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Traffic Characteristics By Video Learning Content in the Secondary School Network

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Abstract: There has been little research on quantitatively how traffic characteristics appear when video learning materials are used in teacher-oriented or self-directed class. In this paper, during the time when video learning materials are being used, we analyzed traffic characteristics using a traffic analysis tool for one of high schools and one of middle schools sampled, respectively. From the traffic measurement, we found that there are a couple of notable things. First, the total amount of traffic has been influenced on by the existence of the caching. Second, the increase of the number of computers connected has caused to stop frequently the streaming of video learning materials. From the results, it was estimated that e-learning based on video data will have many troubles according to the construction form of school network or the number of computers connected simultaneously, when dozens or hundreds of students wants to learn at the same time through Internet.

Key-Words: Traffic characteristics, Multimedia, Video learning materials, Secondary school network, E-learning

1 Introduction

There has increased learning using multimedia learning material like motion images by development of information technology. For example, EBS (EBS stands for Educational Broadcasting System that is a broadcasting TV channel for serving only educational contents) is broadcasting lectures through Internet-based school network to provide e-learning to students. For that reason, at this time, we need to find out if learning using motion images could be provided without any problem with the existing learning equipment in the school network or not.

In this research, we will present the result of measuring quantitatively the traffic when multimedia application service is offered from Internet Broadcasting Station for learning using Internet. Especially, we will examine traffic distribution and problems according to the existence of internal web server in school and the number of simultaneously connected computers.

2 Related work

As the users, who use multimedia learning materials, have increased in the active schools, the network performance has been degraded. To tackle this problem, there has been research regarding plans of enhancing school computing environment.

[1] states that the replacement of the old information equipment and the re-construction of Internet infrastructure should be done immediately through the investigation on the actual condition of the school computerization. The plan of the school network for satisfying the requirements of multimedia class in the elementary and secondary school is presented in [2]. The plan of constructing the network that is suitable for the school is presented in [3].

However, those studies are based on the simulations. In general, the analysis based on the simulations is less exact, compared with that of actually measuring the traffic and then finding how to operate it efficiently in case of using multimedia-learning materials in the class on the existing school network. As the characteristic of multimedia traffic is very different from that of existing traffic, it is said in [4] that the tendency of traffic and statistical analysis should be preceded through the measurement of traffic, and then, on the basis of this result, a plan to use efficiently network resources should be made. There has been research on the web caching for the purpose of reducing network traffic and providing fast response to users [5].

Also, there has been much research on analysis of Internet traffic [6]. However, these researches have been made under a general network environment. So, there has been little research on a specific condition

such as the secondary school. [7] presents the current problems of the primary and secondary school network and proposes the plan of the enhancement and network organization based on the analysis result. However, this paper focuses on multimedia learning materials of Internet broadcasting station, which is established and operated by provincial offices of education, and analyses quantitatively the characteristics of traffic through the actual measurement in the school network. This is different from that of the existing researches.

3 Traffic measurements

3.1 The construction diagram of the school network

The traffic measurement of the school network was carried out in the environment shown in Fig. 1. The main specification of the proxy server installed in the school network consists of Linux, Intel Pentium Ⅲ 450MHz, and 256MB. We installed Top Flash [8] as a traffic-monitoring tool on the proxy server. We measured the traffic in a couple of schools: one middle school and one high school, respectively. There is a little bit difference between them from the aspect of the construction of the school network for the traffic measurement. For example, there is a minor variation in their scale, that is, 18 classes in case of the middle school and 30 classes in case of the high school. However, their basic skeleton is given in Figure 1. We measured and analyzed the traffic characteristics during the operation of the school network like Figure 1.

3.2 The elements of measurement and analysis

This paper presents quantitatively the measurement of traffic under the environment where the experiment parameters are given at the following.

First, we'll analyze quantitatively the change of traffic daily and weekly on average in case of not using motion images in class during a daily routine at school. We'll consider the characteristic of traffic in case of executing the same motion images in internal web server that is connected with the school network and at EIBO.

