QoS INVESTIGATION ON MOODLE'S VIDEO CONFERENCE

Linawati
Electrical Engineering Department Udayana University
Kampus Bukit Jimbaran, Bali INDONESIA Phone/Fax.: +62 361 703315
Email: linawati@unud.ac.id

Abstract

Learning Management System (LMS) supports e-learning as a distant learning. Moodle is one of open source LMS applications that allow embedding multimedia into learning activity in a course, such as video conference session. The paper investigates quality of service (QoS) of video conference session embedded in Moodle, i.e. end-to-end delay, jitter, throughput, packet loss and PSNR. Three scenarios were implemented in the experiment. The scenarios were applied on both wire and wireless transmission, and p2p and p2m connections. The investigation results show that the QoS of video conference session meets the standards issued by ITU-T G.1010 and G.114, for minimum bandwidth of 128 kbps. Thus the application of video conferencing that is integrated in Moodle can run well with minimum bandwidth of 128 Kbps.

Keywords: Video conference, Moodle, QoS

1. INTRODUCTION

In digital era, learning process has been changing dramatically from traditional way to ICT based learning. By connecting to the Internet, everyone can improve themselves without time and place boundaries. Study in America showed that computer based learning is effective. The learning quality improved by 30% with time saving by 40%, and cost effectively by 30% [1].

One of ICT based learning is using Moodle. Moodle is one of popular open-source learning management systems (LMSs) that is applied in many education institutions. Accordingly everyone allow to add module or plug-in to improve its capability [2]. One of plug-ins in Moodle is allowing people to do video conference. Therefore the paper aims to investigate quality of service (QoS) of video conference room of Moodle, i.e. end-to-end delay, jitter, packet loss, throughput, Mean Square Error (MSE), Peak Signal To Noise Ratio (PSNR), and adequate bandwidth for video conference session.

2. LITERATURE REVIEW

A learning framework of video conference usage was discussed from a number of perspectives: the learning framework; the technology; the role of technology within that framework; how to make best use of the technology [3]. The paper also discusses experience of learning management system Moodle usage in a combination with Tandberg conferencing system. The main pedagogical issue is to understand where the new technology will have real impact on learning effectiveness. A technique to present a web lab through a browser delivered by an LMS as a part of SCORM standard packaging and a service-oriented architecture which allow integrating multiple LMSs (Moodle, .LRN, Claroline, etc.) with iLabs and multiples web an remote labs to supply the full functionality needed by educators, were described in [4].

In paper [5] presents the principal aspects and the main results about an integration project between the Moodle LMS and the MicroNet RWL (Remote Web Laboratories) at University of Salento, in Italy. The research tried to answer two lacks of the first generation of Remote Web Laboratories: the lack of integration between LMS and RWL and the lack of synchronous interaction among the participants (teacher and students) to the experiment. Furthermore, the students, staff and faculty of IIT Bombay enthusiastically support distance education [6]. Distance education at IIT Bombay is carried out through live and free transmission of its own courses, through satellite, video conference and webcast. Distance education is a partial solution to improve the dismal state of engineering education in India. Optionally, the transmission is also available under value added modes, using powerful features, such as, video course on demand and the learning management system, Moodle. Other study [7] presents some analyses and comparisons about open source learning management systems. The paper concludes that Moodle was outstanding with many features among other LMS that aims to improve the educational quality and include the tools that an e-learning system should have.

Quality of Service (QoS) for telecommunication system has been standardized by International Organization such as ITU-T. According to ITU-T G.114 that maximum total end –to – end delay can be accepted for real time transmission must be less than 150 ms [8]. Moreover standard for jitter is less than 75 ms and maximum packet loss is less

10%. ITU-T G.1010 states that throughput minimum for video conference is 16 kbps [9]. On the other hand, video quality can be also measured objectively and subjectively. MSE (Mean Squared Error) and PSNR (Peak Signal to Noise Ratio) are objective measurements [10 – 11]. Table 1 shows PSNR values for video streaming service [12].

