American Journal of Engineering Research (AJER) 2016
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-5, Issue-1, pp-111-117
www.ajer.org
Research Paper Open Access

Modelling and Simulation of Load Balancing in Computer Network

[1]Gbadamosi Luqman and [2]Akanbi Lukman
[1]*Computer Science Department, Lagos State Polytechnic, Lagos State, Nigeria*
[2]*Research Scholar, Embeddedkits Technology, Osun State , Osogbo, Nigeria*

Abstract: *The overload of the servers and the resulting decrease in the Quality of Service (QoS) and performance becomes more serious as the use of Web services grows. In order to avoid this, service providers use large distributed networks of servers to attend the requests of the increasing number of visits in popular sites. OPNET (Optimum Network Performance) is used to develop a new model suitable for Osun State University, Nigeria. The model was then evaluated to measure the performance of the wireless local area network. The model was used for two types of applications (ftp and http) and found that among a set of other parameters response time and wireless media access delay were highly affected by the number of users per application with and without load balancing. OPNET simulation showed the impact of load balancing on wireless and wire-line network for two different types of applications.*

Key Words: *WLAN, Load balancing, Media Access Delay, Http response time, ftp response time.*

I. Introduction

Wireless access points are now common place on many university campuses (Bennington and Bartel, 2007) Technologies such as IEEE 802.11b wireless LANs (WLANs) have revolutionalized the way people think about networks, by offering users freedom from the constraints of physical wires. Mobile users are interested in exploiting the full functionality of the technology at their fingertips, as wireless networks bring closer the "anything, anytime, anywhere" promise of mobile networking. Wireless local area networks (WLANs) are spreading rapidly, their major advantage over wired ones being their easy installation.

Wireless communications is one of the most active areas of technology development of our time. Over the recent years it has rapidly emerged in the market providing users with network mobility, scalability and connectivity. Wireless Local Area Networks (WLANs) have been developed to provide users in a limited geographical area with high bandwidth and similar services supported by the wired Local Area Network (LAN) (George et al (2000)) Radio wave signals propagate through walls, ceilings, and even cement structures. A WLAN is a flexible data communications system that can either replace or extend a wired LAN where cost is an issue or running cables between floors or different rooms on the same floor is not feasible (GloMoSim, 2011)Examples of structures that are difficult to wire are warehouses, historic buildings, and manufacturing facilities. A WLAN basically consists of one or more wireless devices connected to each others in a peer-to-peer manner or through APs, which in turn are connected to the backbone network providing wireless connectivity to the covered area. Fig.1 shows a typical layout of a WLAN with two APs (GloMoSim, 2011)

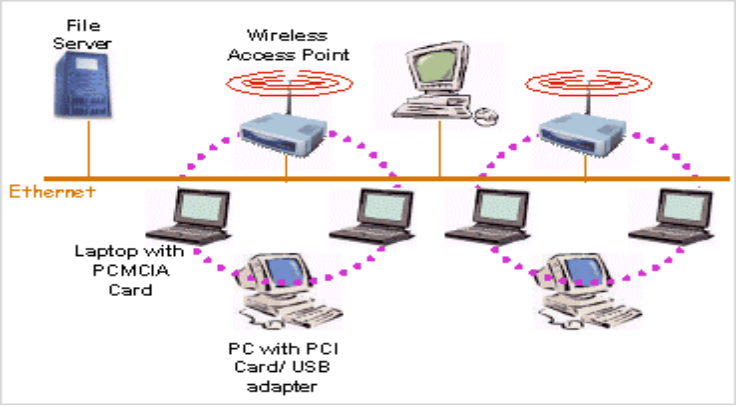

Fig. 1: WLAN with two APs

II. Review of Related Works

Nakagawa et al (2003)is a new bridge architecture proposed to address the problems associated with spanning trees in LANs. Packet forwarding in smartBridge architecture is done along the shortest paths. Although shortest path switching may provide a low latency path, it does not address the load balancing issue in the network and requires all bridges in the network to be smartBridge compliant.

