Study the Best Approach for Virtual Private Network Implementation: CPU and Memory Usage Performance

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Abstract— **In this research, we propose an architectural solution to implement Virtual Private Network (VPN) test bed in campus environment. The objective of this evaluation is to measure the quality of the audio and video streaming on client server performance over different types of VPN technology. Virtual Private Network (VPN) technology has become a discussion issue for this time being. Therefore, this study is to analyze the VPN over open source application and hardware device performance areas related to quality of service delivered by audio and video streaming activities such as CPU and memory usage. In this study, network management system (NMS), ColaSoft Capsa is used to monitor and capture the performance of CPU and memory over VPN. In addition, the most apparent of implementing VPN in campus environment is to define the best solution between open source application and hardware device that can be used in operational environment. Based on the finding result, the VPN measurement through hardware device is able to contribute low percentage of CPU and memory usage compare to open source application.**

Key words—**VPN, CPU, NMS, Memory, Audio and Video Streaming**

I. INTRODUCTION

In this paper we compared the performance of VPN using different type of operating system and hardware base to select which technology able to provide better services. In our experiments, we will conduct a test bed and examine on CPU and memory usage over VPN as follows: i) to minimize usage of CPU and memory percentage between campus branches; ii) comparison between two different platform of VPN based on hardware (Juniper Netscreen 25) and software (Microsoft and Linux). This study is extension from previous work that has been discussed on throughput and delay performance [1].

II. RELATED WORKS

Virtual private networks (VPNs) provide a secure and reliable communication between customer sites over a shared network [2]. Nowadays, VPNs (Virtual Private Networks) is considered the strongest security solutions for communications over IP networks. Most VPN solutions are implemented to tunnel data traffic while the trend toward a converged data and voice network, however, places new demands on VPNs to support real time traffic [3], [4]. The main issues on audio and video are i) security; and ii) QoS. Packet transmission can introduce new impairments, including packet loss, extra sources of delay, and the use of compressed speech coding, all of which may affect audio and video quality delivered to the user [5]. QoS of the voice is affected by delay, jitter, and packet loss [6], [7]. There are several vulnerabilities occur during audio conversation such as [8], [9]: i) circuit-switched technology vulnerabilities; and ii) audio technology vulnerabilities. Therefore, this study is to provide and measure CPU and memory usage over VPN implementation using different types of technology.

III. METHODOLOGY

Figure 1 shows the overall framework of test bed VPN implementation in campus environment. There are five phases development of test bed process such as: i) planning; ii) design; iii) implementation; iv) testing, v) compare, vi) compile. Figure 2 shows the implementation of VPN test bed using operating system and hardware device. In the experiment, the analysis performance will focus on CPU and memory measurement during audio and video streaming. Network management system is used to analyze activities of streaming over VPN technology. Figure 3 shows the process and criteria selection of streaming evaluation.

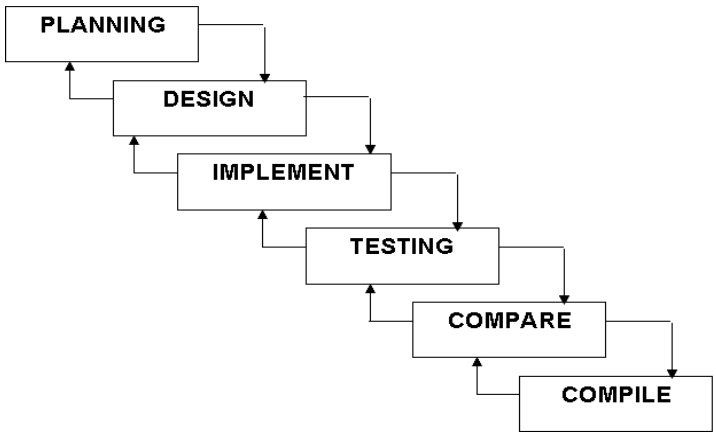

Fig. 1: Framework of VoIP over VPN Technology in Campus Environment

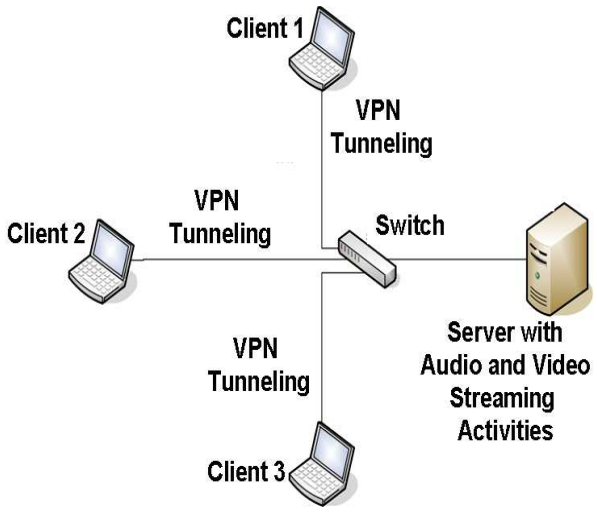

Fig. 2: Implementation of VPN Test Bed using Different Types of Technology

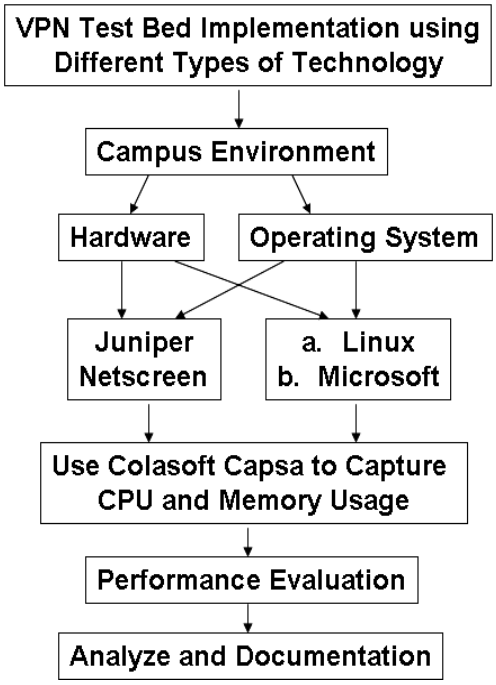

Fig. 3: Process and Criteria of Audio and Video Streaming Evaluation

IV. ANALYSIS AND RESULTS

Several experiments will conduct and to measure the performance of audio and video over VPN such as: i) CPU Utilization; and ii) Memory Performance. All the result is capture using Colasoft Capsa. This VQ manager is suitable application to work in audio and video packet environment.

Table 1 and Table 2 show streaming activities and size of movie that played by clients from streaming server via VPN such as Microsoft Server 2003, Ubuntu and Juniper Netscreen25. In our experiments, we only select three clients and test based on: i) streaming one movie only; and ii) streaming multiple movies concurrently.

Table 1: Users Streaming Activities for One Movie

User	Movie (Audio & Video)	Size
1st User	The Number 23	701MB
2nd User	Full Body Massage	699MB
3rd User	Full Body Massage	699MB

Table 2: Users Streaming Activities for Multiple Movies

User	Movie (Audio & Video)	Size
1st User	1. The Number 23 2. The Heart Break Kid 3. Perfume – The Story of a Murdered	701MB 701MB 800MB
2nd User	1. Perfume – The Story of a Murdered 2. Ratatouille 3. Full Body Massage	800MB 702MB 699MB
3rd User	1. Tom & Jerry 2. The Heart Break Kid 3. Ratatouille	1.07MB 701MB 702MB

A. CPU Utilization:

In this section, it will discuss on system performance (CPU utilization) between hardware and operating system after successfully implementing VPN test bed.

Figure 4.4 and Figure 4.5 show the CPU utilization results during streaming activities. Figure 4.4 shows that one client streaming with one movie has provided 66.6% for Microsoft and 83% for Linux for higher usage of CPU compare to hardware basis (8%). Figure 4.5 shows multiple streaming movies with single user, the results show that VPN implementation using hardware platform does not affect and degrade CPU utilization (6%) compare to VPN implementation via operating system.

The next experiments, we conducted with two clients and following with three clients streaming into the server. The results show that VPN implementation using hardware platform also does not affect the performance of CPU utilization for second and third clients (refer to Figure 6, Figure 7, Figure 8 and Figure 9). VPN implementation using hardware platform has achieved 13% (single movie) and 16% (multiple movies) for two clients. Then, third clients have achieved 12% (single movie) and 17% (multiple movies) compare to VPN implementation using operating system.

It can conclude that CPU utilization performance using hardware platform is not much affected with number of movies streaming and clients.

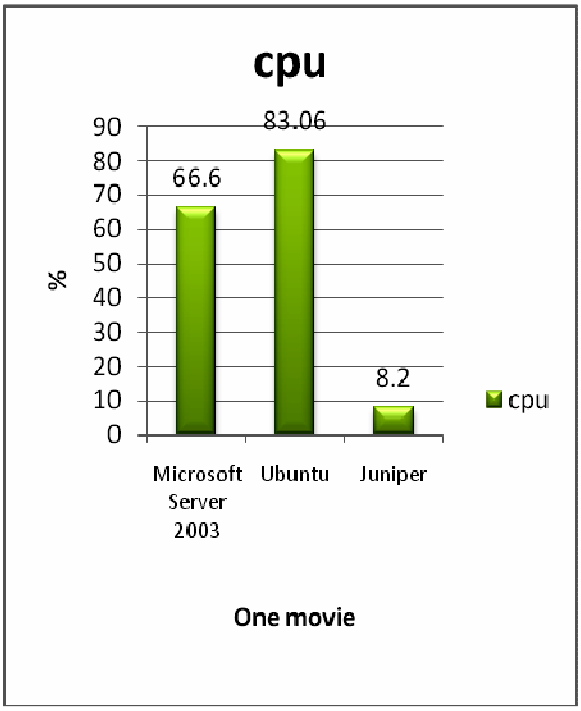

Fig. 4: Streaming Movie- Single Client with Single Movie

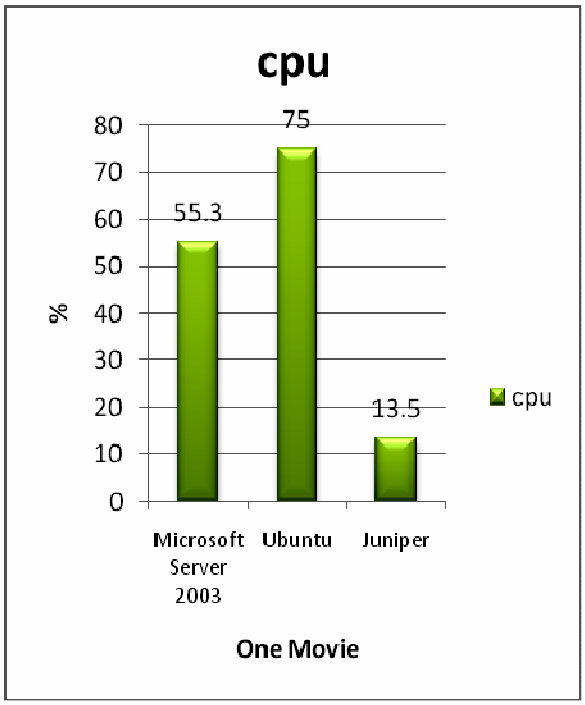

