PART I

Oracle Fusion Middleware Architecture and Management
CHAPTER 1

Fusion Middleware Primer
This chapter serves as a brief primer to Oracle Fusion Middleware. We begin the chapter by introducing the terms “enterprise application” and “middleware,” which are the fundamental concepts behind the purpose of all Fusion Middleware products. The chapter then provides a whirlwind tour of all Fusion Middleware products and highlights the ones that are the subject of the architecture and management deep-dive of the remaining chapters of this section.

Enterprise Applications and Middleware

Simply put, an enterprise application is a data-processing tool on which an enterprise (business) relies to deliver any part of its core capabilities. Using this definition, one could argue that enterprise applications have existed since the dawn of computing, maybe going back to when merchants started using an abacus to perform the basic accounting required for running their business. Of course, in today’s world the term applies specifically to a set of related software services used by an enterprise to conduct its business. Modern-day enterprise applications therefore have their root in the 1960s when companies and government organizations started to establish Information Technology (IT) departments to maintain newly purchased mainframe computers. These computers were in turn used to run software applications for performing such functions as payroll management or census data processing.

As the software and computing world has progressed, so have enterprise applications and IT. The nature of the enterprise applications that today’s IT departments are responsible for managing is vastly different from the early mainframe software applications of the 1960s. For starters, enterprise applications are now much more critical to business needs. No longer are software applications used to execute batch jobs with minimal consequence of failure. Instead, businesses rely on their IT departments to deliver real-time capabilities, such as sending automated notifications to the sales force on imminent opportunities or processing orders from their online channels.
Failure of such capabilities, even if only for a few minutes, can have even in the best of scenarios a significant impact to a company’s bottom line.

Second, enterprise applications are omnipresent, and modern-day knowledge workers rely on them for almost every aspect of their work. Whether it is for executing operational tasks such as managing accounting processes, facilitating the communication of information among the workforce, or running the company’s public website, enterprise applications play a role in almost all aspects of a company’s day-to-day work. As a result, the number of software applications present in modern-day IT shops is typically very large.

Finally, enterprise applications have shifted from their initial incarnation, as centralized mainframe processes, to a set of distributed and interdependent processes running on multiple machines. As a result, the boundary of what a single enterprise application consists of is often hard to determine because each application has a large set of dependencies, and therefore integration points, with other enterprise applications.

The shift of enterprise applications to critical, omnipresent, distributed, and interdependent entities has progressively increased the need for software applications that exist not to provide actual business logic for the enterprise but to facilitate and optimize the execution of software that does. Such software is what typically is referred to as “middleware,” with the idea being that it resides “in the middle” between the enterprise application software and the machine operating system on which software applications execute. In today’s IT organizations, middleware software is used to provide a wide array of capabilities that together allow businesses to more quickly deliver the enterprise applications needed, decrease the cost of ownership in maintaining them, and ensure that they maintain the quality of service required by their users. Figure 1-1 shows—within the boxes highlighted—some of the areas where middleware software can be used within the IT infrastructure.

Oracle Fusion Middleware consists of a wide set of products that cover all areas where middleware software can play a role within an IT organization. In the next section, we go over the set of products that are part of Oracle Fusion Middleware, provide a brief overview of their capabilities, and highlight the set of products covered as part of the scope of this book.
Oracle Fusion Middleware Products

The full set of Oracle Fusion Middleware products can be grouped into different categories based on the type of problems they are meant to solve. Figure 1-2 shows the different categories of Fusion Middleware products in dark grey. The figure also shows—within the boxes highlighted—the products (or in the case of the Identity Management category, the functional areas) that are covered in detail within the scope of this book in subsequent chapters.

The remainder of this chapter provides an overview of each of the categories shown in Figure 1-2.

Integrated Development Environments and Frameworks

Oracle provides two primary integrated development environments (IDEs) that software application developers can use to build enterprise applications: Oracle JDeveloper and the Oracle Enterprise Pack for Eclipse. The next two
sections describe these IDEs, their associated development frameworks, and the Fusion Middleware products they are associated with.

**JDeveloper and Application Development Framework (ADF)**

JDeveloper is the main integrated development environment for building Fusion Middleware–based enterprise applications. It offers a set of capabilities that span software programming, visual design, and definition of metadata, as follows:

- **Programming** JDeveloper allows for the writing of software programs using the Java, JavaScript, PL/SQL, and PHP programming languages. It provides features such as automatic indentation of code and integration with build scripts, which make the life of software developers writing programs in these languages simpler. Additionally, JDeveloper provides features specific to different software specifications.
and standards such as Java Enterprise Edition (Java EE) and Java Swing, which allow for the automatic generation as well as modeling of artifacts related to them. As an example, the JDeveloper Java Swing capabilities allow for the creation of Java Swing widgets using a visual editor.