Sharma *et al*. (2007)discuss a novel approach named STAR (Spanning Tree Alternate Routing) to find and forward frames over alternate paths that are probably shorter than their corresponding tree paths. Although the approach reduces latency between most of the source and destination pairs, it risks overloading of critical links.

Another approach to load balancing is Tree-Based Turn-Prohibition (TBTP) LTE load balancing problem has been investigated in the literature. Steenkiste et al (2003). presented a mathematical framework for quantitative study of self-optimizing wireless networks for LTE system, in which a self-optimizing network algorithm was proposed to adjust the cell-specific handover thresholds for load balancing

Tang *et al (2000).* proposed a handover off set based load balancing algorithm using the parameter "cell specific offset" to force users to handover from the overload eNB to the target eNB . The main goal of the proposed algorithm is to find the optimalhand over offset that allows the maximum number of users to change cell without any admission rejection at the target eNB A directional cell breathing based reactive congestion control algorithm was proposed where the coverage area of a cell can be dynamically extended towards a nearby loaded cell when it is under-loaded, or shrunk towards the cell center when it is over-loaded.

(Tarek , 2007) Has proposed a technique to balance the traffic load among the available gateways nodes in the network. In this technique, an average queue length in the gateway is used to estimate congestion over that period of time and an alert is raised by the congested gateway upon which selective active sources are sent notification messages to switch their internet attachment to an alternative less-congested gateway. This technique can reduce overloading the gateway nodes, but a technique that balance the network load across not only the gateway nodes, but also intermediate nodes in the network thus avoiding centre loading problem is also needed. Sending notification to some sources will also increase the overhead traffic in the network.

King-Shan Lui *et al*. (2009) discuss a novel approach named STAR (Spanning Tree Alternate Routing) to find and forward frames over alternate paths that are probably shorter than their corresponding tree paths. Although the approach reduces latency between most of the source and destination pairs, it risks overloading of critical links.

Another approach to load balancing is Tree-Based Turn-Prohibition (TBTP) (Mikael, 2005)TBTP constructs a less restrictive spanning tree by blocking a small number of pairs of links around nodes, called turn, so that all cycles in a network can be broken. However, TBTP is complex and did not consider the best spanning tree and switch load balancing.

MSTP or Multiple Spanning Tree Protocol (Andreolini et al, 2003) is defined in IEEE 802.1s. MSTP uses a common spanning tree that connects all of the regions in the topology. The regions in MSTP are multiple instances of the spanning tree. An instance of RSTP governs a region, where each region has its own regional root. The regional roots are in turn connected to the common root that belongs to the common spanning tree. Since MSTP runs pure RSTP as the underlying protocol, it inherits some drawbacks of RSTP as well. However, a failure in MSTP can be isolated into a separate region leaving the traffic flows in other regions untouched. In addition, the administrators can perform light load balancing manually by assigning certain flows to a specific spanning tree.

A fault tolerant multiple spanning tree protocol was proposed in Viking (2008). Viking relies on per-VLAN-spanning tree implementation of Cisco where there is a separate spanning tree running on every switch for every VLAN. This has the limitation on the number of VLANs the Metro Ethernet can support due to the maximum VLAN tag size and the number of spanning trees a switch can handle without compromising performance.

III. Methodology

3.1 IMPLEMENTING USING OPNET MODELLER

OPNET is a tool used to simulate the way networks run. In this study, comparative study is carried out on the LAN performance for Low Load Campus environment with without load balancer. We have chosen this simulation tool – OPNET IT GURU Academic Edition for our research because of the several benefits:

i. OPNET IT GURU provides the set of complete tools and a complete user interface for topology design and development.
ii. It is being extensively used and there is wide confidence in the validity of the results it produces.
iii. It enables realistic analysis of performance measures and the effectiveness of WAN design techniques.

