Reducing Multimedia Data Transmission Costs for Digital Library Applications by Using Unreliable, Fast Protocols

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1 Problem Statement

Digital library applications require large amount of network bandwidth because of huge size of multimedia data. High transmission costs are important criteria for these applications. Reducing transmission costs, or in other words reducing response time, can help to improve system efficiency and user satisfaction [1, 2, 3]. Reliable protocols like TCP guarantee the integrity of transmitted multimedia data, but they require extensive handshaking and acknowledgement messaging [6, 7, 8]. However, multimedia data is tolerant to loss or corruption, unlike the text and binary data. In most of the realtime video and audio streaming applications, timeliness is more important than accuracy of information [1]. An unreliable, but fast and lightweight protocol may make improvement in transmission costs of multimedia data. However, loss sensitive parts of multimedia data, such as “header” sections, should still be sent by using a reliable protocol in order to interpret actual multimedia data correctly [1]. In this project, we will research the effects of using an unreliable and fast protocol for image data transfer on transmission costs.

2 Tasks to be done

- We expect that using an unreliable, fast protocol will reduce communication costs, but how my much this gain is valuable to implement is a question that should be answered. By finding simulation (and, if time permits, experimental) results, we will gain valuable statistics about image data transmission on different types of networks.
- Packet losses on an unreliable protocol can be eliminated by an application layer protocol, if accuracy of data is important. The application layer protocol can also be configured to catch a level of accuracy, which means exact accuracy of data is not required, only satisfying over an accuracy level is enough. We will produce some statistics of performance benefits using such an application protocol and compare it with usage of a reliable protocol. Accuracy of data and transmission costs are reversely proportional. We will try to find better proportion for these two criteria.
- Another question that should be answered, how could we give an accuracy level for image data or how user satisfaction can be measured.

3 Solution to Problem

In implementation, we will use TCP as a reliable protocol and UDP as unreliable protocol. Implementation of project will include below tasks:

1 Different image formats will be searched.

2 According to different file formats, some categorized images will be selected as sample inputs. Different categories may be produced according to dimensions, color depths, color tables and contents (space, scenery, text containing etc.) of images[1].

3 Some imaginary LAN, MAN, WAN network model will be constructed for *Network Simulator* (*NS*) tool [5]. The criteria to create such models will be bandwidth, hop counts and router capabilities.

4 Network simulation scenarios will be determined according to protocol type (TCP or UDP) frame and datagram sizes, network traffic, congestion, image sizes etc… In these scenarios, every category of images will be divided to different sizes of frames and datagrams, so we could get better statistics between frame size and performance gain. When UDP is used in a scenario, TCP will be used only for sending loss sensitive image information, for most of image formats, this part will be a header section.

5 *Network Simulator* tool will be used to play scenarios on sample network models. This will be simply simulation of sending and receiving of images over sample networks. During these simulations, some statistics will be computed, such as, number of data and control packet transfers, total and average transmission times of them, number lost and corrupted packets (corrupted packets still can be used to render image data, thus, two separate statistics are important for incorrectly transferred packets), delays, jitter, number of retransmissions(in TCP) etc…

6 According to simulation results, some of simulations can be repeated with different parameters or some new simulations can be defined to improve results

7 One of the aims of the project is to produce satisfaction levels for image data. So, we have to determine how much loss is tolerable for a user. According to the lost and corrupted packets, we will figure out which parts of a sample image is lost and we will reconstruct image file and display it to user using a viewer program, so user would be able to rate the image quality. We expect to get a statistics of unacceptable image transfers in whole image transfers, since it may cause to retransmission of images that increase system response time.

8 After doing this simulation, if time permits, we will try to calibrate our results on some real networks. We will model some real network configurations on *NS* and try same simulations on these models. Then, we will implement a client-server program to transfer images on these real networks. We will do image transfers using the program and try to collect same statistics on it. By comparing the results of real network transfers and results of simulations, we will try to figure out how much our simulation statistics are precise.

9 All the results will be refined and presented in project report.

4 Schedule

For step 8, we will not leave any time for now. If the project schedule permits to further works, we will consider about these step.

- Oct 20th : Background research and tool research will be finalized and step 1 will be completed.
- Oct 30th : Step 2, 3 and 4 will be completed.
- Nov 10th : Step 5 will be completed.
- Nov 15th : Step 6 will be completed.

- Nov 25th : Step 7 will be completed.
- Dec 5th : