December 2004

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Yonghe Yan
DePaul University

Anthony Zoko
DePaul University

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Web Hosting Service Model for E-Commerce Education

Yonghe Yan
School of Computer Science, Telecommunication, and Information Systems
DePaul University
yyan@cti.depaul.edu

Anthony Zoko
School of Computer Science, Telecommunication, and Information Systems
DePaul University
azoko@cti.depaul.edu

ABSTRACT

This paper presents a web hosting service model that provides students web hosting service in e-commerce programs. The web hosting service provides each individual student a client server environment to support the development cycle of web application development. The web hosting service consists of main service and support service. The primary service provider is technical staff. Students in e-commerce programs are the customers and users of the services. Instructors, together with technical staff, provide students the support services. The web hosting service makes it easy for students to learn and develop web application without concerning integrated networks, computer systems and application components required to support web application. Key issues of implementation and management of the web hosting service are addressed in the paper.

Keywords

Web hosting service model, technical support, e-commerce education, web application development.

INTRODUCTION

The Web has become a widely accepted platform for delivering interactive applications for e-commerce. Web application development is a preferred skill that practitioners expect students graduated from e-commerce programs to have (Mitchell and Strauss 2001). Various courses for web application development are offered in e-commerce programs to prepare students meeting the demands of web application development. One of the challenges in e-commerce curriculum is the technical complexity of implementing and managing the client server environment required to support dynamically interactive web sites. It is relative easy to create static web site using text editors or GUI authoring tools such as FrontPage or Dreamweaver. Static web sites are normally designed for providing static information. Business logic is hardly able to be incorporated into static web sites. Dynamic interactive web applications that implement business strategies inevitably involve web server technologies, which are technical, complex, and rapidly evolving.

Web application development emphasizes the implementation of effective user-interface and information architecture. Web application developers are no longer interested in the management and implementation of integrated networks, computer systems and application components that support web applications. Web applications can be developed on the top of a web hosting service, which is provided by an IT service provider. Web hosting services make it easy for developers of web applications to focus on the implementation of effective user-interface and information architecture, shorten development times and improve the flexibility of systems.

Researchers have acknowledged the layered model of IT service development. Garschhammer et al. (2002, 2001) proposed a generic service management model for IT service that are composed of interdependent, layered services hosted by various service providers. Mayerl et al. (2000) addressed an integrated service management architecture supporting IT service provider to assure the quality of IT services. Lewis (2000) reviews various approaches applicable to service management system development from Telecommunications, Distributed Systems, Internet and Software Engineering fields. However, virtually no research has been published that reveals service model for e-commerce education.

E-commerce programs in higher education aim at preparing students for technical and managerial careers in e-commerce fields. Teaching students web application development in e-commerce programs should focus on the implementation of effective user-interface and information architecture. Integrated networks, computer systems and application components that support web applications should not be of concern for e-commerce students. Hence, a web hosting service is needed to build up to support the courses, which teach students web application development and e-commerce strategies based on web applications. Students utilize the service to learn the essential skills of web application development and e-commerce strategies, and leave the implementation and management of the web hosting service to the technical staff.
The objectives of this paper are to address a service model that provide students the web hosting service in an e-commerce curriculum and to identify key issues of implementation and management of the web hosting service. The service provides each individual student a client server environment to support the development cycle of web application development. The primary service provider is technical staff, and students are the customers and users of the services. Instructors, together with technical staff, provide students support services. Overall, the web hosting service makes it easy for students to learn and develop web applications without concerning integrated networks, computer systems and application components required to support web applications. In the following sections, we first present a service model of web hosting service for an e-commerce program, and then key issues of implementation and management of the web hosting service are addressed.

WEB APPLICATION DEVELOPMENT CYCLE

Web hosting service provides a web application development environment for students to practice the skills learned from various courses in an e-commerce curriculum. A client server model for e-commerce technology is the technical foundation for the web application. Students are able to complete a web application development cycle through the service provided.

Client Server Model of E-Commerce Technology

The Web is a platform for the application of Internet technology to support consumer-oriented e-commerce, enterprise e-business solutions, and emerging business-to-business trading models. These web applications are typically implementations of business models and provide up-to-date response with the information customized and personalized to meet each request. Databases play an essential role for information storage and retrieval in such a web application.

The fundamental architecture for a web application is a client server model. This model typically consists of three tiers. Tier 1 is the user interfaces rendered in a web browser running on client computers. Tier 2 is the business logic implemented in a web server. Tier 3 is the databases for data storage and retrieval controlled by a database management system. Figure 1 illustrates the conceptual model. This model meets the major requirements of courses for web application in e-commerce curriculum.

