



Integrating E-Commerce Sites with Existing Heterogeneous Systems

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1. Introduction

It is hard to watch TV, listen to the radio, or surf the web without hearing of yet another new e-business. Regardless ultimate success or failure, their web sites often showcase integrated end-to-end commerce solutions. On the whole, this is because new e-businesses start off with a clean slate. The business infrastructure is developed from scratch with the site itself. There are no legacy systems, no pre-existing customer databases, no arcane business rules, etc. New e-businesses can build an infrastructure uniquely tailored to e-commerce.

Established businesses do not have this luxury. They have existing customers, existing marketplaces, and a pre-existing infrastructure to support it. Nonetheless, these businesses will be forced to compete in the new online marketplace, where they face stiff competition and may already be losing business. The challenge for the established businesses is to integrate their e-business initiatives with their existing infrastructures.

This was the challenge facing the Institute of Electrical and Electronics Engineers (IEEE).

1.1 The IEEE E-commerce Challenge

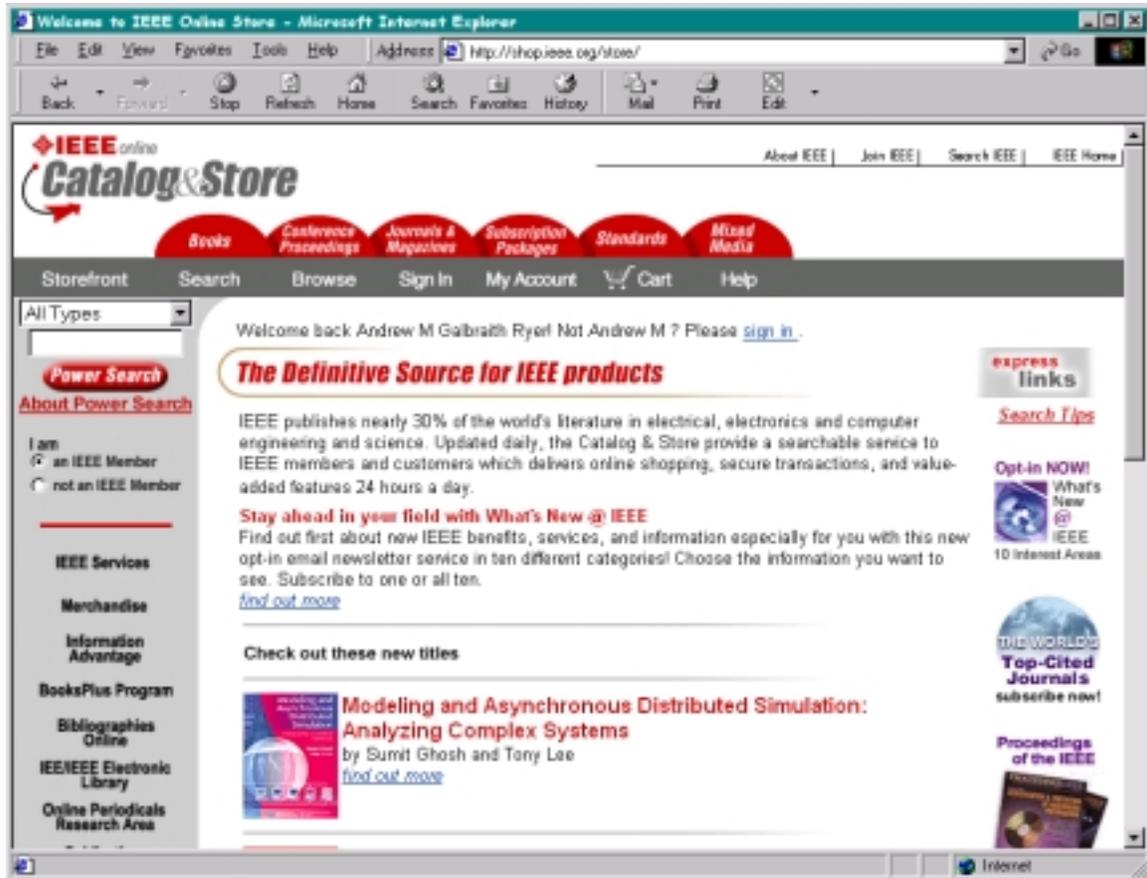
The IEEE is the world's largest technical professional society, producing 30% of the world's published literature in electrical, electronics and computer engineering and science. Their goal was to allow members and customers to browse, search and make purchases from their valuable trove of technical literature.

