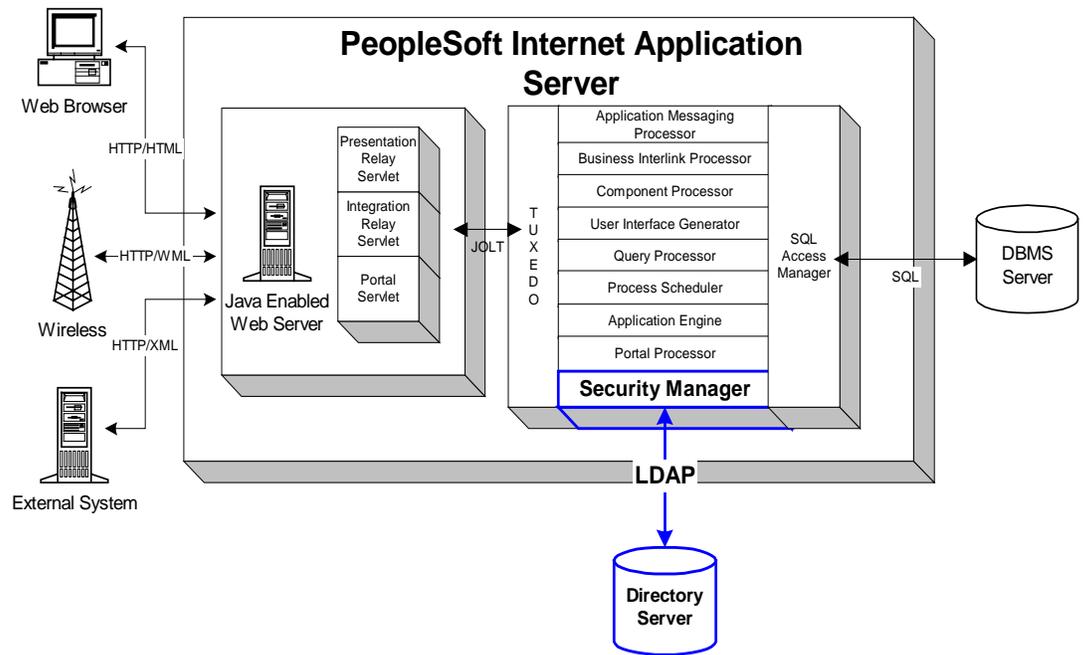


Figure 6 – PeopleSoft Internet Directory Services Integration

When the end user submits the operator ID and password from the PeopleSoft Portal, the Security Manager calls the Directory Server via LDAP to access operator information, authenticate the end user, and provide appropriate access to the PeopleSoft system.

Internet Integration

Internet integration encompasses a diverse range of requirements that varies depending upon the specific systems involved. For example, in some cases using asynchronous, message-based interface is appropriate. In others, a synchronous request/reply, component interface is the optimal solution. The direction of the data flow is also critical—whether a system acts as a client or a server is an important consideration for selecting the appropriate integration technology.

Unfortunately, there is no “silver bullet” for integration—no single solution or technology can accommodate all of the various types of integration required across today’s enterprise. So to address the numerous integration scenarios in today’s enterprise, PeopleSoft Internet Architecture delivers four integration technologies that support the full spectrum of integration both within and external to the organization:

- ❖ **Application Messaging**—Publish/subscribe messaging architecture for asynchronous integration into and out of PeopleSoft applications.
- ❖ **Component Interfaces**—Object-oriented, request/reply, component architecture that allows third-party applications to synchronously invoke PeopleSoft business logic.
- ❖ **Business Interlinks**—Plug-in framework that enables PeopleSoft applications to easily invoke third party Application Program Interfaces over the internet.

- ❖ **Application Engine**—Robust file processing capabilities easily enable file-based integration, which is still a common method for addressing integration requirements.

The following sections explain how PeopleSoft delivers comprehensive internet integration capabilities with the range of technologies available in the PeopleSoft Internet Architecture.

Application Messaging

PeopleSoft Application Messaging features a completely server-based architecture that allows PeopleSoft applications to publish messages in response to the invocation of business events within the Component Processor. These messages are published in XML format and delivered to subscribing systems over a secure HTTP connection. The diagram below illustrates the flow of application messages between two PeopleSoft systems. The system at the top of the diagram represents the publisher; the system at the bottom is the subscriber.