OPNET IT Guru is very similar to an OPNET Modeler. The main differences are that it does not include a process editor, the possibilities of editing code level in C language, and various advanced modules. From that aspect, we cannot change existing communication models or create new components. Maximum network

expanse, which can be simulated, is also bounded in OPNET IT Guru. In this section, it has been considered that the campus having a LAN connected with 3 FTP Server and 3 HTTP Server with and without load balancer. All of these servers are provided to serve the load demand on the campus network. When one server is not enough then it will load the request will be routed to other servers. The simulation scenario is if the campus network had a high load demand, and all the servers serve the load request. These LANs are connected via 100 based T Ethernet wired network. Two different scenarios & setting have been considered to optimize the network

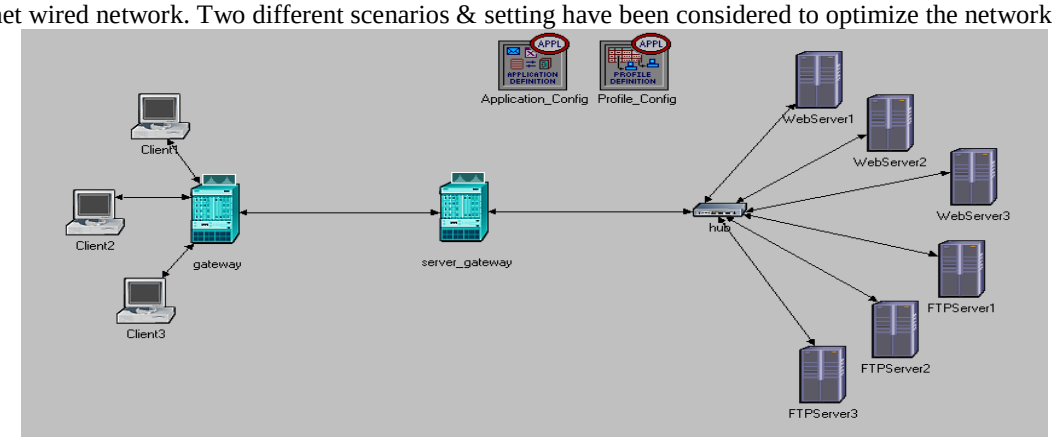

Fig. 2: Scenario I: LAN without Load Balancer

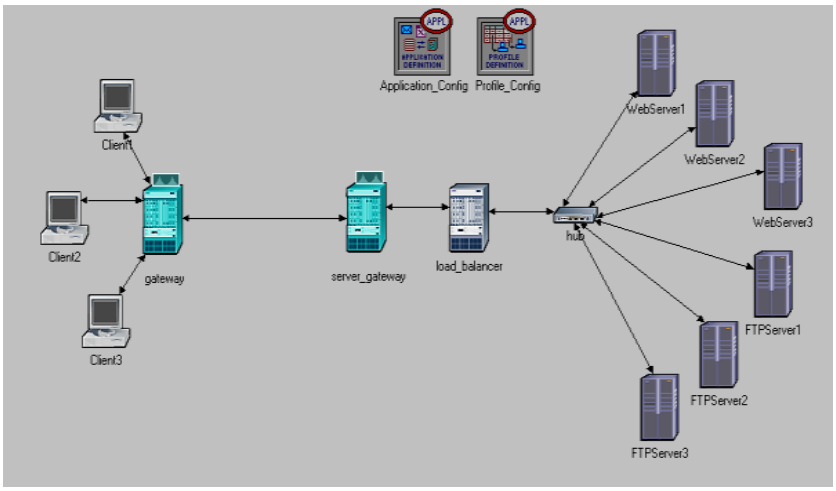

Fig. 3: Scenario II: LAN with Load Balancer

Fig. 2 and 3 show the two scenarios present a Campus Network with Local Area Networks. These scenarios are simulated each LAN with the same network and application configuration. LAN servers support all applications expect for FTP and HTTP which are supported by FTP Server and HTTP Server.