Table 1. PSNR values for video streaming service [12]

PSNR Value	Quality
PSNR ≥ 40 dB	Excellent
30 dB ≤ PSNR < 40 dB	Good
20 dB ≤ PSNR < 30 dB	Poor
PSNR < 20 dB	Unacceptable

3. RESEARCH METHOD

Three scenarios were developed to analyze quality of video conference on Moodle,. First and second scenarios are to measure the QoS on LAN with wire and wireless transmission on campus. Last scenario is to have the QoS on WLAN where links two campuses with air distance of 18 kms. Star topology with up to three clients is used with video time range of 50 minutes which is equal with one hour learning in the class. One client must be a teacher and others must be students. The teacher has a moderator function to determine which student can speak/talk in the video conference session. Then MSE and PSNR are measured using MSU Video Quality Measurement. Data packet is captured and measured using Wireshark for end-to-end delay, jitter, and packet loss. Duration of 50 minutes learning time includes presentation by the teacher, Q&A, and conclusion sessions. Bandwidth minimum for video conference is also considered using bandwidth management of HTB (Hierarchical Token Bucket). Figure 1 up to figure 3 present network diagram for the project.

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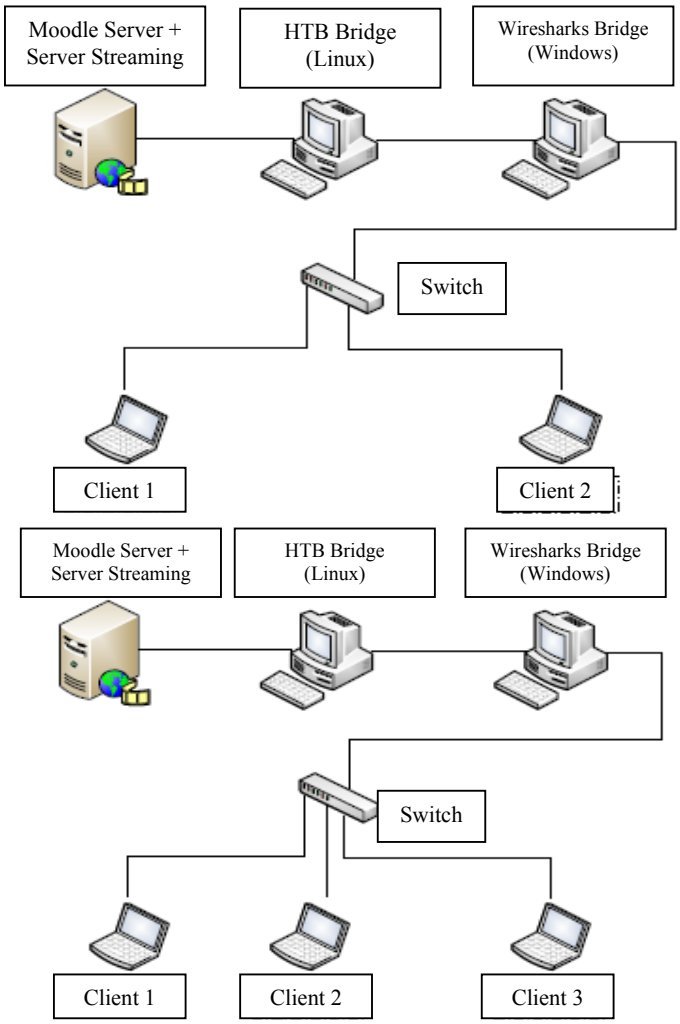

Figure 1. P2P and P2M Connections

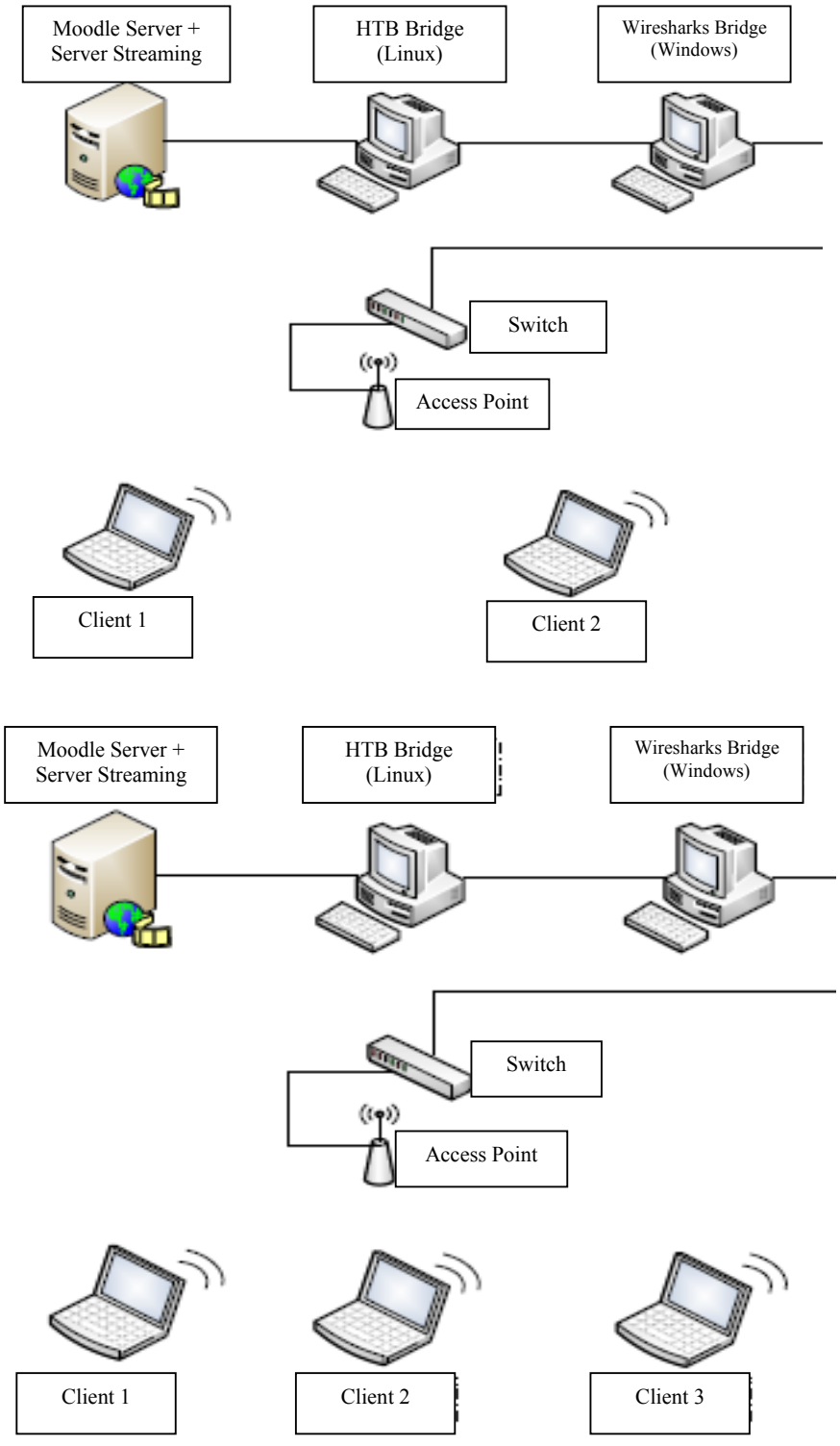

Figure 2. Network diagram of second scenario

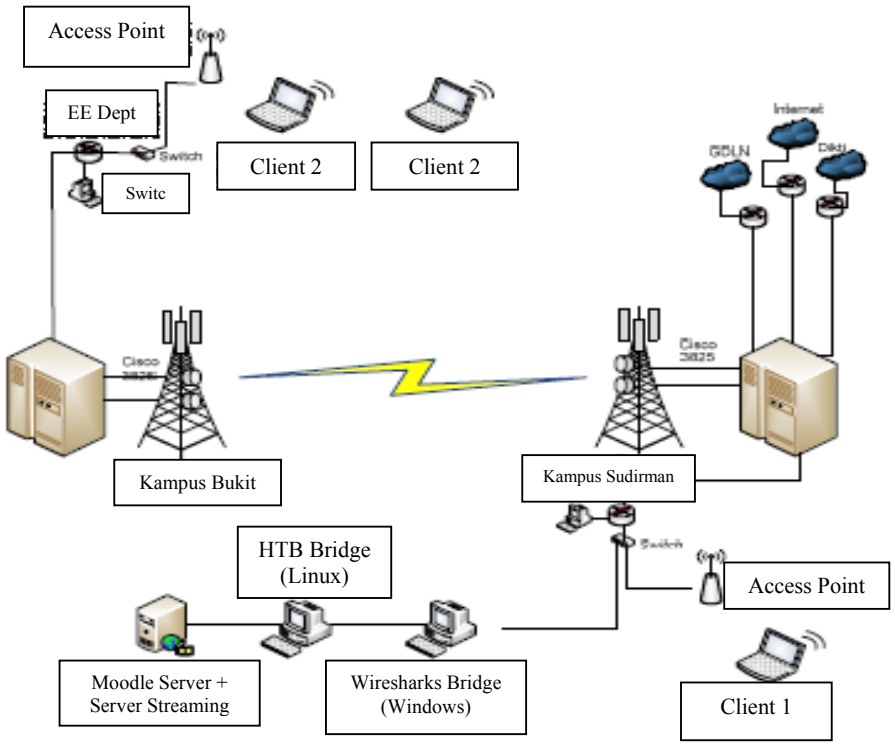

Figure 3. Network Diagram of third scenario

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The experiments employed Linux Fedora 13 operating system and Red5 media server. Red5 is open source software for RTMP media server that needs Java Runtime Environment 1.5. Two bridges are needed, one for HTB and other for Wireshark. Flash browser is applied in client. Video conference session can be initiated when both teacher and students login into Moodle for authentication process. Then on the Moodle window appears 'testing conference' block as seen in figure 4. Then click 'start group chat', choose or activate users in the user's name box as seen in figure 5.

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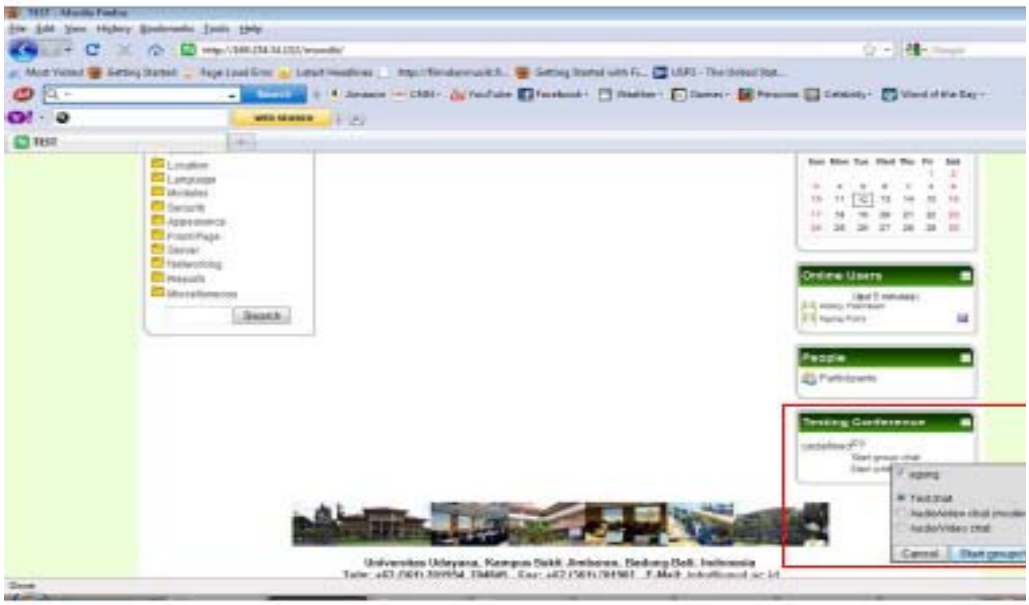

Figure 4. Video conference menu on Moodle

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At user side who is invited to join video conference session will appear invitation pop-up window, then user/student has to choose chat session type in dialog box, then 'click 'start chat', as displayed in figure 6

Figure 5. Video conference session starting

Subsequently, a dialog box appears to ask the user permission that a system will activate user's microphone and web camera. Video conference session starts when user clicks 'allow'. To do point-to-multipoint video conference session, click 'start group chat' and teacher be able to activate more than two users/students to join the session. Input for video conference session is a 50 minute real time video with resolution of 124 x 160 pixels and frame rate of 15 fps. Data flow of video conference is presented by figure 7.