As an established business, the IEEE already had a significant infrastructure in place. In addition to the systems supporting their "brick and mortar" business, they had already begun to move some of their services online. The result was a diverse environment of systems and applications. The new e-commerce site would need to integrate with these systems.

1.2 The End Result

What followed was an eight-month effort to create one of the most complex e-commerce sites on the Internet today, the IEEE Online Catalog & Store.

Since it was introduced in December of 1999, the IEEE Online Catalog & Store has become the fastest growing sales channel at the IEEE. Sales of key IEEE products have shown an increase in sales that is directly attributed to their availability and ease of purchase online.



1.3 Overview

One of the key challenges of the IEEE Online Store & Catalog was integrating it with the diverse environment that already existed. This is a challenge that will be faced by more and more established businesses as they move online to remain competitive.

The goal of this document is to present some of the integration insights and techniques employed to make the IEEE Online Store & Catalog a success.

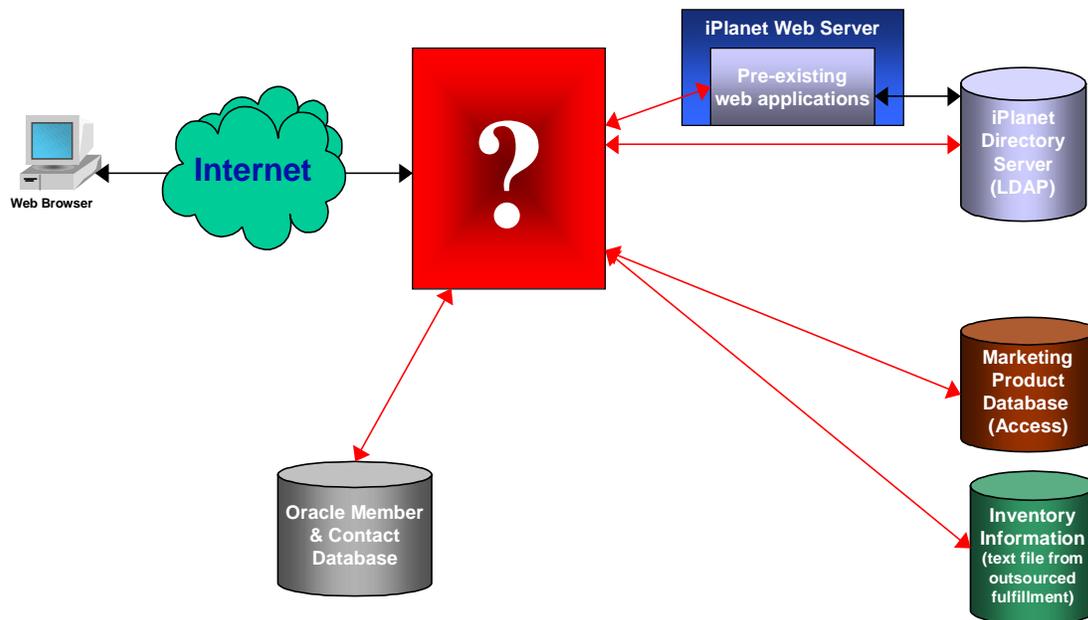
2. Background Information

The first step in the process was a detailed requirements phase. Careful attention was paid to the user experience, particularly when interacting with the existing systems. It is important that users perceive a uniform browsing experience.

2.1 Existing Infrastructure

A significant challenge of the IEEE Online Store & Catalog is integrating it with the systems that make up the current infrastructure:

- An Oracle database of customer contact and address information. The database is shared by numerous web and back-office applications. The online store must be able to update this data according to a complex set of business rules.
- An LDAP database implemented with iPlanet Directory Server.
- An existing suite of Server Side Javascript applications on an iPlanet Enterprise Server that update information in the LDAP database.
- A Microsoft Access database of product information maintained by the marketing organization.
- A text file of updated inventory data. This data is provided daily by an external firm handling inventory management and order fulfillment.



These pre-existing systems needed to be integrated with the new IEEE Online Store & Catalog. The question is how to link them all together.

3. Choosing Tools

The most important step in any e-commerce solution is deciding on the tools that will be used.

3.1 The Commerce Server Software

The most important component of any e-commerce solution is obviously the commerce server. Integration concerns can play a large role in the selection process.

3.1.1 Questions to Consider

Some key questions to consider when evaluating products are:

3.1.1.1 What operating system should it run on?

Stability, scalability, performance, and cost are concerns, but there may also be existing mandates that must be adhered to. Platform independence may also be important in a heterogeneous environment.