Table 1: Application Description

APPLICATIONS	ATTRIBUTE	LOAD
HTTP SERVER	HTTP	Heavy Browsing
FTP SERVER	FTTP	High Load
EMAIL	CPU UTILISATION	%
PRINT	CPU UTILISATION	%

Table 2: Simulated Parameters

APPLICATION	PARAMETER	UNIT
FTP SERVER	Download Response Time Traffic Sent Traffic Received CPU Utilization Load	Seconds packets/seconds packets/seconds percent requests/ seconds

In this network are examples of how LAN models may be used instead of explicitly modeling the entire LAN. This model represents aggregate traffic of many users on a LAN

3.2 Development of OPNET Simulation Algorithm

This project uses OPNET (Optimized Network Engineering Tool) simulation research on artificial spider routing algorithm and comparative analysis. OPNET modeling hierarchy to the network, the process model and its underlying mechanisms using state machine to simulate the network protocol, node model middle usually contain multiple process model for equipment simulation network, network model of the top, each node model are connected, forming network topology. The establishment of three levels of the model OPNET, both structure and the actual communication protocols, communication equipment and network corresponding to complete, evaluation, testing and improvement of the network routing protocol, so as to optimize the performance of the network. OPNET software provides a good experimental platform for artificial spider routing algorithm,

3.3 Development of Design Flowchart

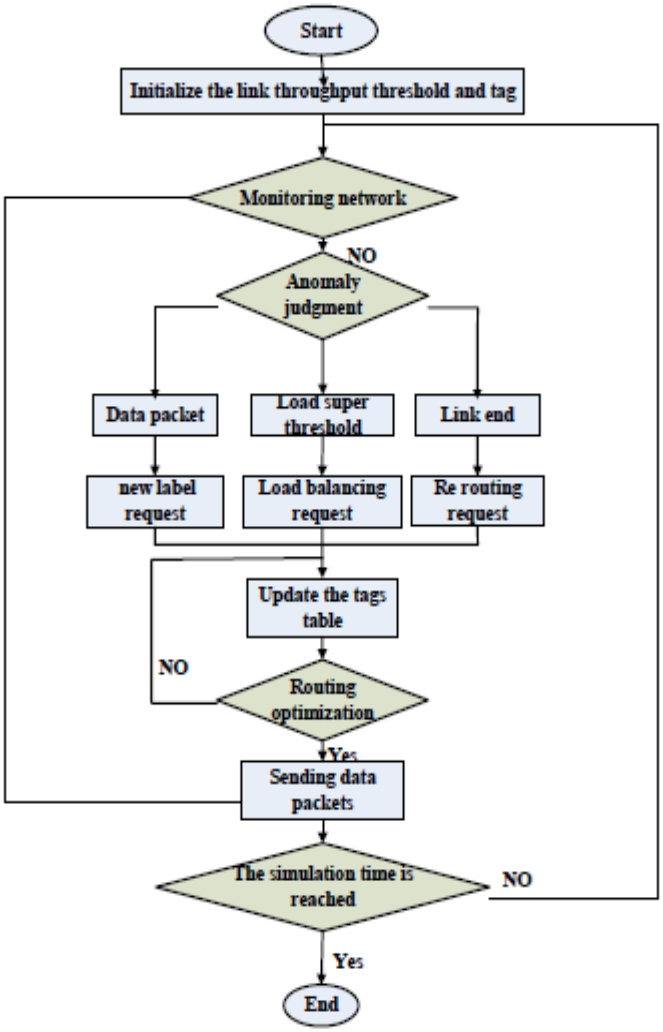

Fig. 4. Design Flowchart

The Figure 8 is the simulation of OPNET software flow chart. In the simulation the flow chart, the unit is bps, average end to end delay in seconds (s), the average packet loss rate is the ratio of overflow data packet and the total contract number, the abscissa simulation map of all are the simulation time, unit for minute (min).