![Figure 1. Web Application Model of E-Commerce Technology](image)

Web Application Development Cycle in E-Commerce Education

Students develop a web application on a client computer. The client computer should be connected to the web server through a network connection. To develop the web application modeled in Figure 1, a student needs the following client software tools on the client computer:

- Web browser;
- Web page authoring software;
- FTP client software; and
- Database management system.

The web page authoring software can be as simple as a text editor or as sophisticated as an integrated development environment, such as Microsoft Visual Studio. Although an experienced developer might be more productive with using graphic user interface (GUI) software, we prefer students to use text editor rather than GUI authoring software for web application development. GUI authoring software can generate code automatically and hide details from the developer. These features help developers in production environment to concentrate on more specific web application development. They are
not good for students who are learning the web application development. Students might not be able to understand some
essential concepts that GUI authoring software hides in automatically generated code. On the other hand, a simple text editor
is ubiquitous on all versions of operating systems. It is ready and simple to use. Students can use a text editor with little
training and technical support. It simplifies students’ needs for training and support services.

FTP client software helps students transferring web pages and related data files from the client computer into the web server.
Nowadays, web browsers such as Microsoft Internet Explorer feature FTP functionality and therefore no extra FTP client
software need to be installed on the client computer as long as the client computer runs Microsoft Windows. This simplifies
software requirements for the client computer.

Students use these client software tools on the client computer to complete the web application development cycle. These
tools are used at different stages of the development cycle. We do not intent to address an entire software development cycle.
We only include web page construction and testing in the web application development cycle, which is described below.

Web application development cycle:
1. Create web pages using a text editor.
2. Create necessary databases with a database management system such as Microsoft Access.
3. Debug and test the web pages by repeating the following steps:
   a. Upload the web pages and databases from the client computer to the web server, typically using FTP
      client software.
   b. Check the web pages and database for errors and accuracy by requesting the web pages, using a web
      browser, from the client computer.
   c. Modify the web pages and/or databases if necessary.
4. View the web pages on the web server as a final check.

The strategy for us to determine the specifications of the client computers is keeping the software requirements for the client
computers simple and minimal. This strategy can benefit students and instructors in term of training and support services for
the client computers. Each individual student may have his/her own computer that is likely used as the client computer. Each
student computer may run different versions of operating systems and have different configurations. It is very difficult and
costly to provide support to run sophisticated client software on these client computers. Moreover, students will not take
away some of the essential concepts of web application which are hidden by sophisticated software development packages. It
is better for students to learn all aspects of web application developments with writing all the code themselves. However,
database management systems are still very sophisticated software packages which are required on the client computer. This
issue will be addressed later in support services of the web hosting service model.

WEB HOSTING SERVICE MODEL

The web hosting service provides students a client server environment for them to complete the web application development
cycle, and develop the web applications that are modeled in Figure 1. Each individual student is provided a web account, i.e.
a web site. The student loads web pages and necessary databases into the web account, debugs and tests the web site to
complete the development cycle described in previous section. The web hosting service model is shown in Figure 2.

The Customer

A student block in Figure 2 represents a student and a client computer used by the student. Students are the customers and the
users of the web hosting service. The specification of the client computer is discussed in previous section. The hollow arrows
are network connections. They connect a student’s client computer to his/her web account, which is the service access point.
Students are also able to access support service through network connections, especially the support services carried out via
email, discussion forums, and the Web.

The Main Service

The web hosting service consists of main service and support service. The web hosting service block in Figure 2 depicts the
main service. Technical staff is responsible for implementing and managing the main service. These will be explained in
detail in section of web hosting service.
The Support Service

Support service processes are shown in support service block of Figure 2. Each support service process is named after the means that carries out the process. The instructor is the primary point of contact for the support services. The solid arrows in Figure 2 represent process connections. Students initiate support service processes, and receive support services. Technical staff, together with instructors, also provides support services.

Figure 2. Web Hosting Service Model

SUPPORT SERVICE PROCESSES

Support services facilitate students to use the main service, i.e. the web hosting service. It is also a major component of the web hosting service. A variety of means are used to carry out support services. These support services help us to maintain the web housing service at high level of responsiveness, reliability, assurance, and empathy, which will have a positive influence on student self-efficacy and satisfaction with the service provided (Parasuraman et al. 1994; Kettinger and Lee 1994). Instructors and technical staff are responsible to provide the support services. An instructor may assign his/her teaching assistant to be the primary point of contact for support services.

Points of contact for support services:

- Primary point of contact: An instructor/teaching assistant is the primary point of contact for the support services. When a student has a problem with the main service, he/she contacts the instructor/teaching assistant of the course for help. Most problems are trivial, repeatedly raised and can be easily solved. Students may be referred to technical staff for technical assistance.
• Complementary point of contact: technical staff is also responsible for providing technical support services. Students contact technical staff either directly or referred by an instructor. Students can also get help from a lab assistant when they are in a lab.