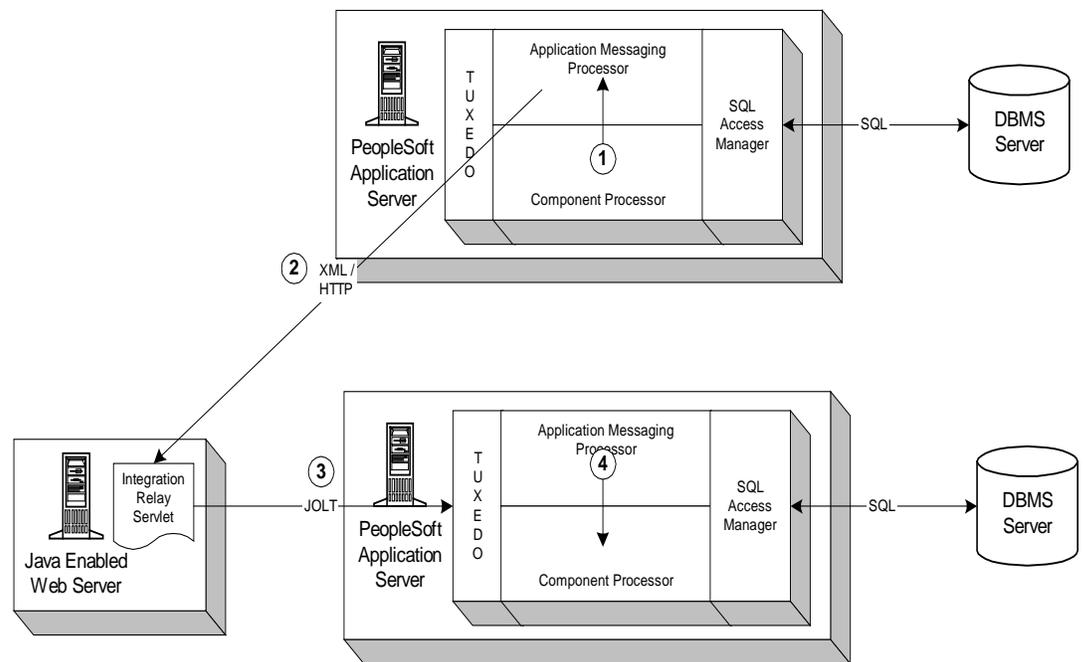


Figure 7 – PeopleSoft Internet Application Messaging Architecture

Component interactions and the flow with Application Messaging between two PeopleSoft systems follows:

1. The publishing application invokes the Component Processor to publish a message based on a business event, which in turn invokes the Application Messaging Processor.
2. The Application Messaging Processor publishes the message as an XML document and logs a copy of the message to a message queue in the database. This process then asynchronously invokes the subscribing system's Integration Relay Servlet, delivering the XML message to the subscribing system(s) over secure HTTP.

3. The subscribing Integration Relay Servlet receives the XML message and invokes the Application Messaging Processor in the subscribing system, which then logs the message in a message queue in the system's database.
4. The Application Messaging Processor in the subscribing system asynchronously invokes the Component Processor to process the inbound message. The Component Processor then edits the message data, invokes the appropriate business rules, and updates the database.

Third-party systems can publish messages and subscribe to messages to and from the Application Messaging architecture over HTTP using XML. To publish a message, the third party simply performs an HTTP Post to the PeopleSoft Internet Application Server, passing the XML document. To subscribe to a message, the third party simply needs to be able to receive and XML message over HTTP from the PeopleSoft Internet Application Server.

Component Interfaces

Using PeopleSoft Component Interfaces, third-party systems can synchronously invoke PeopleSoft business logic using COM, Common Object Request Broker Architecture (CORBA), Enterprise Java Bean (EJB), or XML bindings. The Component interface architecture is illustrated in the following diagram:

