Statistics Comparison in Wireless Network Environment for Balanced and Unbalanced Network

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ABSTRACT
Network parameters are vital ingredients of today's data communication scenario especially Media access delay, Throughput and CPU utilization. This Paper has taken into consideration the modeling and implementation of Wireless Local Area Network (WLAN) based on OPNET simulator and evaluated the performance of the wireless local area network in a campus/university environment. Our model has been tested for two types of applications (PRINT and EMAIL) in two different sites each comprising of 20 users and found that among a set of other parameters Media Access Delay and Load were highly affected by the number of users per application with and without load balancing. Simulation performed shows the behavior of load balancing on wire-line and wireless network for both applications (print and email) [5-15].

General Terms
Load Balancer, OPNET, WLAN, Delay.

Keywords
WLAN, Load balancing, Delay CPU Utilization, Throughput, Media Access Delay.

1. INTRODUCTION
Wireless access points are now common place on many university campuses [1-5]. 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. For this paper we have focused on IEEE 802.11b [6,14,15].
Due to its limited bandwidth, wireless LAN performance is a hot research topic. The literature available showed that the performance of IEEE 802.11b based on wireless networks can be improved in different ways; such as tuning the physical layer related parameters, some IEEE 802.11 parameters, or using an enhanced link layer (media access control) protocol.
Our paper uses simulation to study a campus/university area network scenario. We use the OPNET [7,9,10] simulation environment, with its detailed models of IEEE 802.11b, TCP/IP, PRINT and EMAIL. OPNET is a tool used to simulate the way networks run. We have chosen simulative tool- OPNET for our research because of the several benefits it offers over the other contemporary tools available. We parameterize the simulation model based on campus measurements, and validate the model against LAN performance metrics using simple PRINT and EMAIL workload models. We then build a model of browsing behavior for a Web client and use this model in a simulation study addressing the performance of the campus area network. Our experiments focus on the PRINT and EMAIL delay and end-to-end throughput achievable in the wireless network environment, and the impacts of factors such as page/object response time, wireless LAN media access delay. The comparative investigation on various performance metrics in wireless and wire-line LAN for a balanced and unbalanced network has been presented.
After briefing the introduction in section I, Section II introduces our model, section III covers the scenarios we tested, section IV analyses the results and the conclusion is drawn in section V.

2. MODEL OUTLINE
The IEEE 802.11[12,13] WLAN architecture is built around a Basic Service Set (BSS). A BSS is a set of stations that communicate with one another. Figure 1 & 2 shows an outline to the model and is followed by the one wireless LAN sites (Figure 3).

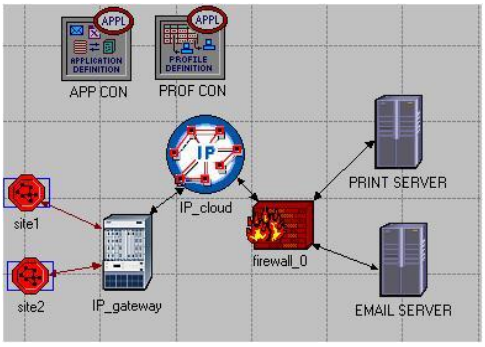

Figure 1 OPNET Model without load balancer

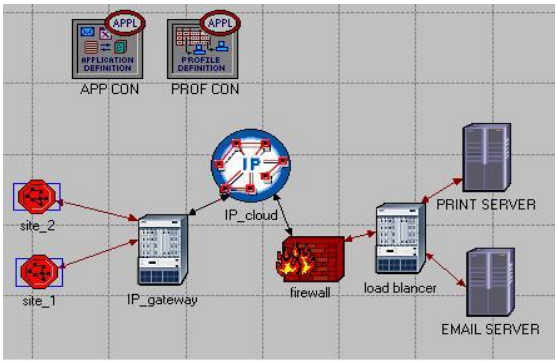

Figure 2 OPNET Model with load balancer.