3.1.1.2 What databases are supported?

The choice of commerce server may require the purchase of new database software or the choice of commerce server limited to one that supports existing database installations.

3.1.1.3 What facilities are there for incorporating custom programming?

This is less of an issue when the e-commerce site is for a brand new business. However, once legacy systems are involved, custom programming on some level will almost certainly be a requirement. The amount of custom development required may be small, but this issue should not be overlooked. Otherwise, the commerce server could itself become a hurdle to integration.

3.1.1.4 What well know programming interfaces are supported?

In addition to custom programming facilities, the software should support well know programming interfaces and standards. This helps to leverage existing software development expertise and training. It can also be an indicator of the long-term viability of the product.

Key programming interfaces include:

- COM: Although this is a Microsoft specific technology, it enjoys wide acceptance and use.
- Active Server Pages: Like COM, it is widely used despite being a Microsoft specific technology.
- Java 2 Enterprise Edition (J2EE): The standard for development of enterprise applications in Java, and offers support for key technologies like Java Server Pages (JSP) and Enterprise Java Beans (EJB).

3.1.1.5 What developer tools are available?

Good development tools streamline the development process and help reduce any initial learning curve. They also help to ensure long-term maintainability.

3.1.2 Some Obvious Choices

There are, of course, numerous e-commerce software packages available. There are, however, some software packages that can be relied on to deliver the features and flexibility to make the e-commerce site a success.

Two in particular are the following

3.1.2.1 Microsoft Site Server Commerce Edition

Widely used for e-commerce solutions across the Web, Site Server Commerce Edition offers a rich suite of tools for building e-commerce applications on the Microsoft platform. and support for a broad collection of third-party add-ins.

The Microsoft Visual Studio development environment is also widely used and ideal for developing Site Server Commerce Edition solutions.

3.1.2.2 BEA WebLogic Server

WebLogic Server provides an industrial-strength set of services for building e-commerce applications using J2EE standards.

BEA offers WebGain Studio, the leading development solution for e-commerce applications in a J2EE environment.

3.1.2.3 There are always others

Each of these products represents an arsenal of tools for tackling and e-commerce challenge. They are particularly flexible and therefore well suited to the task of integrating an e-commerce solution into an existing environment.

They are by no means the only products worth considering. For example, Oracle's dominance in the database market warrants consideration of its commerce software. Iplanet has made a strong showing with their own J2EE application server. These are only a few of the myriad commerce server software solutions available.

3.2 The Database

As is mentioned above, the choices of commerce server platform often determines the database and vice-versa. Established businesses almost always have existing database servers. The decision is whether to try and leverage existing servers for the e-commerce site or build new ones.

3.2.1 Questions to Consider

3.2.1.1 Is this an opportunity to upgrade?

Although legacy systems may need to share data with the e-commerce site, it may not a good idea to base the commerce site such a database. This may be a good time to invest in new technology for the commerce site, and as a first step in migrating data from legacy systems.

3.2.1.2 Can an existing database handle the load?

Performance and scalability is a concern, but even more so when the e-commerce site could take productions applications down with it.

3.2.1.3 What affect will this have on licensing requirements?

Most database servers cannot user per-user licensing if they are being used for Internet applications. The switch to CPU licensing is usually a large price jump

3.2.2 Oracle, SQL Server, and the Rest

The choice of a database is almost invariably a choice between Oracle and SQL Server. Each database has its issues and benefits. Usually the decision comes down to a combination of the following factors:

- Reliability
- Performance
- Scalability
- Price

3.3 Hardware and Operating System

The choice of commerce server platform and database will most likely lead to a hardware and operating system decision already. If not, the decision be between one of the following:

- Commercial UNIX
- Windows
- Linux

Like the database, the reliability, performance, scalability, and price are the key factors driving this decision.

3.4 Choose Wisely

Components of the e-commerce solution should be chosen carefully. The wrong choice could have disastrous affects on the long-term success of an e-commerce site.

3.5 The IEEE Online Store & Catalog

3.5.1 Microsoft Site Server Commerce Edition

It was ultimately decided that the IEEE Online Store & Catalog would be implemented using Microsoft Site Server Commerce Edition. The reasons for this decision include:

- Site Server Commerce Edition includes a number of out-of-the-box features that fit will with the requirements for the site.
- The creative staff responsible for the content of the site felt comfortable working in the Active Server Page based environment.
- Several features of Site Server help solve the integration issues.
- The overall cost of the solution was a concern.