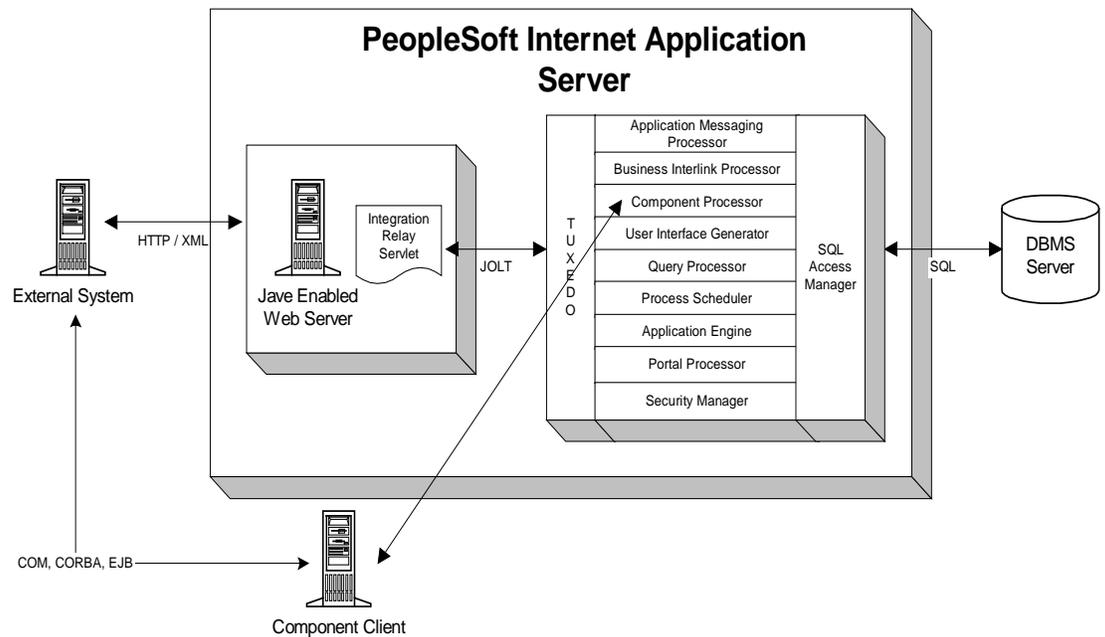


Figure 8 – PeopleSoft Component Interface Architecture

An external system can invoke PeopleSoft Components over HTTP/XML or it can invoke the Component Client using COM, CORBA, or EJB bindings. The Component Client is a multi-threaded client that interacts with the Component Processor to execute PeopleSoft business logic and invoke the Application Messaging Processor and Business Interlink Processor services if needed. The Component Client also interacts with the Query service to execute queries against system data, as well as with the Security Manager for LDAP authentication services.

Business Interlinks

Business Interlinks architecture provides a plug-in framework for PeopleSoft applications to invoke third-party APIs over the internet. Different vendors support different methods for invoking their APIs—including object technologies such as COM, CORBA, EJB; programming language-specific interfaces for C or C++; or interfaces based on HTTP and XML. The Business Interlinks framework provides a consistent framework for application developers to invoke external applications across this wide variety of technologies.

The following diagram illustrates how the Business Interlink Processor interacts within the Internet Application Server:

