

Online Auction Web Site Simulation

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Abstract

Online auctions are a profitable, exciting, and dynamic part of electronic commerce. It behaves in a way, which does not match classical auction. This paper provides a simulation model of an online auction. It models an online auction that helps auction organizer in order to determine his needs of servers and site architecture.

Keywords: Application Server, Auction, Database Server, Router/Firewall, Simulation, Utilization, Web Server.

1. Introduction

Simulation is used in the design process of dynamic systems. The results of simulation are employed for validating a model, and they are helpful for the improvement of the design of a system with respect to both, qualitative and quantitative properties [1]. The paper concentrates on these aspects and applications of simulation on architectures network for auction online presenting resources.

Online auction is one of the major E-commerce rapid growth branches. The E-commerce businesses allow customers to sell, trade, barter over the web. The auction site is the interface through which sellers and buyers can conduct business [2].

The auction site simulation should represent suitable network architecture and resources, since all access transaction from sellers and buyers are done through it. It presents necessary number of resources that are connected with each other in good performance. The simulation model is developed to the auction organizer to determine the resources depending on the statistical results that help him to decide the architecture he prefers.

This paper discusses requirements for simulation and validation auction online and finally suggests some factors that affect the design of network architectures. The paper is organized as follows. Section 2, describes the site architecture. The problem under consideration is formulated in detailed in Section 3. The developed simulation model and our methodology is presented and the results of simulation study are discussed in Section 4.

2. Site Architecture

One goal of the development of the simulation model was to build a package, which allows the auction organizer to find out the best number of resources that will have an accepted utilization of the resources. The site architecture is shown in Figure 1.

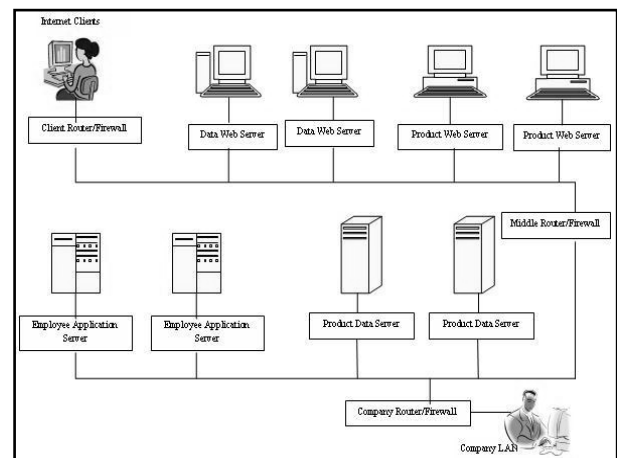


Figure 1: The auction web site resources architectures.

The auction site will have different hardware resources such as Web Servers, Database Servers, Application Servers, Routers/Firewalls and LANs [3]. The Internet visitors (clients) will enter through two Routers/Firewalls (client router) to a LAN containing a bank of Web Servers. The Web Servers are divided into two groups [3]:

1. Group1: to serve normal document requests and static images (ex. Company logo image), and
2. Group2: to serve dynamic images of the products the clients currently auctioning.

The Web Server's bank is separated out from Application Servers and Database Servers LAN through Routers/Firewalls (middle router). The application servers are divided into two groups [3]:

1. Group1: servers supporting client requests.

2. Group 2: servers supporting employee updates to the database.

Also the database servers are divided into two groups.

1. Group 1: servers contain the product database.
2. Group 2: servers contain the customer database.

Traffic also comes from the Company LAN to the employee application servers to maintain the customer databases, the product databases, and the product images on the web server. The company's LAN is separated out from the application/database servers through a Router/Firewall (company router). The Company's LAN is connected the employee application servers to maintain the customer databases, the product databases, and the product images on the web server.

3. Model and Simulation

The simulation of the web site architecture has many steps for requests and responses documents between web servers, application servers and data servers. The simulation is written in C# programming language .It includes statistical measures (e.g. mean, mode, and confidence interval).

3.1. Data

The simulation uses n unique request documents that a client can make and these are contained in a file such as "client.dat". For each document, you can list:

1. The number of static images (SI) contained in the document,
2. The number of product images (PI) contained in the document,
3. The number of product data (PD) queries required to populate the document and,
4. The number of customer data (CD) queries required to populate the document.

Similar data is provided in a file like "internal.dat" for the m unique documents of requests that an employee can make. This includes:

1. The number of static images (SI) contained in the document equal zero,
2. The number of product images (PI) to be copied to the product image web server,
3. The number of product data (PD) queries or updates required,
4. The number of customer data (CD) queries or updates required.

The requests of client and employee will be generated from the two input files randomly.

3.2 Modeling Assumption

Here are assumptions to get results from the simulation:

1. General data as shown in Table 1.

Table 1: General data setup

Variable	Value
Client request mean arrival time	t documents per second
Employee request mean arrival time	s documents per second
LAN speed	p MBPS

2. Approximate processing times for each burst of activity. They are given in Table 2 for the various web site resources.

Table 2: Approximation processing time

Resource	Minimum (milliseconds)	Maximum (milliseconds)
Router	R_{min}	R_{max}
Web Server (Documents)	$WS1_{min}$	$WS1_{max}$
Web Server (Images)	$WS2_{min}$	$WS2_{max}$
Application Server	A_{min}	A_{max}
Database Server	D_{min}	D_{max}

3. Approximate package sizes (bytes) for each type of request, image, or file that circulates over the web server LAN and/or the application server LAN are shown in Table 3.

Table 3: Approximate package sizes

Package	Minimum (bytes)	Mode (bytes)	Maximum (bytes)
HTTP request	H_{min}	H_{mode}	H_{max}
Returned Document	RD_{min}	RD_{mode}	RD_{max}
Database Query	DQ_{min}	DQ_{mode}	DQ_{max}
Query Response	Q_{min}	Q_{mode}	Q_{max}
Image Size	S_{min}	S_{mode}	S_{max}
Copy Confirmation	C_{min}	C_{mode}	C_{max}

4. Maximum numbers of resources available are shown in Table 4.

Table 4: Maximum numbers of resources available

Resources	Numbers
Web server LAN	W_S
Application Server LAN	A_S
Client Router	CR_S
Middle Router	M_S
Company Router	CPR_S
Documents web servers	D_S
Product Image web servers	PI_S
Client Application Server	CA_S
Employee Application servers	E_S
Product database servers	P_S
Customer database servers	CD_S

3.3 Using Zipf’s law within the Model

In this study, we investigate how an assignment of certain documents to certain servers will influence the future behavior of the system. We suggested using Zipf’s law to model the probability that given a document is requested [4].

The simulation will use this law when generate randomly the client request and the employee request.

3.4 System Modeling Processes

The system has two main processing of requests: processing client requests and processing employee requests as shown in Figure 2 and 3 respectively.

A client http request is received by the outside Router/Firewall. The request is belong to one of following:

1. If the request is for a product image, it is assigned to a product image server processed, and returned to the router/firewall to be sent to the client
2. If the request is for a static image (e.g. the company logo), it is assigned to a document web server, processed, and returned to the router/firewall to be sent to the client [5],
3. All other requests will require server side processing and proceed according to the following steps [5]:
 1. The request is assigned to a document web server. Initial processing takes place on the web server. A process thread is left open to receive the document when it is returned, and the request is forwarded to a client application server via the router/firewall

located between the web server LAN and the application server LAN,

2. The http request is now assigned to a client application server to build the page. A given page may make one or more queries to the customer data servers and/or to the product data servers. Each query will be routed along the application server LAN to the appropriate type of data server. The query will be processed and the response returned to the application server making the request (which left a thread open to receive the reply). A unique connection will be made to the appropriate data server for each query,
3. Once the document is fully populated with the appropriate data, it is routed back to the web server making the request, processed, and forwarded to the router/firewall to be sent to the client,
4. Once the client receives the document, additional requests will be sent to the web site for static images and product images.