Fig. 6: Streaming Movie- Two Clients with Single Movie

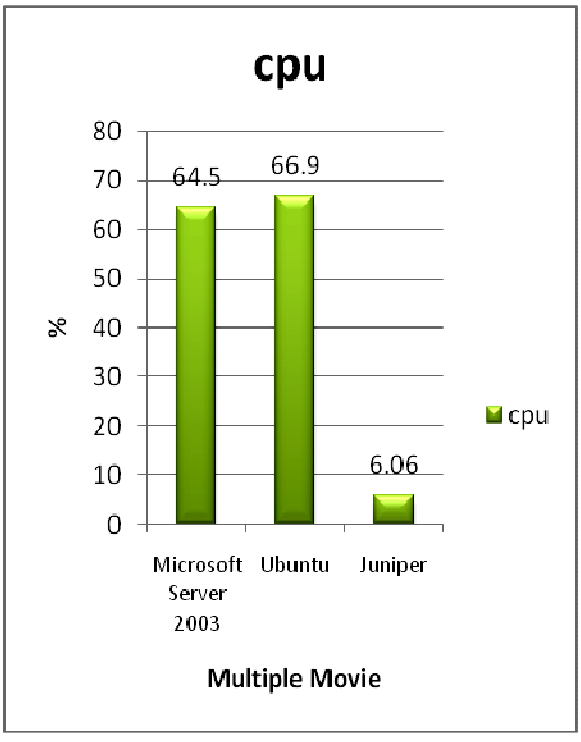

Fig. 5: Streaming Movies – Single Client with Multiple Movies

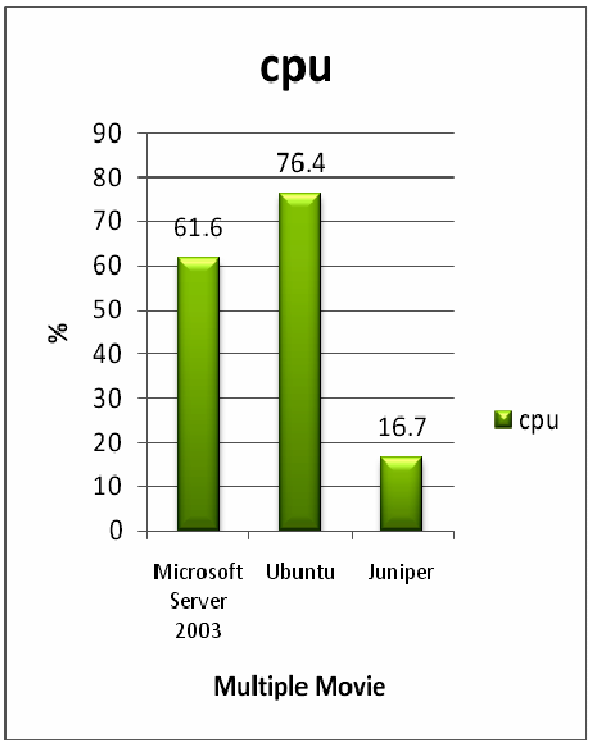

Fig. 7: Streaming Movies – Two Clients with Multiple Movies

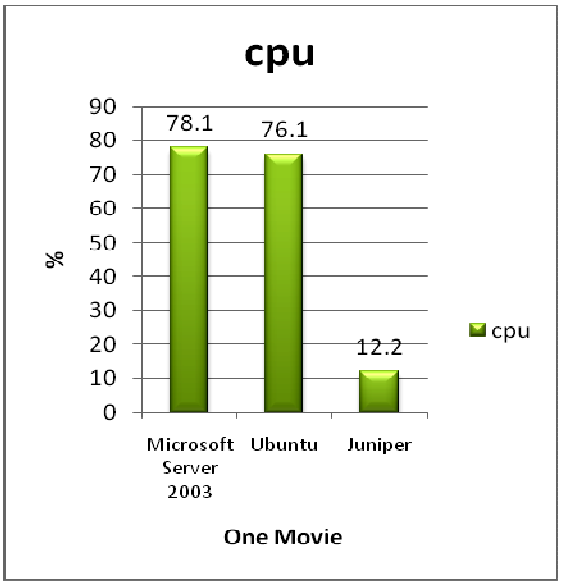

Fig. 8: Streaming Movie- Three Clients with Single Movie

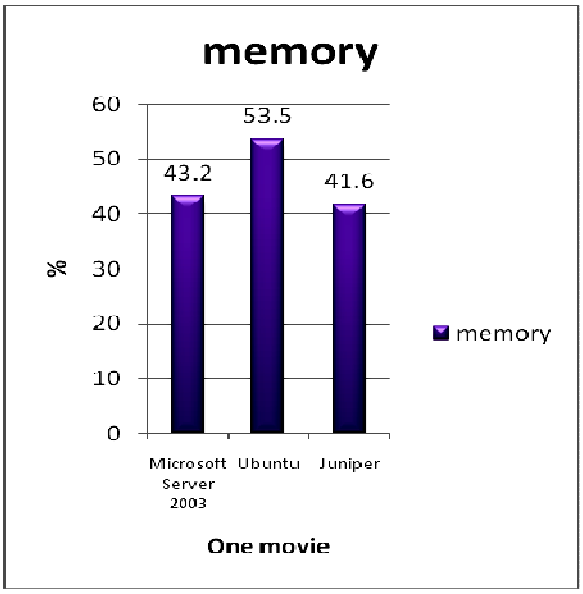

Fig. 10: Streaming Movie- Single Client with Single Movie (memory)

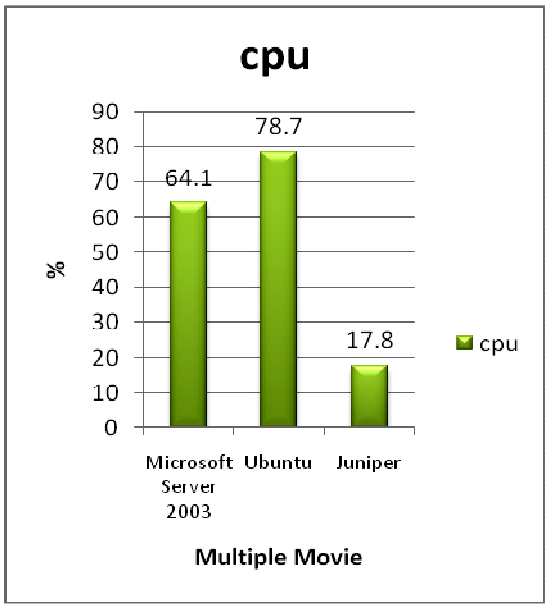

Fig. 9: Streaming Movies – Three Clients with Multiple Movies

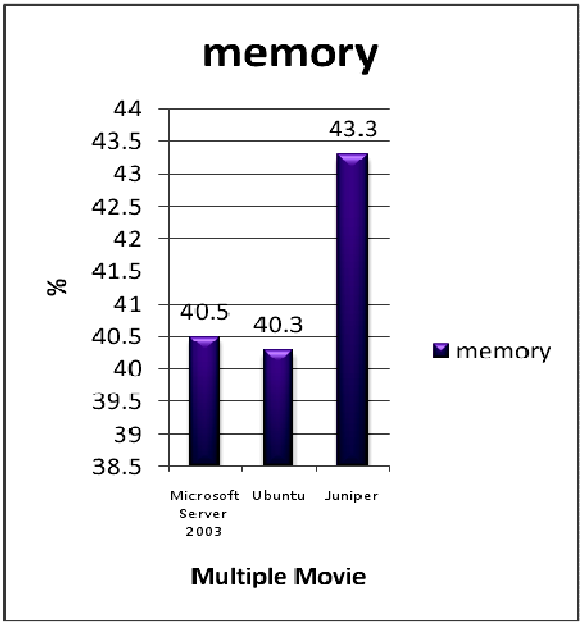

Fig. 11: Streaming Movies – Single Client with Multiple Movies (memory)

