Impact video properties to video transmission performances

A Sani and S Suherman

Electrical Engineering Department, Universitas Sumatera Utara, Indonesia
suherman@usu.ac.id

Abstract. Video streaming has now been popular in many social media such as facebook and whatsapp. Its transmission is no longer to be a problem as video codec technology is able to compress bytes to minimum amount. However, as real-time response is urgently required, suitable parameters should be adjusted accordingly to obtain smooth real-time stream. This article studies impact video parameters to video transmission performances. Streaming experiment on an ad hoc network shows that delay average delay decreases by the equation of \[ y = 0.2218(x/10)^{0.287} \] to frame rates and increases for higher frame size. Higher frame rates (for the same bit rates) and lower frame size are preferred for real-time applications.

1. Introduction

Currently, internet is used as an access point to lots information provided by users, including texts, images and videos. The real-time applications are increasingly popular as social media grows following the mobile device technologies development. As texts, images and videos are intensively exchanged through social medias, real-time response are also expected, mainly for video as its capacity is the largest [1].

Streaming video content in real-time is a great challenges as user datagram protocol (UDP) as the fastest end to end transfer protocol induces high loss, while transmission control protocol (TCP) adds acknowledgement delay [2]. Video transmissions can be done by downloading the whole files or just a piece of video chunks. However, streaming video and decoding video files progressively is the one fulfills real-time requirements [3]. Experimental application as proposed in [4] is an example.

In order to enhance quality, various researches in various layers have been performed. Starting from network layer [5], transport layer [6], application layer and cross layers [7], [8]. Application layers are mainly to optimize encoding, transmission and decoding processes. This paper focuses on examining the impact of video parameters to streaming performances, especially parameters related to size as mobile devices are the most subscribe station used for social media real-time applications. In this case, frame rates and frame sizes are the intension parameters.

2. Research method

In order to evaluate the aforementioned parameters to transmission performances, research steps as outlined in Figure 1 are taken. Since mobile users are the most social media subscribers, experiments on a mobile network, 802.11 are performed. A real time video captured from a camera is sent over and ad hoc infrastructure, where frame sizes and frame rates are adjusted and the transmission delay, losses and throughput are evaluated. In order to do so, the MoSES video streaming application [4] is
employed for both transmitter and receiver. Performance recordings are made by using Wireshark application [9].

![Flowchart](image)

**Figure 1.** Research outline

Experiments are conducted for various frame rates from 10 frames per second (fps) to 60 fps and frame size 160x120 to 1600x1200. The frame size and frame rates adjustment results different video sizes so that the numbers of transmitted packets are differs. The transmission protocol is using the real-time transfer protocol (RTP).

### 3. Experiment Results

#### 3.1. Impact frame rate to transmission performances

Delay characteristics to transmission delay for some frame sizes are shown in Figure 2. Most data show the same pattern that delay decreases as frame rates increase. Regressively, delay trend-lines sometimes are exponentials and others are linear. For instance, for video with frame size 704x576, delay achieves 150 ms for frame rate 10, decreases to about 122 ms for frame rate 60 ms.

![Graphs](image)

**Figure 2.** Impact frame rate to delay
In average, delay decrease as frame rate increases. The delay increment is approximated by the equation $y = 0.2218(x/10)^{-0.287}$, where $y$ is delay in second and $x$ is frame rate (Figure 3). This phenomenon can be explained as frame rate increases, the number of I frame that has higher number of bytes decrease. This decrement results smaller bytes per frames. So video generates lower number of packets per frame. The frame distribution has been shown in previous research [10].

![Figure 3. Average delay](image)

Meanwhile, packet loss has undefined characteristics as the values are up and down over various frame rates. Although the average trend is decreasing, the losses are mostly network dependent. Delay is 1.7% for frame rate 10 fps, downs to 0.05% at 40 fps, increasing to almost 3% for frame rate 60 fps as depicted in Figure 4a. The packet loss characteristic is followed by the network throughput. In average, throughput is 5500 kbps for frame rate 10 fps downs to about 5200 kbps at frame rate 40. This figure is then up to more than 5500 kbps again. In average, the trend is decreasing (Figure 4b).