Second, we'll find out how the proxy server caching has an effect on traffic by examining the change of traffic in case of executing a motion image at first and repeatedly executing a motion image according to the number of connected computers for students to practice.

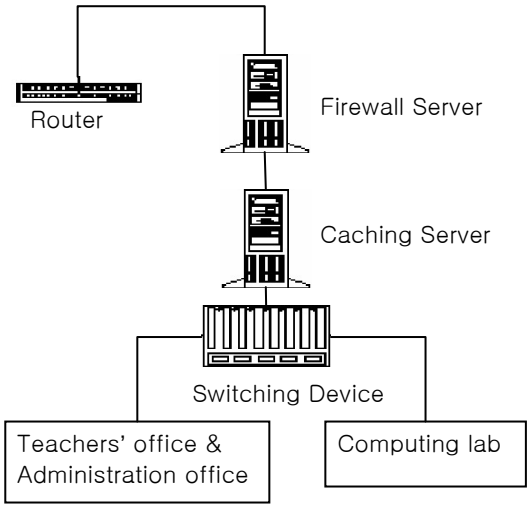

Fig. 1. The construction diagram of middle school/ high school

Third, we'll examine the phenomena of being cutting off when video is executed according to time block and specification of PC for students, because the frequency of using network is different according to time block during a daily routine at school. Fourth, we'll analyze the traffic patterns according to caching. Fifth, we'll compare the stability of video streaming among leased lines having varieties of bandwidths when connecting to EIBO.

4 The experiment results

4.1 Traffic characteristics during day time

Table 2 shows the traffic patterns of middle school and high school during day time measured daily (unit : 5 min.) and weekly (unit : 30 min.), respectively.

Table 1. The measurement value of school traffic during day time

	daily (5 min.)		weekly (30 min.)	
	Max	Current	Max	Current
Middle school	228.8KB/s	34.6KB/s	218.6KB/s	103.4KB/s
High school	225.9KB/s	57.1KB/s	219.3KB/s	109.9KB/s
Average	227.3KB/s	45.9KB/s	218.9KB/s	106.7KB/s

The maximum of the daily average of receiving traffic in the school network is 227.3KB/s (1.8%) and the current of the daily average of receiving traffic is 106.7KB/s (0.8%). The maximum of the weekly average of receiving traffic in the school network is 218.9KB/s (1.7%) and the current of the weekly average of receiving traffic is 106.7KB/s (0.8%).

4.2 The traffic during the connection to EIBO

Figure 2 shows the measurement of the condition of traffic according to the number of connected computers for students using a cache server, when we use motion images in class in middle school connecting to EIBO.

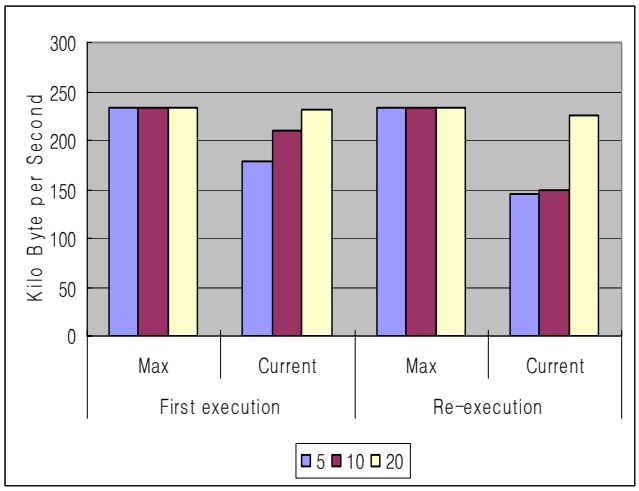

Fig. 2. Comparing traffic according to the number of connected computers, when executing a video after connecting to EIBO.

The result of the experiment shows heavy traffic regardless of the number of computers, when executing motion images. It also shows that the data of motion images don't cache the proxy server. Because the amount of traffic, when repeatedly executing a motion image, is almost the same as executing a motion image at first. When using motion images in real class by connecting to EIBO, according to the number of computers for students, the maximum of the daily average of receiving traffic is 233KB/s ~ 234KB/s (1.8%). It is not a big difference comparing the daily average traffic with the weekly average traffic. On the other hand, the current of the daily average of receiving traffic (per 5min) is at least 3 ~ 5 times higher than the maximum. We can also see heavy traffic during a daily routine, 8 a.m. ~ 4 p.m. because of the characteristic of school.