B. Memory Performance:

In this section, it will discuss on memory performance between hardware and operating system. Figure 10 and Figure 11 show the memory utilization results during streaming activities. Figure 4 show that one client streaming with one movie has achieved approximately the same memory usage between Microsoft (43%), Linux (53%) and hardware platform (41%). Figure 4.5 shows multiple streaming movies with single user, the results show that VPN implementation using hardware platform has affected memory usage (43%) compare to VPN implementation via operating system (40%).

The next experiments, we conducted with two clients and following with three clients streaming into the server. The results show that VPN implementation using hardware platform has approximately the same performance of memory usage for second and third clients (refer to Figure 12, Figure 13, Figure 14 and Figure 15). VPN implementation using hardware platform has achieved 44% (single movie) and 43% (multiple movies) for two clients. Then, third clients have achieved 43% (single movie) and 45% (multiple movies). The results show it is slightly higher compare to VPN implementation using operating system.

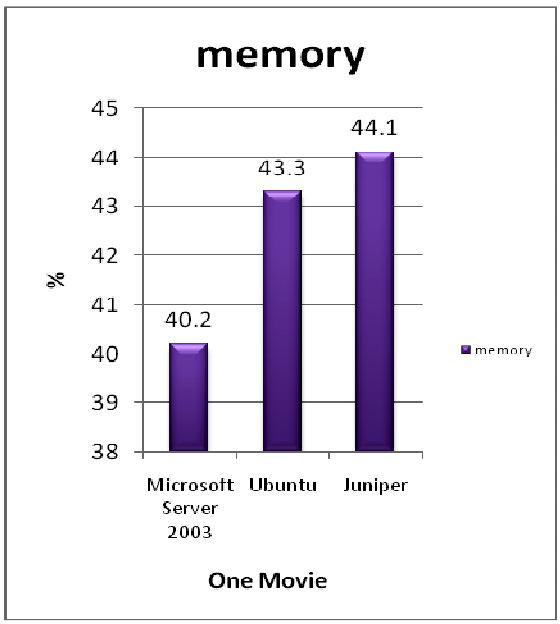

Fig. 12: Streaming Movie- Two Clients with Single Movie (memory)

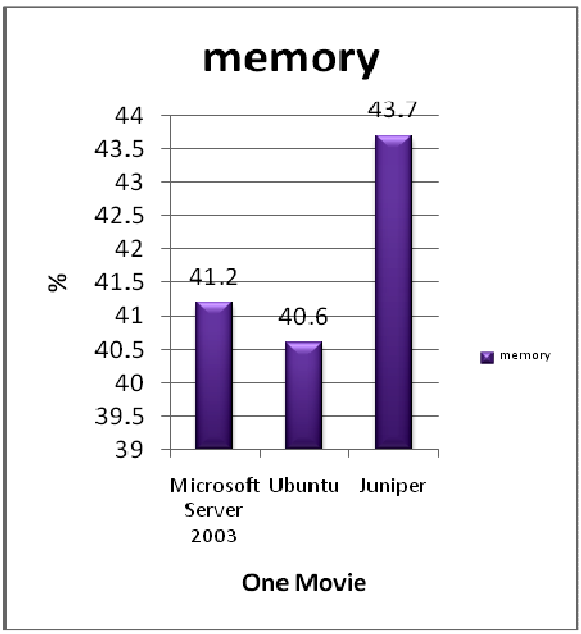

Fig. 14: Streaming Movie- Three Clients with Single Movie (memory)