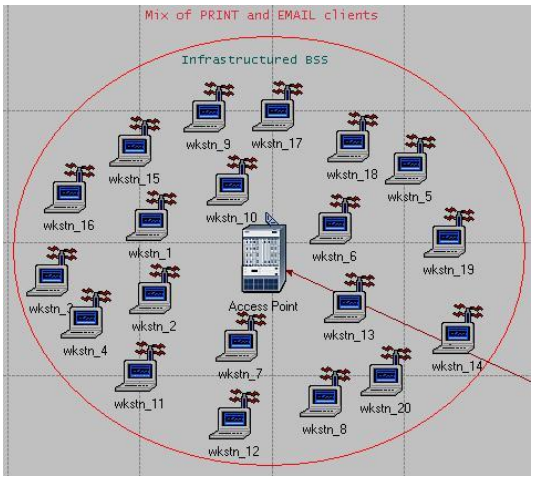

Figure 3 **Sites**: Mix of Print and Email clients

In our research we considered installing two access points in a campus/university environment where mix of PRINT and EMAIL clients were present. Simulations have been carried out for our model to determine the optimal performance metrics.

Table I indicate the application description.

TABLE I. Application Description

Applications	Attribute
Mailing	EMAIL
Office work	PRINT

Table II summarizes the efficiency parameters we simulated.

TABLE II. Simulated Parameters

Application	Parameter	Unit
EMAIL	Cpu utilization	%
PRINT	Cpu utilization	%
WLAN	Delay	Seconds
	Throughput	Bits/sec
	Load	Bits/sec
	Media Access Delay	Seconds

3. SIMULATED SCENARIOS

A simulation model was developed using OPNET [7,8,9,11]. OPNET 802.11b PHY module was used as a standard with maximum data rate up to 11Mb/s. IEEE 802.11b Direct Sequence was used with data rate of 5.5 Mbps in which slot time was 50µs. In this section, we consider the case of two scenarios.

Scenario 1: 2 WLAN Sites each with 20 Users through 1 access points using PRINT (10 users), and EMAIL (10 users) connected with outside wire-line network without load balance.

Scenario 2: 2 WLAN Sites each with 20 Users through 1 access points using PRINT (10 users), and EMAIL (10 users) connected with outside wire-line network with load balance.

4. RESULTS ANALYSIS

Five graphs were selected after simulating our model (Figures 5 through 9). All graphs show a combination of the 2 scenarios. From figure 5 it has been observed that the WLAN Delay (sec) with load balancing is more in comparison with unbalanced network. From figure 6 we have also observed that the WLAN load on the nodes(workstations) in sites with the load balancer is 89.40 (bits/seconds) and while without the load balancer it is 110.26 (bits/seconds) after 2 hours of simulation time, which indicate the performance improvement in case of WLAN Load on the nodes.

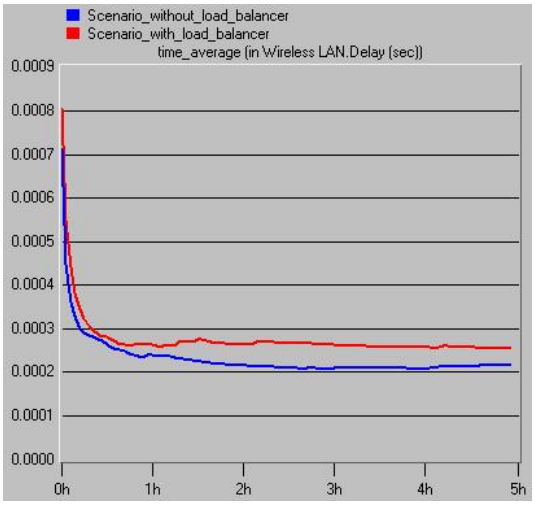

Figure 5 WLAN Delay(sec)