Support service comprises support service processes represented by small blocks in support service block of Figure 2. The support service processes complement one another to facilitate students to use the web hosting service.

**Tutorial**

Tutorials need to be offered on the usage of the web hosting service in an introductory course of web application development. That is, students have to be taught how to use the client software. Among the client software discussed in previous section, FTP client is essential for students to use the service. It gives students, as customers of the service, the access to the main service. Every student needs to know how to use FTP client software to upload web pages and related data files into the web account assigned to him/her. A student simply cannot utilize the main service without mastering FTP client software. A tutorial on FTP client software can pave the way to the usage of the service. Students also access the service as users of the main service using a web browser. Web browser is so popularly used that no special treatment is needed.

A tutorial on creating and maintaining a database using a DBMS, like MS Access, also needs to be offered to students. Of course, the tutorial is very brief and basic. Although DBMS is the most sophisticated among the client software packages, it will not cause a problem because courses on database are typically required in e-commerce curriculum. Students are expected to learn it from database courses. Instructors should point out that students should learn database concepts and the use of a DBMS from a designated database courses. Therefore student’s expectation for support services of the DBMS is low and easy to be satisfied.

**Lab Session and Lab Assistant**

Given that students’ mastering of learning material is statistically always a student distribution, having every student comfortable with the FTP client software is not an easy task. A tutorial on FTP client software may not be sufficient for some students. A lab session can help an instructor to check whether every student has known how to use his/her web account.

Lab assistants are placed in the lab that primarily serves students from the e-commerce program. The lab assistant is a student worker, who has completed a web development course with good standing or is a senior student from Computer Science program. Therefore, the lab assistant is well-trained for the web hosting service and is ready for helping other students. Lab assistants work directly under the technical staff and are the primary source of help for students using lab facilities. Issues that lab assistants cannot directly attend to can be immediately routed to technical staff. After hours issues are routed through emails.

**Office Visit**

After tutorial and lab session, some students still need an instructor’s attention. The student can meet with the instructor for one-on-one instructions.

**Email**

Email is the major communication tool for students seeking technical support. Students can contact an instructor via email. Students may be referred to the helpdesk, which is administrated by technical staff. The helpdesk is broken up to serve two populations, a primary helpdesk for faculty and staff, and another for student related issues. Administrators of the web hosting service answer helpdesk email.

**Discussion Forums**

Discussion forums are good for peer discussion among students. Technical staff and instructors can guide the discussion and post solutions to common problems. Discussion forums help the instructor to disseminate the solutions to common problems. Lab assistants are also entrusted to monitor discussion forums and report to technical staff any issues that fall out of their immediate capabilities.

**Web**

A central web portal ties together all of the different services for students, and provides a central place to look for tutorials, FAQs, links to the helpdesk, and related support discussion forums. Students sign up the web hosting service from the web
site. The main page is comprised of links to lab information guides, most common tutorials, news alerts, policies and procedures, and the last 10 postings to the discussion forums. It gives an immediate view to the student of all the different types of information resources they have access to.

WEB HOSTING SERVICE

A web hosting system relies on a number of subsystems in order to operate stably, effectively, and securely. As part of integrated architecture, students themselves activate and discover their accounts (along with all other department resources) at the beginning of each academic term. Centralized directory services provide the authentication and authorization services for the web hosting system. Microsoft Active Directory (Microsoft 2000) is used to provide the centralized directory services. It stores information about its users and can act similar to a phone book. This allows all of the information and computer settings about an organization to be stored in a central, organized database. Students are each provisioned a single departmental user account. They use the user account to access a variety of network resources such as Lab Machines, Terminal Serves, and their web accounts through FTP. In this section, we will detail how the accounts are configured as well as how the web servers are managed to handle large numbers of students developing web applications.

Web Account Configuration

Web accounts are hosted on a Microsoft Windows 2000 Server running Internet Information Services (IIS) with a number of runtimes available for student to use, namely, ASP, .NET Framework, Perl and PHP. Each web account is configured as an out-of-process ISAPI (Trent et al. 1997) application so that each process will not affect other web accounts should it become unstable. ISAPI applications are similar to CGI applications in that they are executed in their own process space on the server and highly isolated from one another. However, ISAPI applications are still managed by IIS. This configuration decreases performance slightly but increases overall server stability and availability. Since students’ web applications are often full of bugs and prone to request exorbitant computer resources, isolating students’ web applications from one another can achieve better overall server stability and availability.