- **Visual Design and Roundtrip Engineering** JDeveloper allows for the design of software applications using a visual model. A number of software development frameworks and modeling languages are supported, including the Oracle Application Development Framework (ADF), Universal Modeling Language (UML), Business Process Execution Language (BPEL), and Service Component Architecture (SCA). In some cases, such as for the creation of Java Server Pages (JSP), JDeveloper also provides WYSIWYG (What You See Is What You Get) user interface design capabilities. These visual modeling capabilities lead to the generation of backing code or metadata necessary for the execution of the artifacts being designed. In all cases, JDeveloper provides a capability known as “roundtrip engineering.” This means that changes to the model lead to the associated changes within the code and metadata, and more importantly the opposite—that is, changes to the underlying code or metadata lead to changes within the model.

- **Metadata Definition** JDeveloper allows for the creation of metadata for dependent components used by developers when writing code or modeling their application. These include a connection framework that allows for the definition of connection properties such as databases and application servers that can be used as part of the testing of the applications being developed. Other metadata definition artifacts include the ability to create Ant scripts that can be used to build and package the elements of the application being developed, as appropriate.

The main development framework that is exposed by JDeveloper is known as the Oracle Application Development Framework (ADF). ADF is a set of application programming interfaces (API) and JDeveloper-based modeling tools that allow for the creation of Java EE–based applications with user interfaces that can be exposed through a variety of ways, including thick-client (Java Swing-based) applications, rich Java Server Faces–based
web applications, and mobile applications. ADF is an integral part of Fusion Middleware, and its architectural details are the subject of Chapter 6. Other than being the main design tool for ADF applications, JDeveloper is also the primary IDE for a number of Fusion Middleware product categories, including Application Grid, SOA Suite, WebCenter, Data Integration, and Business Intelligence. For these products, special extensions to JDeveloper must be downloaded to enable their capabilities. These capabilities usually include a set of dedicated editors, wizards, and ADF component extensions for the development of custom user interfaces that provide end-user integration with the associated products.

Oracle Enterprise Pack for Eclipse

The Oracle Enterprise Pack for Eclipse (OEPE) is a packaged set of Oracle-certified plugins to the Eclipse open-source IDE. The history of OEPE goes back to Oracle’s acquisition of BEA Systems Corporation: BEA was using Eclipse as its main IDE platform. Today, OEPE offers developers who prefer to use Eclipse as their IDE an option for its continued use. OEPE plugins can be grouped into three categories, as follows:

- **Application Grid Development Plugins**  A set of plugins that facilitate the development of custom Java EE applications targeted for deployment to the Fusion Middleware application grid set of products. Specifically, these plugins allow for the creation of Java EE artifacts such as servlets, Enterprise Java Beans, and others with a set of wizards and modeling tools to streamline their deployment to the WebLogic Server application server, a core product of Fusion Middleware that we will explore in detail in Chapter 2.

- **Oracle Service Bus Development Plugins**  A set of plugins that enable the offline development of Oracle Service Bus (OSB) message flows, the main unit of deployment for this product. A detailed discussion of OSB is beyond the scope of this book, although we briefly discuss the OSB capabilities in Chapter 5.

- **Plugin for Ex-BEA Products**  A number of products which Oracle inherited in its acquisition of BEA Systems have their development capabilities rooted in OEPE. These products include WebLogic Integration and Workshop Page Flows. These products now have a different strategic alternative within the Oracle Fusion Middleware
set of products (for example, WebLogic Integration Java process definitions should be replaced with SOA Suite BPEL processes) and as such are not further discussed in this book.

Given the focus of this book on the architecture and post-development management practices for Fusion Middleware products, the two IDEs we discussed in this section are not explored in any further detail within the rest of this book.

**Application Grid**

The Fusion Middleware products under the Application Grid category provide middleware application execution services on which enterprise applications can be built. The primary product in this category is the WebLogic Server, a Java EE–based application server that provides a set of services that optimize the execution of Java EE–based applications. The services provided by WebLogic Server allow for the separation of concerns between the development of applications and elements such as their database, security, and performance-tuning configurations. We will explore WebLogic Server and its architecture in detail within Chapter 2. Other important products in the Application Grid category are Oracle JRockit, Oracle Coherence, and the Oracle Web Tier set of products. Oracle JRockit is a Java Standard Edition virtual machine that provides advanced capabilities such as the ability to monitor the virtual machine’s detailed performance parameters in production environments and the ability to execute Java code with deterministic response times. Oracle Coherence provides a clustered, distributed, and partitioned in-memory data cache—also known as a “data grid”—that can be used by software developers to improve the reliability, availability, scalability, and performance of enterprise applications. Finally, the Web Tier package of products consists of the Oracle HTTP Server (OHS), which is a reverse-proxy based on the open-source Apache HTTP server, and Oracle Web Cache, which, as the name suggests, is used for fronting an HTTP server to allow for the caching of frequently accessed web content.