3.5.2 Oracle Database

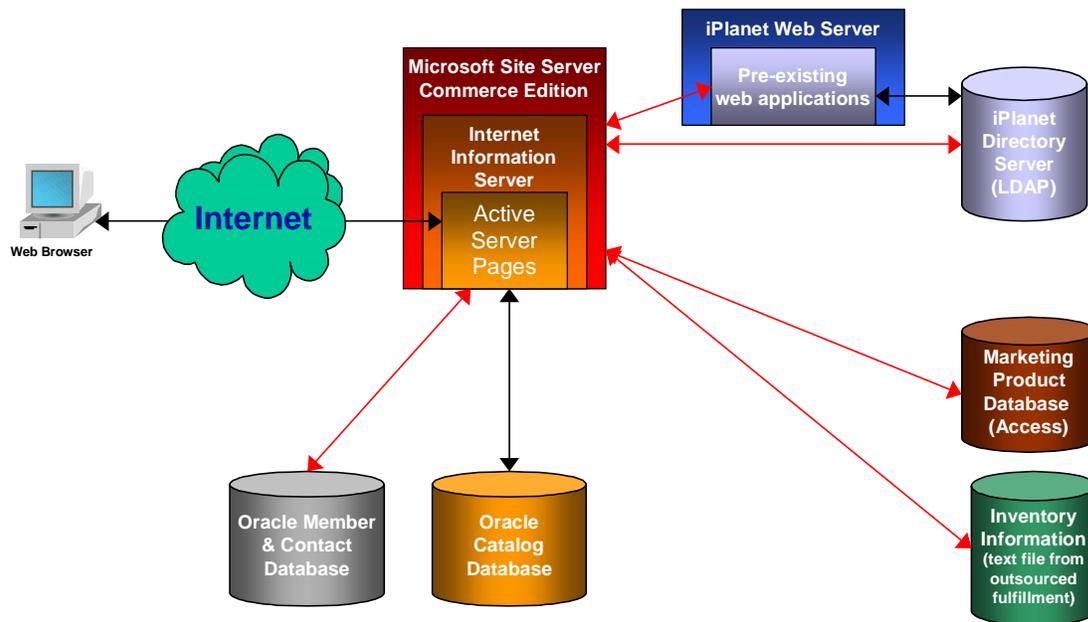
The IEEE already has a significant Oracle installation. Since there are ample resources available on the existing Oracle server, it was decided to use Oracle for the database.

A new database instance would be created to serve the catalog. This instance could be moved to a separate server if performance became an issue.

3.5.3 Windows NT

Once the choice of Site Server was made, the choice of operating system was also clear.

In production, the site is load balanced between dual P-III servers running Windows NT 4.0 with Windows Load Balancing Service installed.



Microsoft Site Server Commerce Edition was chosen for the commerce server. Oracle would be used as the database for the site. The site would run on Window NT Enterprise Edition 4.0.

4. Integrating the Site

4.1 Integrating Oracle Member and Contact Data and Business Logic

Address and contact information of IEEE members and customers is stored in an Oracle database. This data needs to be accessible from the catalog, so the billing and shipping information for members can be retrieved.

In addition, customers need to be able to update this information from the catalog, as part of the check out process. Updates to address information include address verification and must follow IEEE business rules.

4.1.1 *Centralizing the Business Logic*

Address update logic already existed in several places. In addition to the Oracle Forms applications used by processors in the back office, the update logic had already been implemented in a standalone web application.

Instead of re-implementing this logic for a third time, the catalog & store was used as an opportunity to develop the basis for a centralized business logic, which would ultimately be deployed in a multitier environment.