![Figure 4. Average loss and throughput](image)

From these characteristics, video with higher frame rates may produce lower delay for real-time applications, given that frame size and bit rate are fixed.

### 3.2. Impact frame size to transmission performances

By taking average data for each frame size, it is known that delay increases exponentially as frame size increases. Delay is only 120 ms for 160x120 frame size, increases up to more than 300 ms for 800x500 frame size (Figure 5). Meanwhile, losses are not consistent; changing over time depending upon network conditions (data is not shown).
Finally, throughput increases for increasing frame size. It can be approximated by linier trend equation of \( y = 1016.1x + 809.45 \) where \( x \) is frame size index. Throughput is consistently rising from 2712.16 kbps at frame size of 160x120 to about 9006.94 kbps at frame size of 1600x1200 (Figure 6).

Increasing delay and throughput for increasing frame size are acceptable as number of transmitted bytes higher. This proofs that lower frame size video for real-time applications may exerts lower delay. But if, speed is not a concern, higher frame size produces higher throughput.

4. Conclusions
This works has assessed video transmission over an ad hoc 802.11 network by changing the transmitted video parameters, namely frame rate and frame size. The experiments show that the average delay decreases by the equation of \( y = 0.2218(x/10)^{0.287} \) to frame rates. Losses and throughput varied to frame rates.

Meanwhile, the impact of frame size increment produces increasing delay exponentially and throughput linearly. The higher frame rate with fixed bit rate and the lower frame size may produce lower delay for real-time applications.

Acknowledgement
This research has been supported by the Penelitian Produk Terapan, funded by DIKTI through the grant No /UN5.2.3.1/PPM/KP-DRPM/2018.
References

[1] Al-Akaidi M, 2017 A review on transport layer protocol performance for delivering video on an adhoc network in *IOP Conference Series: Materials Science and Engineering* p. Vol. 237, No. 1, 012018.

[2] Suherman S Suwendri S and Al-Akaidi M, 2017 A review on transport layer protocol performance for delivering video on an adhoc network in *IOP Conference Series: Materials Science and Engineering* 237, 1.

[3] Jiang J Sekar V and Zhang H, 2014 Improving fairness, efficiency, and stability in HTTP-based adaptive video streaming with festive *IEEE/ACM Trans. Netw.* 22, 1 p. 326–340.

[4] Gualdi and Cucchiara, 2006 Low-latency live video streaming over low-capacity network *Proc. IEEEI nt* p. 449–456.

[5] DW Gillies, CN Lo, MG Luby T S, IP broadcast streaming services distribution using file delivery methods *US Pat. 9,026,671, 2015 - Google Patents*.

[6] Abdurrahman, H., Sitompul, O. S., & Mubarakah N, 2017 UDP-Lite Enhancement Through Checksum Protection. *IOP Conf. Ser. Mater. Sci. Eng.* 180, 1 p. 012146.

[7] Xie X Zhang X Kumar S and Li L E, 2015 piStream: Physical Layer Informed Adaptive Video Streaming over LTE *Proc. 21st Annu. Int. Conf. Mob. Comput. Netw. - MobiCom ’15* p. 413–425.

[8] Suherman, S., & Al-Akaidi M, 2013 Increasing uplink broadband video streaming protocol performance in WiMAX network. *Int. J. Internet Protoc. Technol.* 7, 3 p. 176–185.

[9] Sanders C, 2017 Practical packet analysis: Using Wireshark to solve real-world network problems *No Starch Press*.

[10] Suherman S Mubarakah N and Al-akaidi M, 2018 Minimizing Energy Consumption on Mobile Phone by Rearranging Transport Protocol Load 7 p. 713–717.