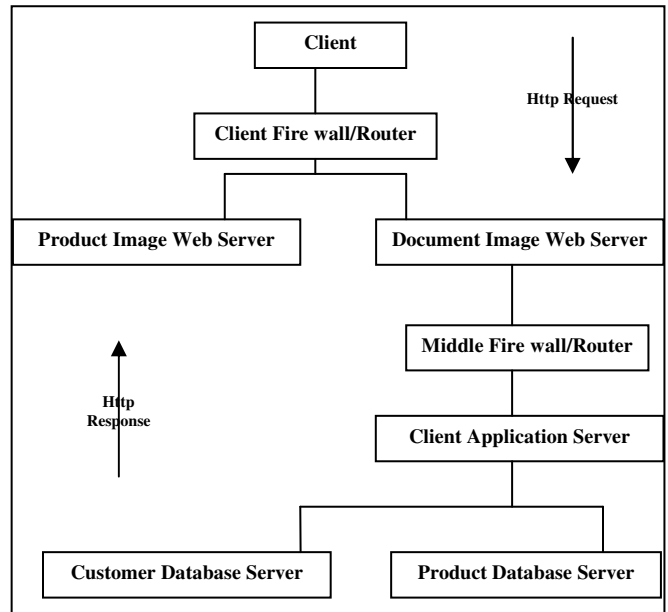


Figure 2: Processing Client Request.

The Company LAN has its own web server as well as a web development environment, which we do not need to model. Employees use the Company web server to run applications to maintain the auction product database and the customer databases. The employee request will be handling as follow:

1. The http requests from the company LAN are assigned to an employee application server. A given request may make one or more queries or updates to the customer data servers and/or to the product data servers.
2. Each query/update will be routed along the application server LAN to the appropriate type of data server. The query/update will be processed and the response returned to the application server making the request. A unique connection will be made to the appropriate data server for each action [5].
3. In addition, some http requests will require copying auction product images to the product image web servers. Each image will be sent to the router/firewall connecting the application server LAN and the web server LAN and assigned to a product image web server. The product image web server will save the image and send a copy confirmation back to the application server making the copy. A unique connection will be made to the appropriate product image web server for each image [2].
4. Once the http request is complete a document is created with the appropriate data and routed back to the web server on the company LAN via the appropriate router/firewall [2].

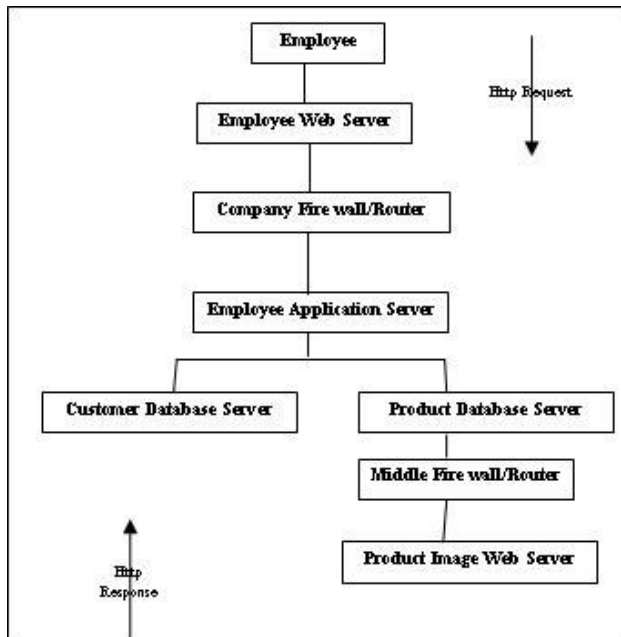


Figure 3: Processing Employee Request.

4. Results and Analysis

The simulation model is valid since it processes the client and employee request, as they are required. The model was developed using Microsoft .NET framework

SDK v1.1, C#.Net and Microsoft Office Excel 2003 to store the output statistical from the model. The results of running the simulation produce results close to the real ones.

The interface *Resources Determination Screen* is shown in Figure 4. The input resources are:

1. Web server Document,
2. Web server Image,
3. Application server Client,
4. Application server Employee,
5. Database Server Customer,
6. Database Server Products,
7. Client Router,
8. Employee Request,
9. Client Request.

