Module (Middleware)

Application Interconnectivity Through Middleware

e-Business Applications, Architectures, Integration

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Chapter 3: Database Technologies and SQL -- A Tutorial
Chapter 4: Web Engineering and XML Processing – A Closer Look
Chapter 5: CORBA -- A Closer Look

A Technology Briefing Module from

" e-Bsiness and Distributed Systems Handbook "

Amjad Umar, Ph.D.
(www.amjadumar.com)
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MODULE (Middleware): Application Interconnectivity Through Middleware

Reader Background Expected

We live in a world where the order processing system of a bookstore in Atlanta can check the inventory stocks in New York, Paris, and Singapore. To accomplish this, network pipes are not enough -- you need interconnectivity software, known as middleware, that enables applications and users to interconnect over a network. As we will see in this module, middleware is the software that handles distributed communications between applications and resides above the network transport layer and below the business-aware application software. This definition excludes "stand alone" system software such as math libraries, operating systems, and file systems. The focus of this module is on the general-purpose and core middleware services that are used in a wide range of applications. These middleware services, as shown in the dark borders in Figure1, reside above the network and can directly support the general-purpose distributed applications or more specialized middleware services.

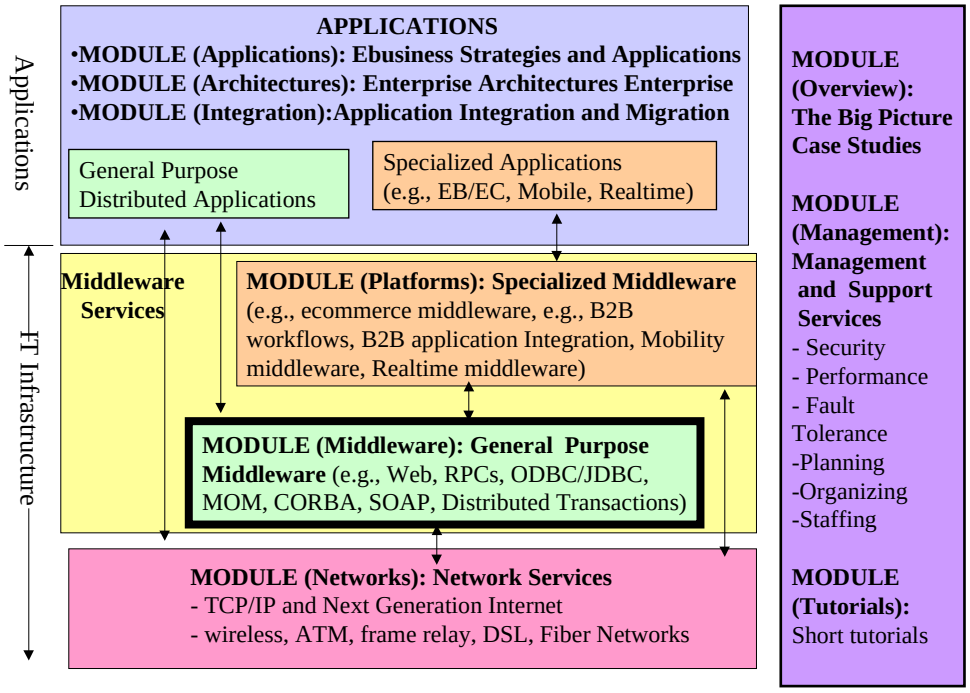

Figure 1: Middleware as Building Block of Modern Systems

Advances in middleware services have enabled rapid and cost effective development of distributed applications ranging from remote database access to large scale B2B systems. Because of their position, these services hide the underlying complexities of networks, operating systems, and computer hardware from the applications. They also manage distributed resources while also leveraging hardware/software technology advances. Although it is possible to build applications directly on top of hardware, OS and network protocols without using any middleware services but this turns out to be extremely tedious, error-prone and costly over system life-cycles.