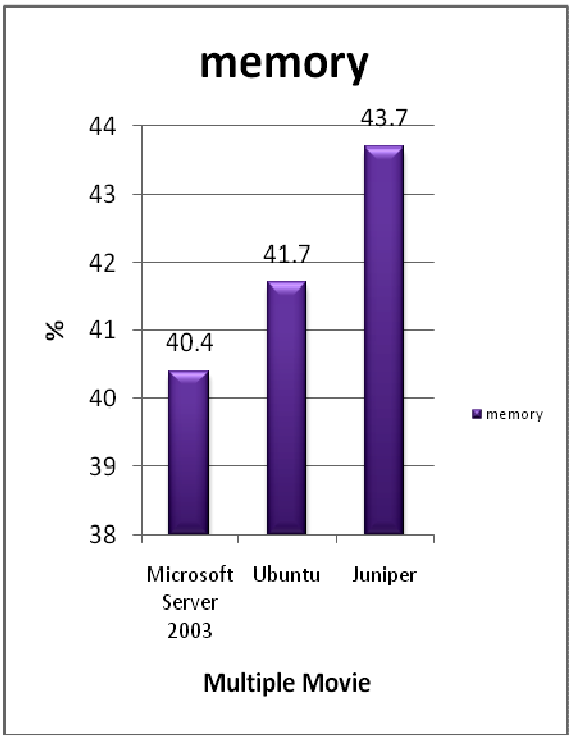

Fig. 13: Streaming Movie- Two Clients with Multiple Movie (memory)

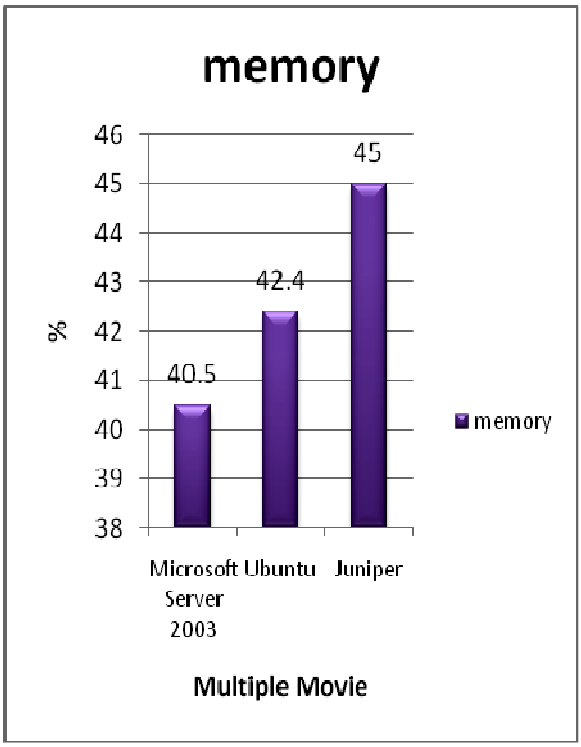

Fig. 15: Streaming Movie- Three Clients with Multiple Movie (memory)

V. CONCLUSION

This paper discussed which VPN technology implementation is able to reduce system resources between software and hardware device in campus environment. This research was to investigate and define the performance of audio and video streaming over VPN technology. In this article, we have shown the performance of: i) CPU utilization; and ii) memory usage. We conclude that base on our findings, streaming movie over VPN using software base contribute higher CPU utilization compare to VPN hardware device (refer to Table 3). The experiment also show that memory usage achieved approximately the same result for software and hardware over VPN (refer to Table 3).

Table 3: CPU and Memory Performance

	Window Server 2003	Ubuntu 8.01	Juniper Netscreen 25
CPU performance (%)	medium	high	Low
Memory usage (%)	medium	medium	medium

Low = 0 – 40; Medium = 41 – 70; High = 71 – 100

It is recommended to implement streaming movie over VPN using hardware platform in order that to achieve a good quality service. It is also suggested to have a high CPU and memory performance in order to support VPN using software and hardware platform. In future work, it should consider implementing techniques to improve quality of streaming movie over VPN using mesh wireless network.

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