3.4 Development of Load Balancing Algorithm

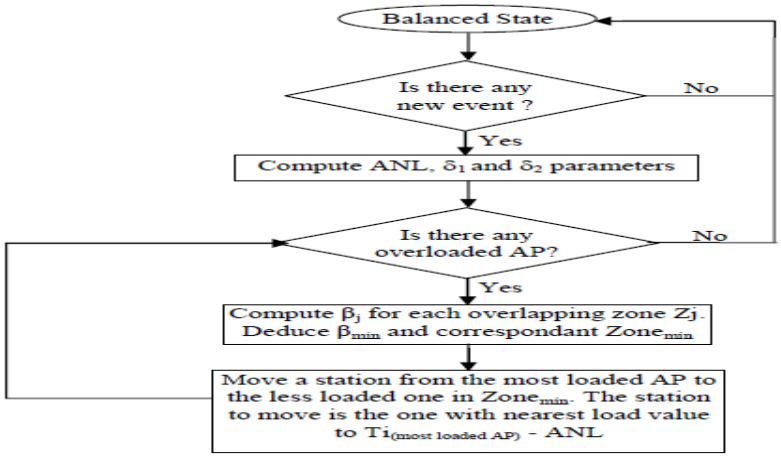

Fig.5 : the Load Balancing Algorithm

IV. Result and Discussions

In each network in both scenario there are 3 HTTP Server and 3 FTP Server. This 3 servers is provided to server the HTTP and FTP load in the campus's network. In Fig. 6, it shows that FTP Download Response Time faster at starting point in network without load balancer, but after that network with load balancer has faster Download Response Time. In Fig. 7, Traffic Received in FTP Server in network without load balancer and with load balancer is similar, but after that network with load balancer is faster, and the Traffic Sent is faster at starting point in network without load balancer, but after that network with load balancer is faster.