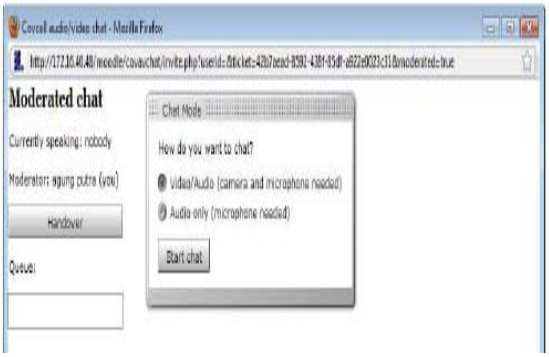

Figure 6. Chat session type in a dialog box

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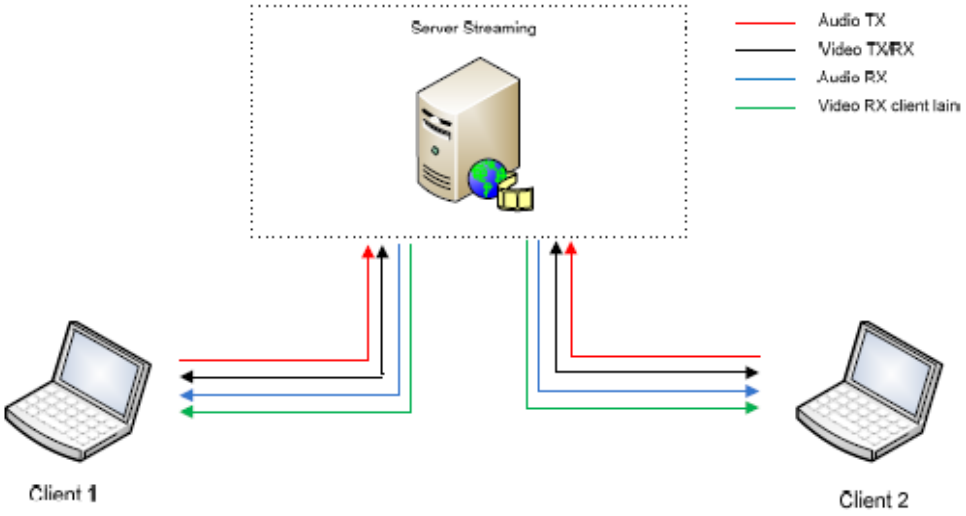

Figure 7. Client's Data flow

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4. RESULTS AND ANALYSIS

4.1. Qos On Campus Lan

The results show that average end-to-end delay of p2p connection is 83.3 ms from client 1 to client 2 and 75.4 ms from client 2 to client 1. Average delay is 79.36 ms. Average jitter of client 1 to client 2 is 37.2 ms, packet loss is 0%. Packet loss is calculated from table 2. Therefore throughput is 42,601.102 bps or 100%, as seen in table 3. Average MSE for p2p connection with wired LAN is 444.97. Therefore PSNR is obtained to be 22.93 dB. Figure 8 shows PSNR result visualization of frame 8381th.

Table 2. Tx and Rx Packets

IP Address	Port	Tx - RX Packets (bps)
172.16.40.26 (client 1)	1801	73860
172.16.40.25 (client 2)	49344	73946
172.16.40.48 (server)	1935	147806

Table 3. Throughput point-to-point

IP Address	Throughput (bps)
172.16.40.26 (client 1)	74,586.07
172.16.40.25 (client 2)	70,476.44

Figure 8. PSNR value visualization of frame 8381th

Point-to-Multipoint connection results average end-to-end delay for 3 clients is 82.1 ms and average jitter is 32.89 ms. Packet loss is 0%. From wireshark, throughput can be obtained as 88,405.419 bps. Table 4 – 6 present the results.

Table 4. Tx and Rx packets of three clients

IP Address	Port	Tx & Rx Packets (bps)
172.16.40.25 (client 1)	49293	51,027
	49292	0
	49322	16
	49323	40,081
172.16.40.26 (client 2)	49390	82,298
172.16.40.27 (client 3)	1141	100,370
172.16.40.48 (server)	1935	273,792

Table 5. Throughput of clients

IP Address	Throughput (bps)
172.16.40.25 (client 1)	161,413.08
172.16.40.26 (client 2)	86,226.20
172.16.40.27 (client 3)	211,268.28

Table 6. MSE and PSNR in wireless LAN multipoint scenario

Connection	MSE	PSNR
Client 1	571.93	20.6 dB
Client 2	259.56	24.05 dB

The results explain that end-to-end delay of P2M with 3 clients is 3.6 % bigger than P2P with 2 clients. However according to ITU-T G.1010, the delay is acceptable, since it is below than 150 ms. Jitter of P2M is greater of 13% than p2p connection and the value is acceptable for ITU-T G.114 standard. There was no packet loss for both p2p and p2m connection. Throughput of p2m is greater of 110% than p2p connection. On the contrary, PSNR is categorized as Poor Quality (ITU-T G.114).