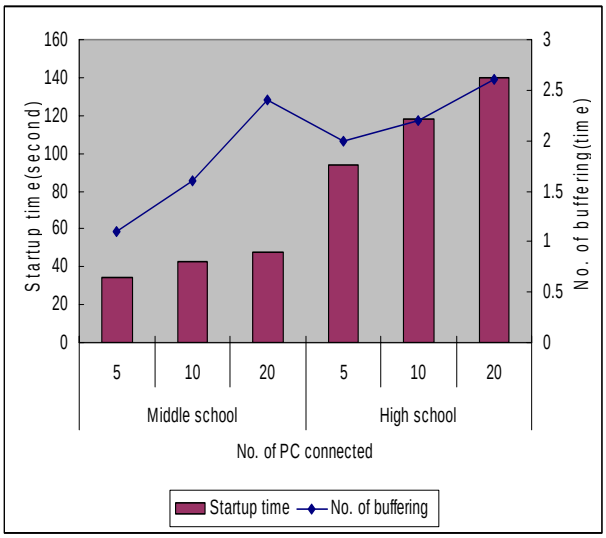

Fig. 3. Startup time according to the number of computers during the connection (first execution)

In the case of the first execution, Figure 3 represents the average startup time and the number of the average buffering according to the number of computers connected at the same time during the period of the connection to EIBO. We examined the traffic characteristics in case the number of computers is 5, 10, and 20, respectively. In the case of the middle school, the video was displayed without any problem up to 10 computers. However, in the case of 20 computers, the buffering has increased and the stop of the streaming has occurred during two-thirds of the period of the total display, which couldn't be enough to precede the class. In particular, in the case of the high school, the video couldn't be played even though the number of computers connected is 5 because the specifications of computers used were not good. From the results of the measurement, we tried to identify exactly what the problem of the video play on the secondary school network is.

In case of re-execution, Figure 4 represents the average time and the number of the average buffering according to the number of computers connected at the same time during the period of the connection to EIBO. We can see in the figure that the average startup time in the middle school reduced to one-third due to the effect of the web browser. However, the average startup time in the high school had little change and the video display has still gotten in trouble like that of the first execution.

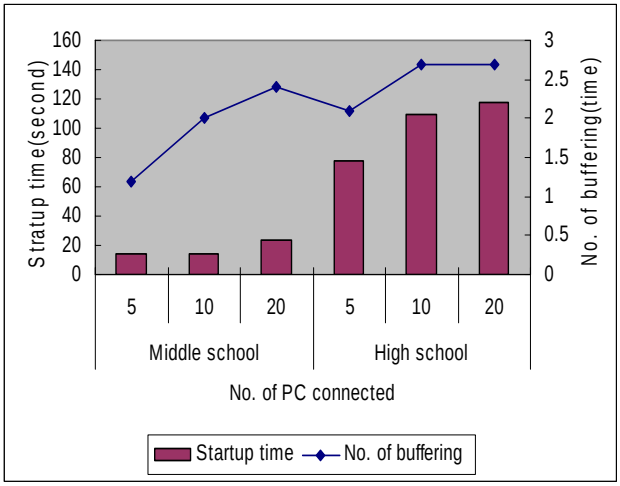

Fig. 4. Number of buffering according to the number of computers during the connection (re-execution)