At the same time, currently existing COTS (commercial-off-the-shelf) middleware packages have many problems associated with them. In essence, middleware must satisfy the needs of two very demanding masters: applications that reside above the middleware and networks that exist below the middleware (see the figure below). Both masters are evolving rapidly and impose ever-changing requirements. The chapters of this module, listed below, will introduce you to basic middleware principles and go through details of most popular middleware services such as remote SQL, remote procedure calls, message oriented middleware, Web technologies, distributed object technologies, and distributed data and transaction management. The emphasis, as always, is on building blocks and how these building blocks can be used to develop working solutions.

- Chapter 1: Middleware Principles and Basic Middleware Services
- Chapter 2: Web, XML, Semantic Web, and Web Services
- Chapter 3: Distributed Objects, CORBA, J2EE, and .NET
- Chapter 4: Enterprise Data and Transaction Management
- Chapter 5: Middleware State of the Practice, Market, and Art

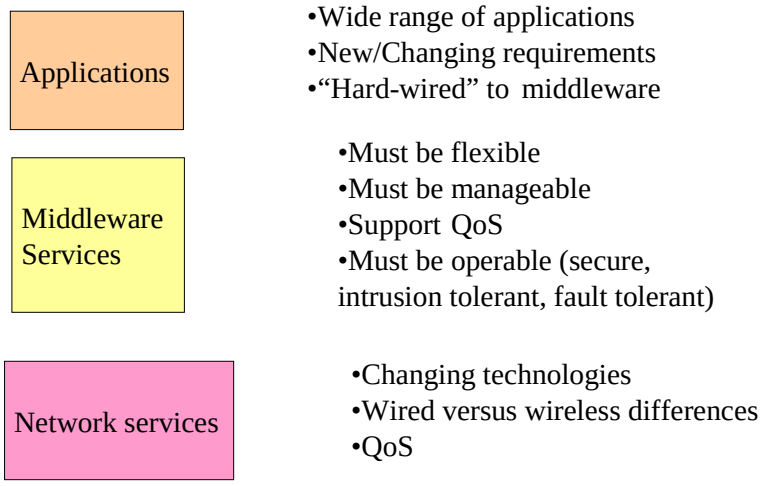

Figure 2: Middleware as the "Middle-man"

Reader Background Expected

This module is written for people with basic background in computing. The information contained in the Overview Module is highly recommended as a prerequisite. Specific chapters assume some additional background. For example:

- Chapter 3 assumes some background in object-orientation. This background can be obtained by reviewing the object-orientation chapter of the Tutorials Module.
- Chapter 4 assumes some background in database technologies. This background can be obtained by reviewing the database technologies chapter of the Tutorials Module.

Module Case Studies

XYZCorp Case Study: Middleware for IT Interconnectivity Task

The company has embarked on a major corporate wide interconnectivity effort. The objective is to allow anyone from any part of the company to access any information ("any information, anywhere, anytime"). The customers must be able to do online purchasing over the web and the business partners should be connected for B2B trade. In particular, the corporate center needs to be connected to the regional offices to transfer files and provide corporate wide information sharing. The corporate network must also accommodate a merger with a financial institution (a totally IBM mainframe shop). The management wants to understand the various interconnectivity issues and approaches. The management finally understands at least two levels of IT interconnectivity:

- Network interconnectivity that provides physical paths for the messages to be transported between various computers
- Application interconnectivity so that the users at one site can access applications and databases at other sites of the organization.

The network interconnectivity task was completed in the Network Module. The focus of the XYZCorp case study in this Module is Application Interconnectivity through Middleware (see Figure 3). This task concentrates on the basic middleware architecture. The Platform Module will address the more complex issues involving commercially available "Middleware Platforms" that package several middleware technologies to support mobility and B2B as well as C2B trade. We will develop the Application Interconnectivity Architecture by working through the following projects that will be completed in different chapters of this Module:

Project 1. How the corporate databases (customer, price, inventory) will be accessed from the various purchasing and marketing systems across the corporation by using the network developed in the Network Module (see Chapter 1 for additional details on this project).

Project 2 Choice of a corporate wide Web architecture. The company is interested in moving toward an "Intranet" as soon as possible and wants to develop a customer relationship management portal. We will discuss this project in Chapter 2.

Project 3. Assess the role of distributed object technologies for the corporation with special attention to Web Services, J2EE, and .NET. Project 3: XYZCorp has initiated a technology assessment effort that focuses on distributed object technologies. We will discuss this project in Chapter 3.

Project 4. How the corporate databases will be allocated, accessed, and updated from multiple users from multiple sites. We will discuss this project in Chapter 4.

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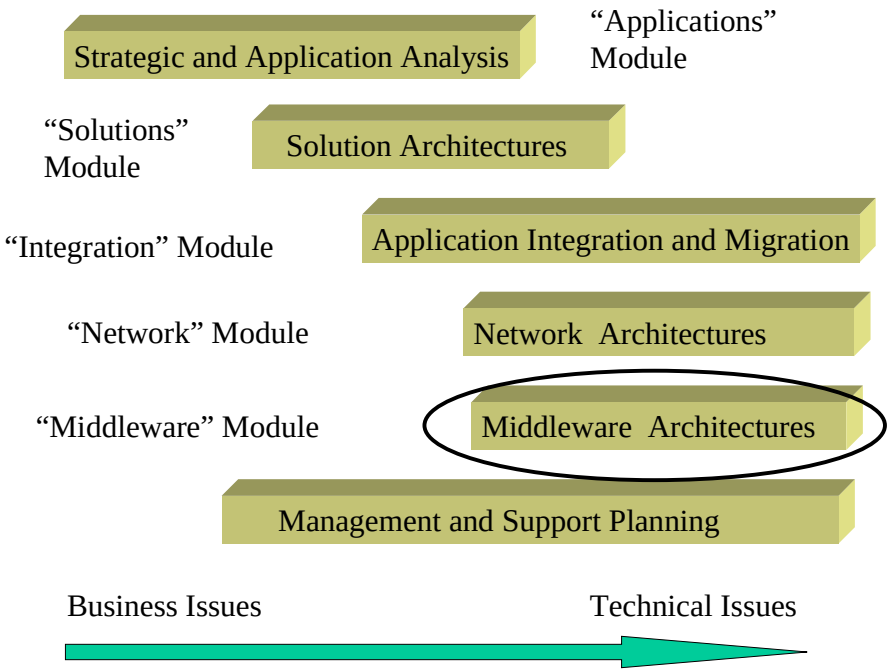

Figure 3: XYZCorp Planning Tasks

Additional Case Studies and Examples

Several additional case studies and examples are discussed in the chapters of this Module. A number of case studies that are relevant to the topics discussed in this Module appear regularly in trade magazines, vendor documents, web sites and books. Chapter 5 of this Module gives a sample of relevant case studies and points to numerous sources for additional case studies and examples.

In addition, several chapters of the Cases Module contain relevant case studies. For example, the following case studies in the first chapter of the Cases Module can be used to illustrate different aspects of the material in this Module: Section 2.3 Ecommerce/eBusiness Examples: These examples can be used to understand how technical choices were made some time ago and to analyze different interconnectivity options through middleware services for the cases.

Section 2.4 Ecommerce - Online Purchasing Examples. These examples can be used to determine the type of middleware services needed for these systems. You should determine what, why, and where.

Section 2.5 A Financial Marketplace. After reviewing this case study, you can choose the middleware services for application connectivity for this marketplace.

Section 2.8 An Integrated Manufacturing System. A good example to examine how the current and future middleware services (basic middleware, XML-Web Services, .NET, J2EE, distributed data and transaction processors) can be used to integrate in manufacturing environments.

Section 2.9 A Customer Relationship Management Portal. Many technical choices are made in this case study. Can you use XML web services, .NET, or J2EE in this portal?Where and why?

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