4.1.1.1 Long Range Goals for Multitier Environment

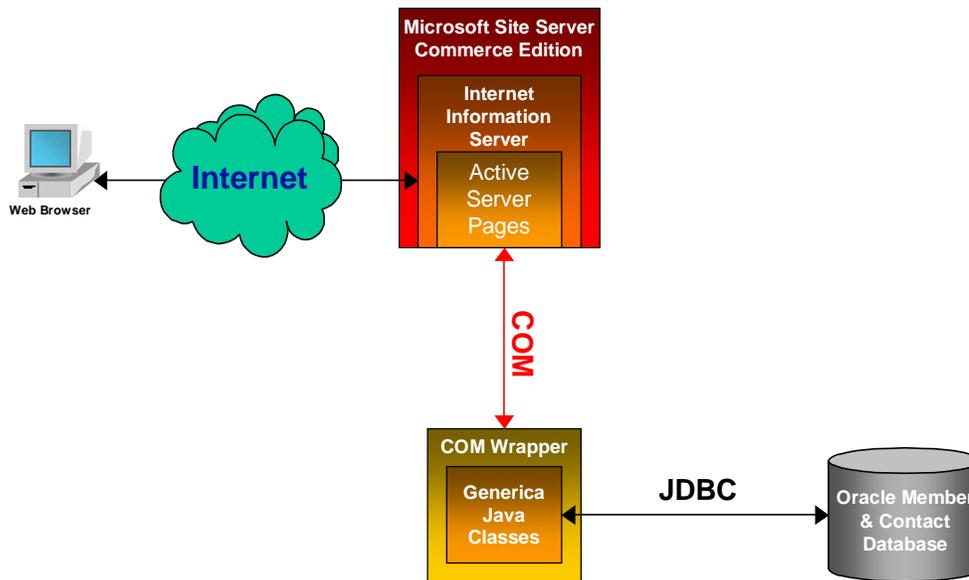
The multitier architecture at the IEEE would ultimately use CORBA and Enterprise Java Beans (EJB). COM to CORBA bridges would be employed to support Windows system access to the middle tier.

This environment was not in place when the site was being developed. However, it was still a goal create re-usable business logic for the contact update procedure.

4.1.2 *COM-Wrapped Generic Java Classes*

The solution was to develop Generic Java classes that implemented the business logic. These java classes could be used by any Java application to perform contact and address information changes. Access to the database is done with JDBC to remain platform independent.

To access the classes from the catalog, a thin COM wrapper was also written Java. This wrapper provided a COM interface to the store and instantiated the generic classes for performing contact information changes.



Generic Java classes implement the IEEE business logic for updating contact and address information. These classes use JDBC to access the Oracle database. A thin COM wrapper is used to make these classes available to the store.

4.1.3 Path to Multitier

In the future, when the multitier environment is online, these classes can be incorporated into a true Enterprise Java bean. The store can, in turn, be modified to process contact updates through the middle tier.

In the meantime, the store has a functioning address update mechanism.

4.2 Integrating the LDAP Membership Directory

All IEEE members are entitled to IEEE Web Accounts. These are LDAP accounts that give the member access to online services, including online renewal of their membership. It also gives them access to significant discounts in the store.

The Web Account is also the key for retrieving and updating contact and address information.

4.2.1.1 Obtaining Web Account Information from LDAP

The online store must authenticate web account username/password combinations against the LDAP. It also retrieves information about the user. This is accomplished with the Microsoft Active Directory Services Interfaces (ADSI). ADSI is a collection of tools and programming interfaces to set and retrieve user information in, among others, an LDAP database.

ADSI proved to be an important feature of Windows NT and Site Server Commerce Edition. Integrating the existing web application was not as easy.

4.3 Integrating Pre-existing Web Applications

The web applications on the iPlanet Enterprise Server have been in use as standalone applications for over two years. Now, users of the online store would need to access the services provided by these applications.

Although an overhaul of these applications and the LDAP in general are in the works, they were not going to happen before the catalog went live. So it was necessary to integrate the existing web applications with the catalog.

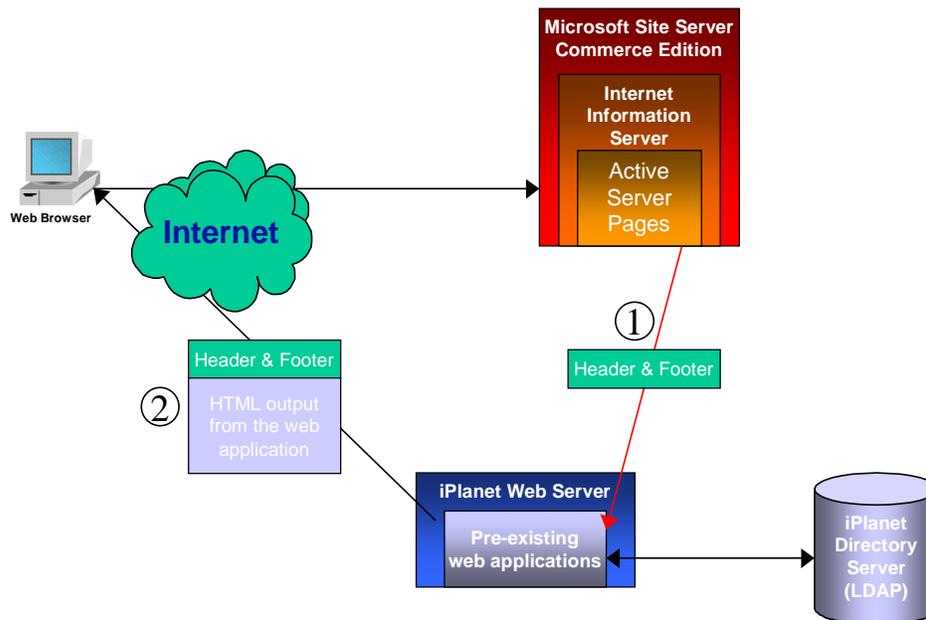
The solution needed to be designed so that the catalog user did not lose their current session, nor would they be completely aware that they are accessing a different application.