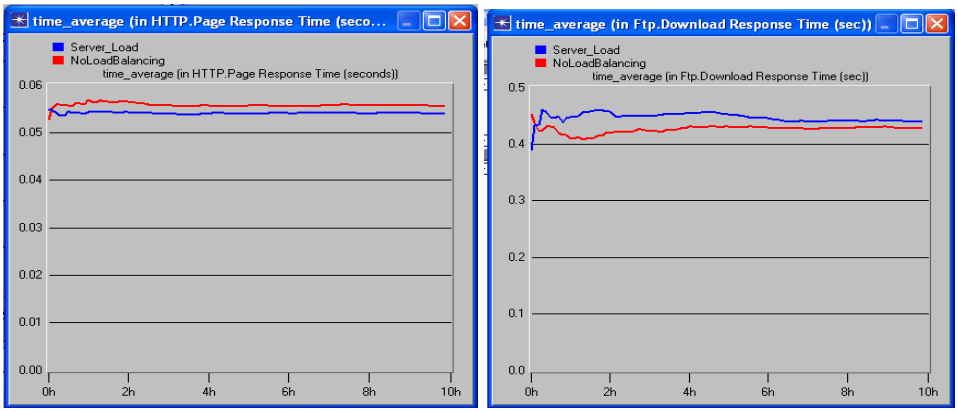

Fig. 6: FTP Download Response Time and HTTP Page Response

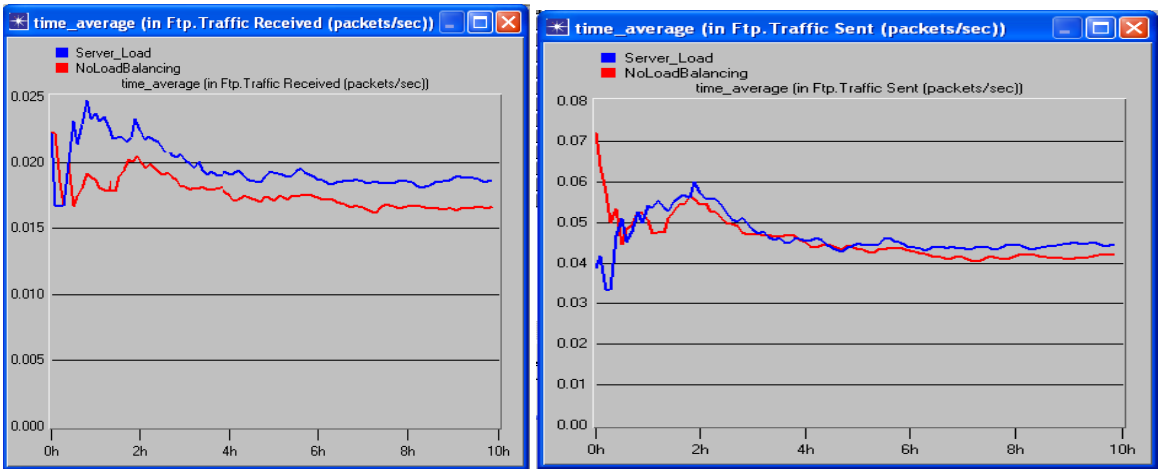

Fig. 7: FTP Server Traffic Received and Traffic Sent

Fig. 8: HTTP Server Traffic Received and Traffic Sent

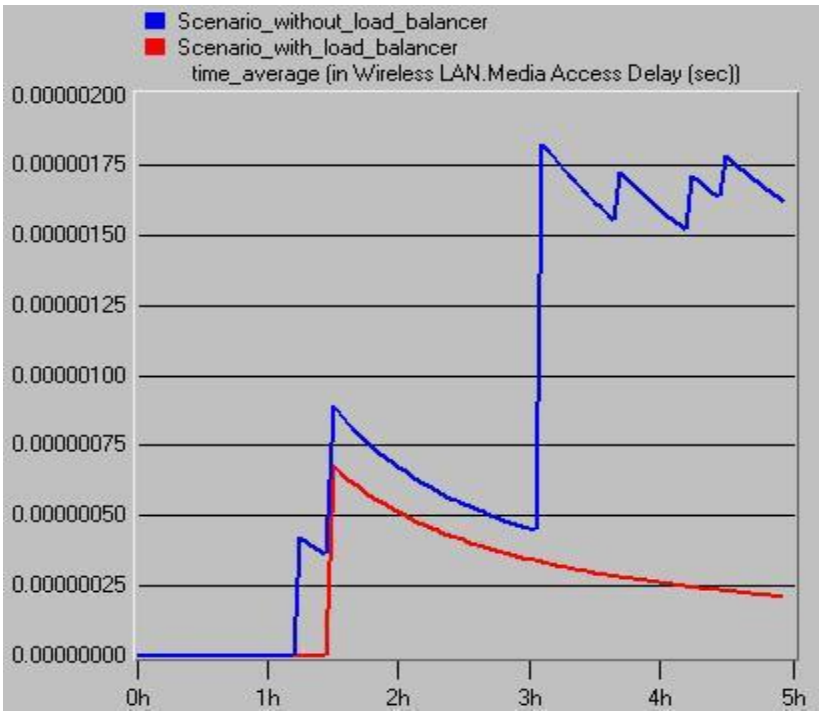

Fig. 9: Media Access Delay (sec)

V. Conclusion

This project investigates the load for Osun State University, Nigeria campus environment with and without Load Balancer. In this study we have build a model of browsing behavior for a HTTP and downloading for FTP application, and use this model in a simulation study addressing the performance of the campus area network. Our investigations reveal that load balancer is useful to increase the FTP download response time. Thus, it is evident that the use of load balancer is recommended for downloading processes. The observations indicate that FTP and HTTP traffic send and received is less in case of using load. Thus we conclude that the overall performance is better with load balancer as comparison of without load balancer.

References

[1] Bennington B. and Bartel C., (2007) 'Wireless Andrew: xperience Building a High Speed, Campus-WideWireless Data Network', Proceedings of ACM MOBICOM, Budapest, Hungary, September, pp. 55-65,

[2] Fitzhugh, S. (2012). Portable network laboratory. 32nd ASEE/IEEE Frontier in Education Conference, Boston, MA, November 2002.