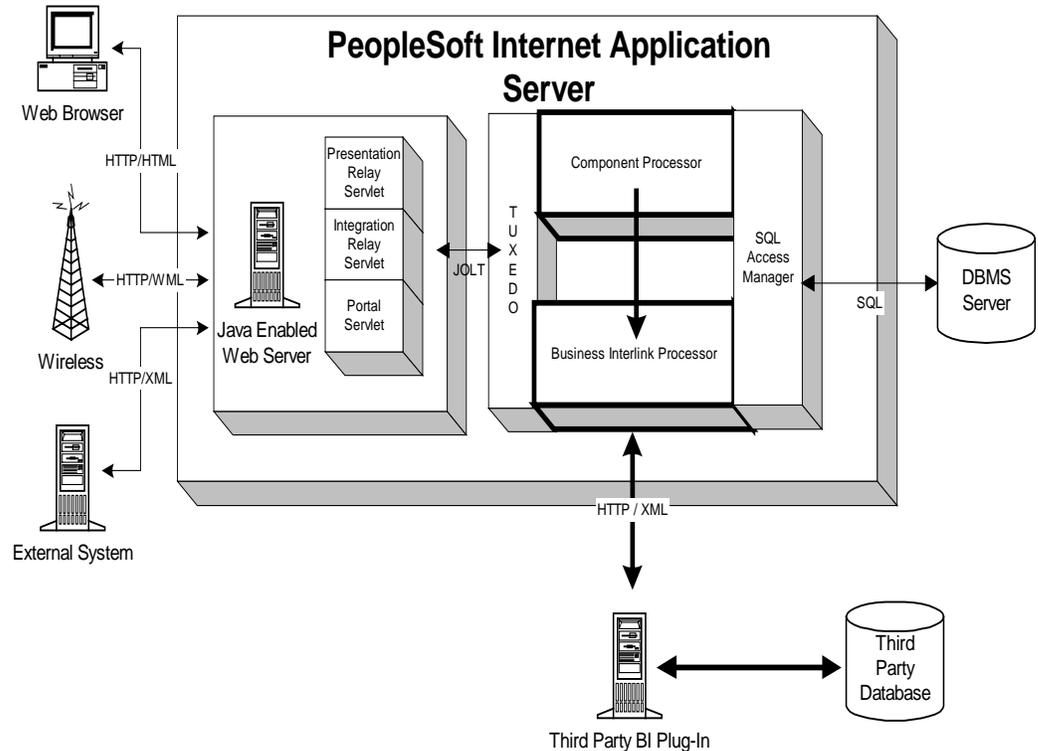


Figure 9 – Business Interlinks and the Internet Application Server

When a business event triggers the execution of a Business Interlink, the Component Processor synchronously calls the Business Interlink Processor, which in turn invokes the appropriate Business Interlink plug-in. The plug-in provides a wrapper around the third-party API and is designed to support any type of interface binding (COM, CORBA, EJB, XML) exposed by the third-party interface. The third-party system could be hosted on the same machine as the PeopleSoft Internet Application Server—or on a separate machine on the other side of the world—invoked over the internet using HTTP and XML.

Application Engine

Application Engine is the PeopleSoft high-volume application processor for large-scale batch processes. It uses Internet Application Server services such as the Component Processor, Application Messaging, and Business Interlinks.

Application Engine leverages the file I/O processing available in the Component Processor to read and write files in fixed-length, delimited, and XML formats. File-based processing is still a very popular technique used by customers today to integrate PeopleSoft applications with legacy systems.

Support for Standard Internet Technologies

PeopleSoft Internet Architecture supports a number of standard internet technologies that allow customers to leverage their corporate computing infrastructures as well as the capabilities of the internet and World Wide Web.

HTML

Internet Architecture heavily leverages HTML for presentation. The HTML Processor layer of the PeopleSoft Internet Application Server dynamically generates HTML—which is delivered to the end user's web browser via the PeopleSoft Presentation Servlet.

HTTP

Internet enabled clients (web browser, cell phone, etc.) communicate with the PeopleSoft Presentation Relay Servlet, Integration Relay Servlet, and Portal Servlet over a secure HTTP connection. The XML-based bindings for Application Messaging, Business Interlinks, and Component Interfaces also use secure HTTP for communications, as does the Application Messaging architecture for delivering XML messages between servers.

Java

Java is used on the Internet Application Server tier. The Presentation Java Servlets are used to serve HTML to the web browser and the Integration Java Servlets are used to pass the XML messages over secure HTTP for Application Messaging-based integration.

JavaScript

The PeopleSoft Internet Architecture uses JavaScript for client-side processing within the web browser to perform required field checking and field format edits, among other tasks.

WAP

WAP (Wireless Access Protocol) is currently the standard for wireless information and telephony services on digital mobile phones and other wireless devices. It is an open, global wireless protocol specification based on existing internet standards—such as XML and Internet Protocol (IP)—for all wireless networks. The PeopleSoft Internet Architecture natively supports WAP wireless applications. The User Interface Generator and Presentation Relay Servlet are key pieces of the architecture that leverage WAP technologies such as WML and WMLScript.

LDAP

The PeopleSoft Security Manager uses LDAP to communicate with the Directory Server for end-user authentication during login. Applications also use LDAP to read and update the Directory Server through the Component Processor executing on the PeopleSoft Internet Application Server.

Web Servers

PeopleSoft Internet Architecture leverages web servers to perform several functions, including executing Java Servlets to serve HTML and JavaScript to web browser clients and using Java Servlets in the integration architecture to pass XML messages between systems.

XML

PeopleSoft Internet Architecture uses XML in several areas to deliver powerful integration capabilities. Application Messaging publishes messages as XML documents, which provides a highly flexible and extensible platform for integration. In addition, Business Interlinks and Component Interfaces support XML-based bindings. Application Engine provides robust XML file processing support.

COM/DCOM

PeopleSoft supports this technology in its Component Interfaces, which provide native support for COM/DCOM bindings.

CORBA

PeopleSoft leverages technology from software partner Visual Edge to provide CORBA support for the Component Interfaces.

Enterprise Java Beans

PeopleSoft leverages technology from partners Visual Edge and BEA Systems to provide EJB support for Component Interfaces.

Tuxedo

BEA Systems Tuxedo is the leading transaction processing monitor in the marketplace today and has been a key component of the PeopleSoft architecture since PeopleSoft 7. PeopleSoft Internet Architecture leverages Tuxedo to manage the set of PeopleSoft Internet Application services—such as Component Processor and SQL Access Manager.