4.3.1 Handing Off

A system was devised whereby the online store could pass the user to the iPlanet applications, which would, in turn, hand the user back when finished. This was accomplished with some simple modifications to the existing web applications.

Each web application was modified to accept several additional parameters in the URL. These were:

- The name of the application handing off the user. This is used in some descriptive text and instructions.
- A URL for a header and footer graphic to be displayed. With the customized header and footer, the logo for the online store is always there, presenting a unified browsing experience to the user.
- The URL to send the user to when they are done. When the user is finished, they'll end up back in the catalog.



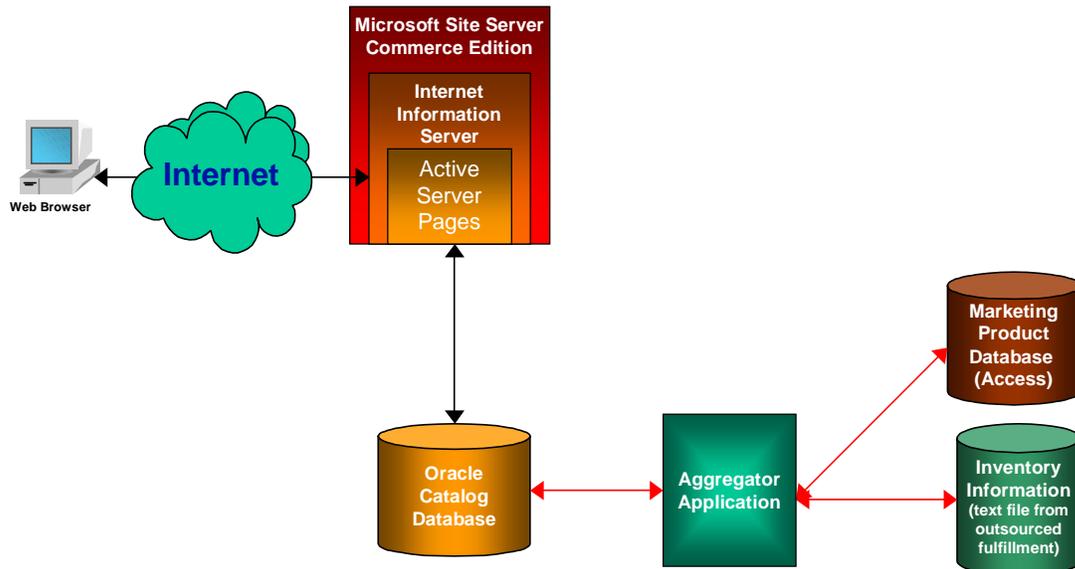
- 1) The online store passes the URL of a header and footer image to the iPlanet server. The web application adds the header and footer to the HTML output.
- 2) The result is a page from the IES server that looks like it is from the store/

4.4 Merging the product data

Product data comes from two sources:

- A Microsoft Access database of product information maintained by the marketing organization.
- A text file of updated inventory data. This data is provided daily by an external firm handling inventory management and order fulfillment

The content of these two data sources needs to be merged and placed into the product database used by the catalog. Data integrity must also be checked.



The Aggregator Application combines the data from the two sources and makes it available to the online store.

4.4.1 The Aggregator

A custom application was called for to solve this problem. The application would be scheduled to run when new inventory data has arrived. It is merged with the contents of the Marketing access database. The application was dubbed the aggregator.

It supported command line and windowed operation modes. In this way, it was easy for an operator to run it by hand in the windowed mode, but the command line mode could be used for batch scheduling.

5. Conclusion

The IEEE Online Store & Catalog is just an example of the success that can be achieved in an established business. Industry analysts are predicting that more established businesses need to launch e-commerce sites if they are to remain competitive. Good techniques for integrations can help those businesses remain successful.