The application grid set of products, and specially WebLogic Server, form the foundation on which all other Java-based (and that is almost all of them) Fusion Middleware products are founded. As such, Fusion Middleware products that do not fall into this category are sometimes referred to as “layered products,” meaning that they introduce another layer of logic on top of the application grid base layer.
Identity Management

The Fusion Middleware products under the Identity Management category provide services that allow IT organizations to establish and manage security across their enterprise applications. The core set of identity management services provided by the products in this category are as follows:

- **Directory Services**  Allow for the central storage and management of information about users of enterprise applications.
- **Access Management**  Allows for the centralization of authentication services to enable Single Sign-On (SSO).
- **Identity Federation**  Allows for federation of access management services across departmental and organizational boundaries.
- **Fraud Detection**  Allows for the definition of advanced algorithms for strengthening authentication mechanism and detecting potential fraudulent access attempts.
- **Entitlement Services**  Allow for the centralization of enterprise resource access control information.
- **Identity Administration**  Allows for the orchestrated management of user information across enterprise applications. These services facilitate the implementation of processes such as provisioning of user access and password management across multiple applications.
- **Identity Analytics**  Allow for the analysis of identity access information through audit violations and access review.

Fusion Middleware products in other categories can integrate with the Identity Management set of products to take advantage of the security services they offer. These services are discussed in detail in Chapter 4.

Service-Oriented Architecture

A Service-Oriented Architecture (SOA) is a set of enterprise application architecture principles that allow IT organizations to organize such applications and their environments in a more efficient and cost-effective manner. At a very high level, SOA principles dictate the organization of an enterprise’s IT
applications into loosely coupled and highly cohesive services with a clear separation of their interface description from their implementation technology. New services are then composed using the existing set of services. SOA thus allows for reuse and facilitates the introduction of enterprise application changes over time. These changes can be holistic in nature, such as implementation rewrites using a new language, or they can be evolutionary, such as the application of defect patches or upgrades of a service.

Products within the SOA category of Fusion Middleware Products enable an enterprise to organize their environments and build applications according to SOA principles. The main products within this category are the Oracle SOA Suite and Oracle Service Bus. Oracle SOA Suite allows for the development and deployment of applications that follow the Service Component Architecture (SCA) specification. SOA Suite allows for the creation and deployment of applications that are made up of components with different implementation technologies. The implementation technologies supported by SOA Suite are as follows:

- **Business Process Execution Language (BPEL) and Business Process Modeling Notation (BPMN) Processes**  Used to define end-to-end business processes that involve orchestration of human user tasks, business rules, and invocation of other services

- **Mediations**  Used to define transformation and routing logic that maps services with different interfaces, protocols, and implementations

- **Human Tasks**  Used to implement interaction points with business users

- **Business Rules**  Used to expose application parameters that need to be adjusted over time based on business needs

- **Spring Service Components**  Used to create components implemented in Java using the Spring framework

Beside its SCA-based service implementation capabilities, SOA Suite also provides three other core capabilities: Business Activity Monitoring (BAM), User Messaging Services (UMS), and Business-to-Business (B2B). BAM allows for the real-time monitoring of the business parameters associated with enterprise applications. UMS provides a framework that enterprise
applications can use to interact with end users through various mechanisms, such as instant messaging, SMS text, and e-mail. Finally, the SOA Suite B2B component allows for enterprise applications to interact with services in other departments or businesses using a standard B2B protocol (for example, ebXML or RosettaNet) and the due diligence (auditing, message integrity check, security requirements, and so on) that might be required for such interactions. The SCA, BAM, and UMS capabilities of SOA Suite are explored in detail in Chapter 5.

The second core product of the SOA category of Fusion Middleware Products is the Oracle Service Bus (OSB). In a similar fashion to the mediations implementation type of SOA Suite, OSB allows for the implementation of message flows that define transformation and routing logic that maps services with different interfaces, protocols, and implementations. The primary differences between OSB and SOA Suite mediations are two-fold: First, OSB is designed for handling more complex and high-volume scenarios. Second, all aspects of OSB message flows can be dynamically defined and modified on the runtime environment itself, without the need for a full develop/deploy cycle.

User Experience

The User Experience category of products contains, as the name suggests, products that are used for the creation of user interfaces for enterprise applications. The two core products that fall into this category are the Oracle Application Development Framework (ADF) and Oracle WebCenter.