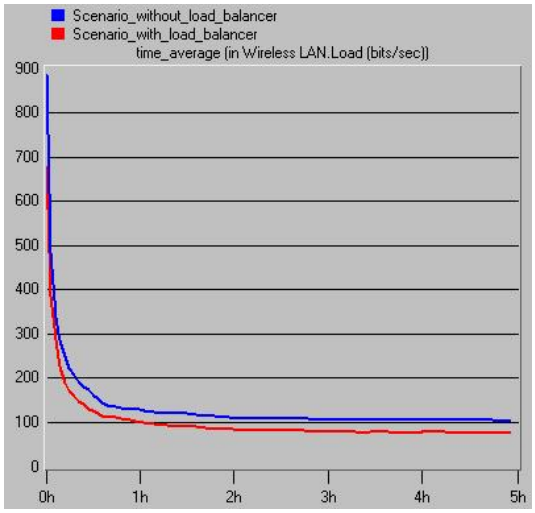

Figure 6 WLAN Load (bits/sec)

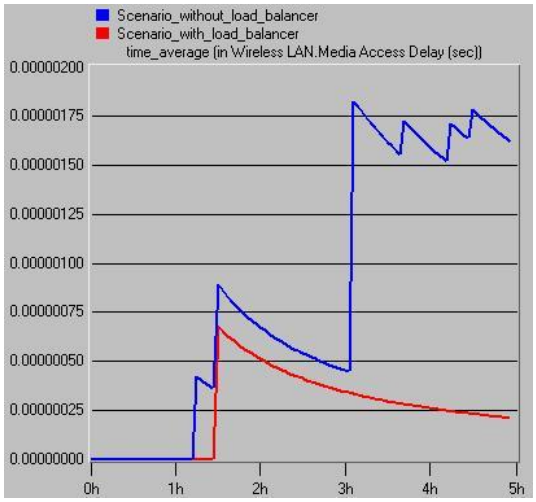

Figure 7 Media Access Delay (sec)

The observations in figure 7 indicate that Media Access Delay in the scenario with load balancer has decreased drastically as compare to the scenario which is not balanced. This shows the huge improvement of network environment in case load balancer scenario.

The difference of 0.000001298 seconds has been observed at 4 Hours of simulation time.

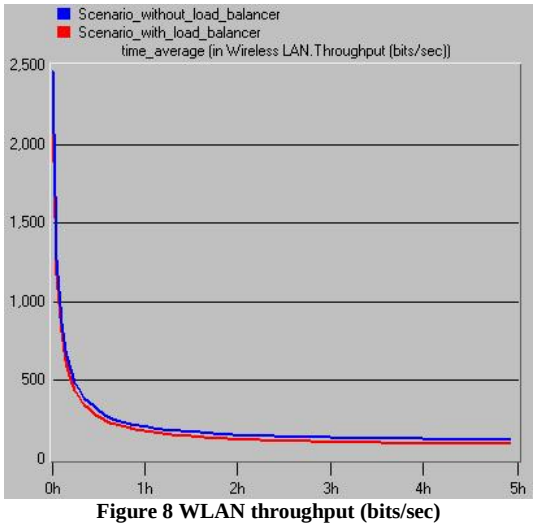

Figure 8 WLAN throughput (bits/sec)

From figure 8 it has been noticed that there is a minute difference of throughput of the order of 24 bits/sec in both the scenario with load balancer and without load balancer. This also shows the improvement because of small change of throughput.

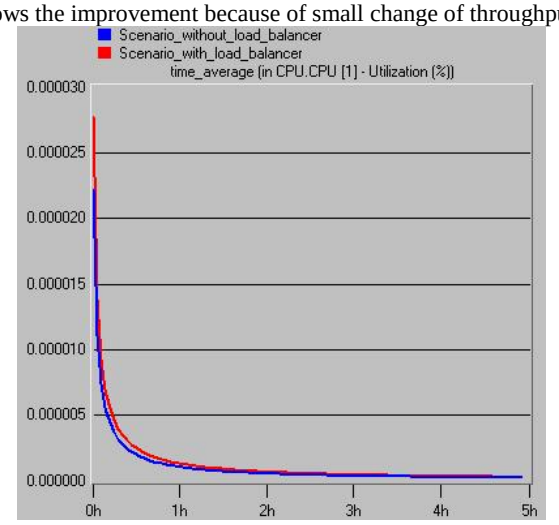

Figure 9 CPU Utilization (%)

In figure 9, it has been observed that Utilization of CPU for both the servers (Print and Email) is nearly same for both the scenarios. Thus it reveals that there is no effect on Utilization of CPU weather the network is balanced or not in case of Print and Email server.