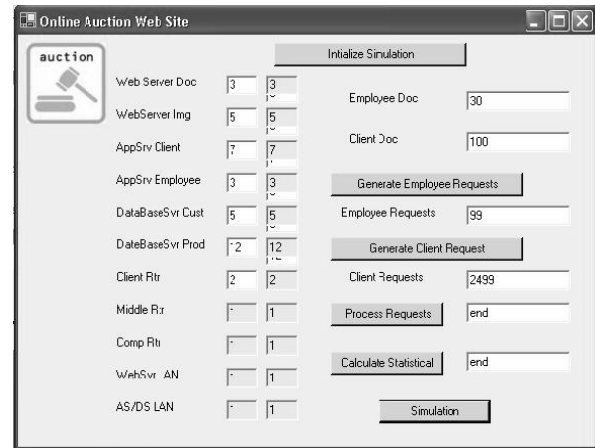


Figure 4: Resources Determination Screen.

After the organizer click on the simulation button *Simulation Running Screen* is displayed, similar to the one in Figure 5.

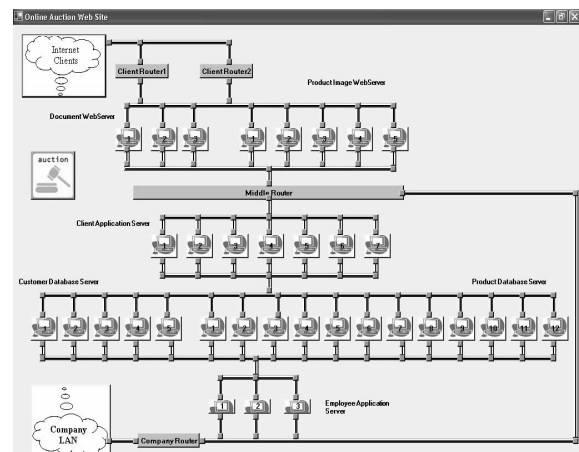


Figure 5: Simulation Running Screen.

On running the simulation, the user can notice the messages animation. The output of the simulation is generated in excel files.

We have determined results depending on the two main processes as described in Section 3.4 and shown in Table 9. These results generate to be discussed [6].

From the result in the Table 5, it is clear that when the utilization is greater than 0.5, the resources are used very well. Otherwise, it means that the organizer should reduce the number of resources that have lower utilization. This is done by the simulation. The organizer feels free to increase or reduce the number of each resource. He can increase or decrease the approximate number of client's requests and employee's requests in order he to reach good utilization.

Other set of results are shown in Table 10, with different number of resources.

From the result of the previous experiments, we can see that the utilization for each resource depends on the number of each one as mention in the tables. This gives the auction organizer to control the site utilization by changing the number of resources.

In the simulation, we are using 100 unique request documents that a client can make it, and using 30 unique documents of requests that an employee can make it. The random function that using to generate values for the variables in Table 1, 2, 3 and 4 as shown in the following tables.

Table 5: General data setup

Variable	Value
t	50 documents per second
s	s documents per second
p	p MBPS

Table 6: Approximation processing time

Resource	Minimum (milliseconds)	Maximum (milliseconds)
R	0.5	0.5
WS1	5	15
WS2	1	5
A	5	15
D	10	50

Table 7: Approximate package sizes

Package	Minimum (bytes)	Mode (bytes)	Maximum (bytes)
H	200	-----	1,500
RD	15,000	30,000	100,000
DQ	100	-----	300
Q	300	-----	5,000
S	200	2,000	10,000
C	-----	200	-----

Table 8: Maximum numbers of resources available

Resources	Values
W_s	1
A_s	1
CR_s	2
M_s	1
CPR_s	1
D_s	3
PI_s	5
CA_s	7
E_s	3
P_s	12
CD_s	5

5. Conclusion and Benefit

The concepts described here are just an initial outline of the role that models, simulations, and decision support tools can play in the auction site design. Based on the simulation results, the auction organizer should run the simulation many times until he/she reaches the suitable number of resources that produce accepted utilization. From the simulation, we can have the following benefits, that the auction organizer can estimate the cost of developing an auction site before establish it. It depends on the number of resources that give indicate the suitable utilization (70 percent at minimum).