ADF is a Java EE-based framework that provides a set of tools and widgets that simplify the creation of web and thick-client user interfaces that can be used through different access points, such as web browser and mobile phones. For web applications, ADF builds on top of the Java Server Faces (JSF) components and controllers to enable the construction of rich AJAX-based applications. ADF also provides other capabilities that are meant to simplify the management of enterprise applications. One of these capabilities is the ability for ADF developers to specify separate customization layers as part of the design of user interfaces in order to expose different customization features to end users, depending on their roles, and to simplify the upgrade of applications after their user interfaces have undergone such customizations.

Oracle WebCenter allows for the creation of applications that bring together services from other enterprise applications and allows for the extension of these applications with collaboration services. WebCenter functionality can be
separated into a set of different services. WebCenter framework services provide the capabilities usually associated with traditional portals, such as the ability to create portlet-based user interfaces as well as customization and personalization features. WebCenter Social Computing services provide out-of-the-box collaboration tools—such as instant messaging, discussion forums, and presence detection—that can be integrated with other enterprise applications. WebCenter Composer and Business Directory services allow business users to create enterprise applications on the fly by bringing together content exposed through web services and feeds. Finally, WebCenter Spaces is an out-of-the-box enterprise application that brings together the core capabilities of WebCenter so that they can be used without development effort within the enterprise. The WebCenter Spaces application is composed of a personal area where users can store and manage information such as notes and calendar content, a business roles area that allows the broadcasting of information to end users of specific roles, and finally a group spaces area that allows end users with common interests to collaborate using tools such as blogs and wikis.

The functionality and architecture of ADF and WebCenter are discussed in detail within Chapters 6 and 7, respectively.

Content Management, Data Integration, and Business Intelligence

Fusion Middleware products within the Content Management, Data Integration, and Business Intelligence categories are outside of the scope of this book. However, the following sections provide a brief description of each category and the products they contain.

Content Management

The Oracle Enterprise Content Management suite of products can be used across an organization for the management of heterogeneous documents such as spreadsheets, web pages, e-mails, and digital images (generally referred to as “content”). The products contained in the Enterprise Content Management suite are as follows:

- **Universal Content Management**  Provides a central repository for the storage and management of content. It also provides the ability to define and execute life-cycle processes for the content it stores (for example, submission process, publishing process, deletion process, and so on).
Universal Records Management  Used for the storage and management of archive data retained for legal, historical, or other use. It provides the ability for end users to specify archiving and disposition rules to be associated with different types of documents.

Imaging and Process Management  Used for the storage and management of scanned images of physical documents. The Imaging and Process Management product is often used in the context of business functions that by nature involve the need for scanned images, such as expense and invoice management.

Information Rights Management  Enables documents to be secured to ensure that users can only perform the operations (read, write, modify, delete) for which they have proper authorization. Furthermore, the Information and Rights Management product allows for the auditing of all operations performed on documents that are secured. This product is often used for the management of digital content with sensitive information such as corporate financial or legal documents.

The Enterprise Content Management products rely on each other to provide their functionality. As an example, the content server of the Universal Content Management product serves as the content repository for all other products in this category.

Data Integration
The two core products within the Fusion Middleware Data Integration category are Oracle Data Integrator and Oracle Golden Gate. Oracle Data Integrator is used to process data from source repositories and transform it for inclusion in destination repositories of different types. It provides the ability to define and execute Extract, Transform, Load (ETL) functions between heterogeneous sources of data, such as RDBMS schemas, File (in XML and other formats), Web Services, and others. Oracle Golden Gate allows for the bridging of databases between multiple sites in order to ensure that their content stays synchronized according to a set of administrator-configured polices. Golden Gate is often used to facilitate disaster recovery topologies by replicating data in real time between different sites.
Business Intelligence
The Oracle Business Intelligence suite of products allows for the analysis of historical, current, and predictive business data. These products allow for the aggregation of multiple heterogeneous physical data sources into a single logical model that can then be used for analysis and reporting purposes. The core products contained in the Business Intelligence suite are as follows:

- **Business Intelligence Enterprise Edition**  Allows for the collection of data from multiple heterogeneous data sources and the organization of this data into a logical data model. The logical data model can then be queried and its content can be used for the creation of dashboards and alerts.

- **Business Intelligence Publisher**  Allows for the creation of report templates that can contain data retrieved from multiple data sources. The report templates can then be used to generate reports in multiple formats, such as spreadsheets and HTML. Business Intelligence Publisher also allows for the advanced scheduling of report generation.

The Fusion Middleware products within the Business Intelligence category are tightly integrated. As an example, the Business Intelligence Enterprise Edition and Business Intelligence Publisher products can share a single set of data objects for reporting and dashboards.

Conclusion
In this chapter we reviewed the key concepts of enterprise applications and middleware. We then proceeded with a quick tour of Oracle Fusion Middleware and the different types of products it offers. In the next chapters of Part I, we proceed with a deep dive of some of the key Oracle Fusion Middleware products introduced in this chapter.