4.3 Traffic in the presence of caching

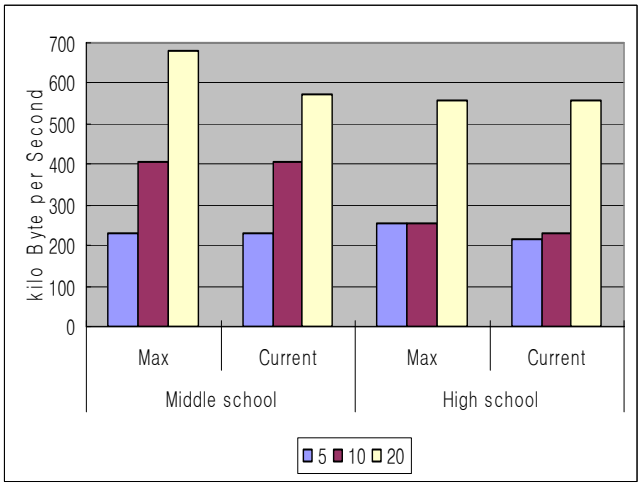

Fig. 5. Traffic measurement (middle school and high school)

Figure 5 shows the results of traffic measurement according to the number of the computers connected, when the video data was displayed from the cache server. We can see straightforward that the traffic volume increased as the number of computers connected increased. It is notable that it should be normal to display the video data, compared with no caching.

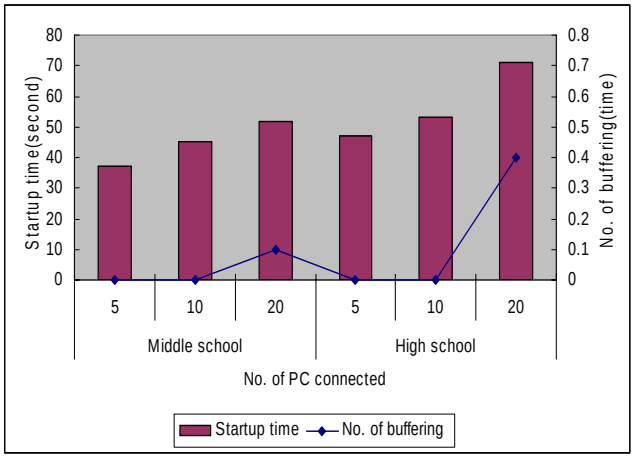

Fig. 6. Startup time with caching according to the number of the connected PCs

Figure 6 shows the number of the average buffering considering the number of connected PCs when caching has been made in the cache server within the school. From the perspective of the number of the buffering, there is no significant between the first execution and the re-execution. As you can see in Figure 6, the video display has been made successfully without buffering in most cases except the 20 PCs in the high school, although the startup time slowly increased as the number of PCs connected increased.

Table 2. The measurement result of a middle school (in the morning)

	middle school					
	No caching			Caching		
	5	10	20	5	10	20
First execution	0%	10%	70%	0%	0%	0%
Re-execution	0%	0%	65%	0%	0%	0%

Table 2 is the result of the experiment that we execute motion images using computers for students in middle school by using EIBO and the internal web server in the morning. According to the result, when executing motion images in the morning classes, after connecting with EIBO have no trouble up to 10 computers. On the other hand, in case of 20 connected computers, motion images were not executed normally and were often cut off in 65%~70% of the connected computers.

Table 3. The measurement result of a high school (in the morning)

	High school					
	No Caching			Caching		
	5	10	20	5	10	20
First execution	100%	100%	100%	100%	100%	100%
Re-execution	100%	100%	100%	100%	100%	100%

Table 3 is the result of the experiment that we execute motion images using computers for students in high school by using EIBO and the internal web server in the morning. In case of high school motion images were not executed and screens were stopped in all computers connected with EIBO and the internal web server, so the class using motion images was interrupted. It was found that this was somewhat be-cause of traffic bandwidth in web, especially that specification of PC for students was so low to execute motion images normally.

Table 4. The measurement result of a middle school (in the afternoon)

	Middle school					
	No caching			Caching		
	5	10	20	5	10	20
First execution	40%	60%	95%	0%	0%	0%
Re-execution	40%	50%	80%	0%	0%	0%

Table 4 is the result of the experiment that we execute motion images using EIBO and the internal web server in the afternoon. According to the result, the load of network is heavier in the afternoon than in the morning. For this reason executing motion images, after connecting with the server in EIBO, class was interrupted. Because the screens stopped consist of about 50% of the hour of executing motion images, increasing the number of computers connected.