In the future, the simulation system can be improved to have other options, like change the network architecture of the site (ability to have more routers and make the network architecture dynamic.), We are working on the simulation program to include more statistical results and graph drawing and have the simulation model in more GUI and animation.

6. References

- [1] Hideyuki Mizuta, Ken Steiglitz, "AGENT-BASED SIMULATION OF DYNAMIC ONLINE AUCTIONS", 2000, Proceedings of the 33rd conference on Winter simulation , Virginia .
- [2] Michael Rappa, "BUSINESS MODELS ON THE WEB",
<http://ecommerce.ncsu.edu/topics/models/models.html>
(25/12/2004-10/1/2005).
- [3] "APPLICATION SERVER DEFINITION",
http://www.service-architecture.com/application-servers/articles/application_server_definition.html
(29/12/2004 – 10/1/2005).
- [4] Catriona Tullo and James R Hurford, "MODELLING ZIPFIAN DISTRIBUTIONS IN LANGUAGE", University of Edinburgh ,2003.
- [5] Tony Sintès, "APPLICATION SERVER, WEB SERVER: WHAT'S THE DIFFERENCE? HOW DO WEB AND APPLICATION SERVERS FIT INTO THE ENTERPRISE?" ,
<http://www.javaworld.com/javaqa/2002-08/01-qa-0823-appvswebserver.html>. (29/12/2004 – 10/1/2005).
- [6] Dana H. Halabi, Deema H. Halabi, "Case Study: Online Auction Web Site Simulation ", CS, University of Jordan, 2005.

Table 9: The output statistical result in run the simulation (millisecond)

Resources	Numbers of resources	Max numbers of resources	Min	Max	Mean	Median	Variance	CI-Min	CI-Max	Utilization
Web Server LAN	1	1	0	9.9834	0.604996	0.1414	2.11658	0.604968	0.605024	0.95
Application Server LAN	1	1	0	9.9834	2.874727	0.1448	11.29269	2.873687	2.875767	0.305526
Client Router	2	2	0.5	0.5	0.5	0.5	0	0.5	0.5	0.38716
Middle Router	1	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.05002
Company Router	1	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.3302
Documents Web Servers	3	3	5	14	9.611161	10	7.232878	9.610762	9.611561	0.7115
Product Image Web Servers	5	5	5	14	9.814494	10	8.635391	9.814043	9.814944	0.6312
Client Application Server	7	7	5	14	9.42577	10	7.194615	9.413411	9.43813	0.0673
Employee Application Servers	3	3	5	14	9.055556	9	2.883648	9.003825	9.107286	0.50978
Product Database Servers	12	12	29	45	37	37	128	27.69447	46.30553	0.00148
Customer Database Servers	5	5	27	34	30.5	30.5	12.33333	29.05574	31.94426	0.60244

Table 10: Another result of the simulation system (millisecond)

Resources	Numbers of resources	Max numbers of resources	Min	Max	Mean	Median	Variance	CI-Min	CI-Max	Utilization
Web server LAN	1	1	0	9.9834	0.604996	0.1414	2.11658	0.604968	0.605024	0.95
Application Server LAN	1	1	0	9.9834	2.874727	0.1448	11.29269	2.873687	2.875767	0.305526
Client Router	1	2	0.5	0.5	0.5	0.5	0	0.5	0.5	0.85132
Middle Router	1	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.05002
Company Router	1	1	0.5	0.5	0.5	0.5	0	0.5	0.5	0.002
Documents web servers	2	3	5	14	9.655381	10	8.211527	9.654968	9.655793	0.95
Product Image web servers	3	5	1	14	9.672081	10	8.335109	9.670625	9.673536	0.95
Client Application Server	4	7	5	14	9.528302	9	9.169276	9.52047	9.536134	0.1212
Employee Application servers	3	3	5	12	11.42105	12	3.385491	11.3414	11.5007	0.50868
Product database servers	6	12	30	48	39	39	162	28.53128	49.46872	0.70156
Customer database servers	3	5	20	45	32.6	30	130.8	28.8373	36.3627	0.80326