5. CONCLUSION

In this paper we have observed that WLAN Delay (sec) with load balancing is more in comparison with unbalanced network. the difference is quite less of the order of 0.000045 seconds but on the other hand load on the nodes(workstations) has been decreased in case of balanced scenario which shows the improvement in the network while using with the load balancer. The value WLAN load in case of load balancer is 89.40 (bits/seconds) and while without the load balancer it is 110.26 (bits/seconds) after 2 hours of simulation time.

The observations indicate that Media Access Delay has improved a lot in case of load balancing scenario. The difference of 0.000001298 seconds has been observed at 4 Hours of simulation time. This shows network improvement in case of Media Access Delay. Throughput has minute difference of the order of 24 bits/sec in both the scenario with load balancer and without load balancer.

It has also been noticed that Utilization of CPU for both the servers (Print and Email) is nearly same for both the

scenarios. Thus it reveals that there is no effect on Utilization of CPU weather the network is balanced or not in case of Print and Email server.

6. REFERENCES

[1] B. Bennington and C. Bartel, "Wireless Andrew: xperience Building a High Speed, Campus-WideWireless Data Network", Proceedings of ACM MOBICOM, Budapest, Hungary, pp. 55-65, September 1997.

[2] T. Hansen, P. Yalamanchili and H-W. Braun, "Wireless Measurement and Analysis on HPWREN", Proceedings of Passive and Active Measurement Workshop, Fort Collins, Co, pp. 222-229, March 2002.

[3] D. Kotz and K. Essein, "Analysis of a Campus-Wide Wireless Network", Proceedings of ACM MOBICOM, Atlanta, GA, September 2002.

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

[5] Manju Sharma, Manoj Kumar and Ajay K Sharma, "HTTP and FTP Statistics for Wireless and Wire-Line Network with and without Load Balance Based on OPNET" International Journal of Information and Systems Sciences, Institute for Scientific Computing and Information, Canada, Vol. 5, No. 1 pp 112-125, 2009.

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

[7] IT Guru Academic Edition. OPNET Technologies, ftp://www.opnet.com/university_program/itguru academic_edition, 2007.

[8] Manju Sharma and Manoj, "Comparative Investigation on Throughput and Client Response Time for a Switched and Routed Wireless LAN based on OPNET" Presented and published in the proceedings of National Conference on "Emerging Trends in "Computing and Communication (ETCC-07) at national institute of Technology, Hamirpur, (HP), India during July 27-28, 2007, pp 436-440.

[9] Wlan_lab_script_1_2 from http:// www.comnets.unibremen.de/~mms/wlan_lab_script_1_2.pdf

[10] Walid Hneiti,"Performance Enhancement of Wireless Local Area Networks" Amman Arab University for Graduate Studies, Jordan. (2006)

[11] RajanVohra, R.S.Sawhney, Manju Sharma"Analysis of Statistics HTTP and DATABASE for Wireless and Wire-line Network with and without Load Balance",Proceedings of 2010 International Conference on Computer Communications and Networks (CCN-10) held in Orlando, Florida, USA ,pp. 123-129, July 2010.

[12] R. Al-Sayyed, C. Pattinson, "Performance Evaluation of Redundancy in Wireless Network", IEEE Proc. of Second IFIP International Conference on Wireless and Optical Comm Networks WOCN 2005, Dubai, 6-8 March, 2005.

[13] R. Al-Sayyed, C. Pattinson, and T. Dacre, "VoIP and Database Traffic Co-existence over IEEE 802.11b WLAN with Redundancy", proceedings of world academy of science, engineering and technology volume 20, 2007.

[14] M. Gast. 802.11 Wireless Networks. The Definitive Guide. O'Reilly & Associates, Inc., April 2002.

[15] Tanenbaum A.S., "computer Networks" 4th Edition, Prentice-Hall International, Inc, 2003.