Directories and access permissions set for each directory are illustrated in Figure 3. The Server Root is the root directory of both web server and FTP server. The access permissions are set to allow the web server read from all files. Account Roots are directories below the Server Root. Each Account Root is named after a student’s username. An Account Root is the root directory of a web account. This directory allows the user to have full access. The access to web accounts is provided through FTP. The user can read, write, add, and remove files under Account Root and any sub-directories he/she creates (shown as dotted directory in Figure 3). These directories grant the web server, i.e. outside world, read-only permission. Finally, below an Account Root, a directory named Database is created with write permission to the web server. It gives students a place to put database files or other files that their web applications can write to. Student’s user accounts, which have access to the web server, are populated into an Active Directory domain group which is given read permission only to server root directory so that they can be authenticated by the FTP server and bypass the server root directory to access their account directories.

![Figure 3. Directory Structure and Access Permissions](image)

Web Server Management

Students are assigned web accounts based on course enrollment. These accounts are provisioned across multiple web servers based on enrollment size. A number of key services are needed to ensure students to discover what accounts they have, authenticate to the account, and develop web applications on a web server that is stable and operational 24 hours a day 7 days a week. We follow OSI network management model (Yemini 1993) to address the web server management as illustrated in
web hosting service block of Figure 2. Because accounting management is not applicable under the circumstances, we do not implement it.

Configuration Management

Configuration management is handled at two specific points. A user is given an account within Active Directory and granted access to a domain group that controls access to the Web Server Root directory. We developed a custom script that runs daily on each web server. This script collects enrollment data from a database and user account information from the Active Directory to generate the accounts on each web server. It also runs in a diagnostic mode to ensure that directory permissions are correct on a daily basis and fixes any problems it encounters.

One of the key elements in the support infrastructure is the notion of account activations and resource discovery at the beginning of each academic term. Students at the beginning of each academic term are required to log into a central site, enter their university credentials and activate their departmental user accounts. This procedure serves two purposes

1. has the user agree to a central end user agreement for all services accessible through the user account and
2. discovers what resources he/she has access to.

A standardized configuration policy for each computer resource is created. The policies and procedures ensure that resources are configured in a standard way and are reproducible each term. The introduction of new services must fit into the configuration framework and any new additions or modifications must be reported to the entire administrative staff.

Fault Management

A number of key facilities are used to enable fault management on the web servers. One of the primary tools we built is a garbage collector called SNIPER. It is able to ensure the stability of the server. SNIPER monitors out-of-process ISAPI applications that run on the server. After a specific length of time or if the process exceeds a predefined memory threshold, it kills the process. Each web server runs within a VMWare Virtual Machine (VMWare 2003) to maximize the usage of the underlying hardware and to segment populations better without the need for additional hardware. One of the added bonuses of using virtualization is that the entire state of the machine can be backed up and restored within minutes. Regular backups of the students’ work within the virtual machine and the backup of the Virtual Machines allows for nearly complete recovery of the entire server in the event of a catastrophic failure within a few hours.

Performance Management

Performance monitoring is critical to preempting a critical failure on the servers. A number of metrics are constantly polled on the server including CPU usage, memory usage and disk usage to gauge the health of the server. If any of the thresholds have been exceeded, administrators receive a page on their cell phones notifying them of the state of the server. A third party tool, IPMonitor (Tsarfin 2004) is used to monitor whether the server is responding at all. In the event of a catastrophic failure, a page is sent out within 15 minutes detailing which server is no longer accessible.

Security Management

Tools such as Shavlik Security Patch Management (Shavlik 2004) and Panda Antivirus (Panda 2004) are deployed on the server to keep system files and virus definitions up to date. Policies and Procedures are the keys to the security of the server. Directory services provide a uniformed model of access control through out of the school infrastructure.

Access control is modeled closely to the administrative model of the school. Access lists in the Active Directory are modeled after rosters. The resource access list is a specific list of resources a user can access with their school credential and any supplemental information they need to access the resource. For example, a student will be told that he/she has access to a specific lab and what privileges he/she has for that term on those machines. Students also have access to web server. In this case a discovery tool will point out that they need to use FTP and provide a link to a tutorial on how to access the resource. This information about the resource is stored within the Active Directory. This tool is critical to the success of our helpdesk as it provides a standard procedure to find his/her web account and a detailed list of what can be done with the account.

CONCLUSION

We believe that the web hosting service model is a technical foundation of e-commerce education. The web hosting service model provides e-commerce education a systemic method for providing technical support to an e-commerce curriculum. We have implemented the web hosting model and provide services to about 500 students each term. Since we implemented the
web hosting service model, workload for providing technical support to e-commerce students has dramatically dropped. A single dedicated technical staff spent over 50% of his time dedicated to the management of the servers and handling technical support questions for users of this system. With the implementing of the service model this figure dramatically dropped to below 10% even as more students began using the services. The infrastructure and methodologies used to support the web hosting service model for e-commerce students was continuously refined and eventually extended to other services. Overall the students and faculty are pleased with the service and support provided.

REFERENCES