[3] George Apostolopoulos, David Aubespin, Vinod G. J. Peris, Prashant Pradhan, and Debanjan Saha. Design, implementation and performance of a content-based switch. In proc. of INFOCOM, 2000

[4] GloMoSim. (2011). Global mobile information systems simulation library. Retrieved January 26, 2006, from http://pcl.cs.ucla.edu/projects/glomosim

[5] Hansen T., Yalamanchili P. and Braun H-W., (2002) 'Wireless Measurement and Analysis on HPWREN', Proceedings of Passive and Active Measurement Workshop, Fort Collins, Co, March, pp. 222-229.

[6] IT Guru Academic Edition. OPNET Technologies, (2007) http://www.opnet.com/university _program/ itguru academic_edition.

[7] Jipping, et al (2003). Using Java to teach networking concepts with a programmable network sniffer. Proceedings of the 34th SIGCSE Technical Symposium on Computer Science Education, 120-124.

[8] Jussara Almeida, Mihaela Dabu, and Pei Cao. Providing differentiated levels of service in web content hosting. In proc. of the First Workshop on Internet Server Performance, 2008.

[9] Keshav, S. (2008). REAL: A network simulator. Technical report 88/472, University of California, Berkeley.

[10] Kneale, B. & Box, L. (2003). A virtual learning environment for real-world networking. Information Science, 71.

[11] Kurose, J., Leibeherr, J., Ostermann, S., & Ott-Boisseau, T. (2002). Workshop report. ACM SIGCOMM Workshop on Computer Networking: Curriculum Designs and Educational Challenges.

[12] Kotz D. and Essein K., (2009) 'Analysis of a Campus-Wide Wireless Network', Proceedings of ACM MOBICOM, Atlanta, GA, September.

[13] Mauro Andreolini, Michele Colajanni, and Marcello Nuccio. Kernel-based web switches providing content-aware routing. In proc. of the 2nd IEEE International Symposium on Network Computing and Applications (NCA'03), 2003.

[14] Mayo, J. & Kearns, P. (1999). A secure unrestricted advanced systems laboratory. The Proceedings of the 30th SIGCSE Technical Symposium on Computer Science Education (SIGCSE'99), 165-169.

[15] Mikael Andersson, Jianhua Cao, Maria Kihl, and Christian Nyberg. Admission Control with service level agreements for a web server. In proc. of European Internet and Multimedia Systems and Applications, 2005.

[16] Nakagawa, Y., Suda, H., Ukigai, M., & Miida, Y. (2003). An innovative hands-on laboratory for teaching a networking course. 33rd ASEE/IEEE Frontier in Education Conference, Boulder, CO, November 2003.

[17] NS-2 (2006). The Network Simulator – NS2. Retrieved February 18, 2006, from http://www.isi.edu/nsnam/ns

[18] OPNET (2006). OPNET network simulator. Retrieved February 21, 2006, from http://www.opnet.com

[19] Richards, B. (2001). Rtp: a transport layer implementation project. Proceedings of the Sixth Annual CCSC Northeastern Conference on the Journal of Computing in Small Colleges, 134-141.

[20] Sharma M. and Manoj, (2007) 'Comparative Investigation on Throughput and Client Response Time for a Switched and Routed Wireless LAN based on OPNET' Proceedings of National Conference on "Emerging Trends in "Computing and Communication

[21] Soliman A. Wabie Al-, (2002) 'The New Wireless Local Area Networks (WLAN's) Standard', University of Maryland.

[22] Steenkiste, P. (2003). A network project course based on network processors. Proceedings of the 34th SIGCSE Technical Symposium on Computer Science Education, 262-266.

[23] Tang D. and Baker M., (2000) 'Analysis of a Local-Area Wireless Network', Proceedings of ACM MOBICOM, Boston, MA, August, pp. 1-10.