Table 5 is the result of the experiment that we execute motion images using computers for students in high school by using EIBO and the internal web server in the afternoon. In case of high school motion images were not executed normally in all computers for students regardless of the number of connected computers. It is a problem of performance of computers for students rather than the load of traffic in the school network. It is considered that computers should be upgraded or replaced. In the result, we can see the delaying time and buffering of computers more in the afternoon than in the morning. In case of using the internal web server, we could see heavy traffic, however, we found out that motion images are normally executed in computers for students without being cut off by experiment data.

Table 5. The measurement result of a high school (in the afternoon)

	High school					
	No caching			Caching		
	5	10	20	5	10	20
First execution	100%	100%	100%	100%	100%	100%
Re-execution	100%	100%	100%	100%	100%	100%

4.4 Traffic Characteristics from EBS Internet Entering Examination Broad-casting Office (E-IEEBO)

Nowadays, most of schools are providing examinees, who want to enter into university, with video-centered lectures using E-IEEBO. So, we measured to analyze traffic characteristics in case examinees take lectures using video learning materials downloaded from E-IEEBO. We chose one of video learning materials as an experiment sample. Its file size is 108.23 MB and its running time is 49 minutes. The basic specifications of PCs for examinees consist of Pentium Ⅳ 1.7 GHz, 256 MB and Windows 98.

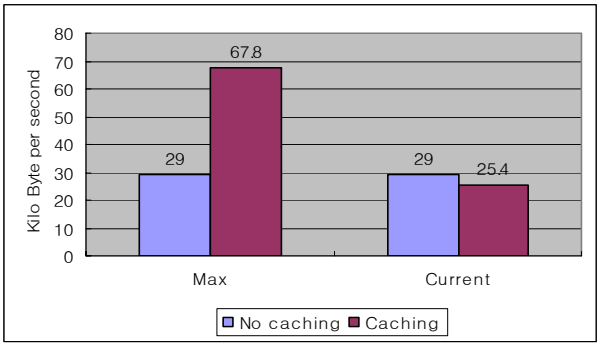

Fig. 8. The effect of caching when video is downloaded from E-IEEBO

We measured the traffic under the situation where the 5 PCs are connected to E-IEEBO at the same time. In this case, we identified that the streaming is very frequently paused during the play. Figure 8 shows the

effect of caching. As you can see in the figure, traffic rate per second is much higher in the presence of caching, compared with no caching.

5 Conclusion

This paper analyzes quantitatively the characteristic of traffic and presents the result, using video learning materials to be used in class in the school network established by a high school and a middle school, respectively.

We can see two obvious characteristics from the analysis of the result. First, there is a big difference in the characteristic of traffic according to the existence of a cache server. That is, when the number of computers executing video data at the same time is more than 10, in case of not operating the internal web server, the class using motion images cannot be proceeded well. Second, the specification of PC for students affects a class using motion images no less than the school network or the characteristic of Internet. That is, if the specification of PC is too old-fashioned to execute motion images, it affects the class using motion images much more than the school network and the characteristic of Internet.

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References:

[1] M. Park, Y. Seo, and Y. Kim, Analysis and Enhancement Plan of School Computing Infra-structure, KERIS Report, 1999.
[2] T. Lee, School Network Design Using Network Simulator, Master's Thesis, Korea National University of Education, 1999.
[3] S. Jung Performance Analysis of School-Network for Transmission Multimedia Data, Master's Thesis, University of Incheon, 2001.
[4] T. Kim, A Study on the Analysis of Internet Traffic, Master thesis, SoongSil University, 2001.
[5] S.Sahu, P.Shenoy, D.Towsley: Design Consideration for Integrated Proxy Servers, In Proceedings of IEEE NOSSDAV'99, pp.247-250, June, 1999.
[6] Carey Williamson, Internet Traffic Measurement, Department of Computer Science University of Calgary, 2001.
[7] T. Min, Performance Analysis of Primary and Secondary School Network and Its Improvement, Master's Thesis, SoGang University, 2002.
[8] ITOP, Topflash User's Guide, ITOP, http://itop.biz