4.2. QoS on Two Campuses LAN

End-to-end delay P2M on two locations of campus is 127.72 ms that is below than 150 ms. Therefore it is acceptable according to ITU-T G.1010 with has excellent quality. Jitter is measured of 56.11 ms (figure 9) and it is below than 75 ms. Therefore is classified as good quality (ITU-T G.114). There is no packet loss and throughput is 100%. PSNR is measured as of 20.23 dB (p2p), 18.39 dB (p2m), and 21.18 dB (p2m on 2 campuses). As a result the PSNR value is classified as poor quality.

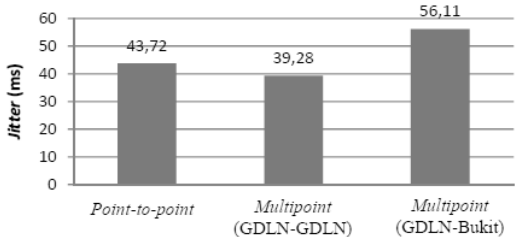

Figure 9. Jitter on Wireless LAN

4.3. Bandwidth Dimension

The purpose of this experiment is to have minimum bandwidth requirement with good QoS on Video Conference integrated in Moodle application. Bandwidth requirement is managed by HTB. Results of bandwidth dimension are shown by table 7. The results show that end-to-end delay is acceptable for bandwidth 128 kbps or more. Jitter is good according to ITU-T G.114 when bandwidth minimum is 128 kbps. There is no packet loss as of the scenarios implemented RTMP protocol for media streaming. PSNR with bandwidth range of 64 kbps up to 1024 kbps is categorized as Poor Quality category and Unacceptable Quality for bandwidth of 32 kbps.

Table 7. QoS vs Bandwidth Dimension

Bandwidth (kbps)	Average end-to-end Delay (s)	Jitter (s)	Packet Loss	PSNR (dB)
512	0.1362	0.0557	0	21.63
256	0.1364	0.0559	0	21.39
128	0.1374	0.0595	0	21.34
64	0.1831	0.0831	0	20.54
32	0.2773	0.333	0	19.73

4.4. Subjective Assessment

Subjective assessment is required to compare the results with the objective assessment above. Table 8 demonstrates subjective assessment of video streaming by 5 students. The assessment shows that video has little bit blur images with clear audio at minimum bandwidth of 128 kbps. The video has clear images and clear audio at bandwidth of 1024 kbps. However, based on PSNR measurement, the results are classified as poor quality. Therefore the comparisons results conclude that the quality of video conference is sufficient for learning process at minimum bandwidth of 128 kbps.

Table 8. Subjective Assessment vs PSNR

Connection	PSNR (dB)	Visual Assessment
A. Wire Transmission (128 kbps)		
P2P	22.93	Little bit blur image, clear audio
P2M	22.32	Little bit blur image, clear audio
B. Wireless Transmission (128 kbps)		
P2P	20.32	Little bit blur image, clear audio
P2M (on 2 campuses)	21.18	Little bit blur image, clear audio
C. Bandwidth Dimension (P2M)		
32 Kbps	19.73	Freeze and blur image, unclear audio
64 Kbps – 128 Kbps	20.54 – 21.34	Blur image and unclear audio
512 kbps	21.63	Little bit blur image and clear audio
1024 kbps	22.01	Clear image and clear audio

5. CONCLUSIONS

Generally, QoS of video conference session integrated with Moodle is satisfactory according to ITU-T standards for minimum bandwidth of 128 kbps. The resolution of video input is 124 x 160 pixel with frame rate of 15 fps, and 50 minutes duration. The objective measurements result that end-to-end delay is less than 100 ms, the jitter is below than 56.11 ms, minimum throughput is 75 kbps, there is no packet loss, PSNR value is around 20 dB and it is considered as Poor Quality. On the other hand, the subjective assessment agrees to the objective measurements. In conclusion, video conference session integrated with Moodle has good quality in any transmission media with bandwidth minimum of 128 kbps. Further work is to investigate performance of mobile learning using Moodle.

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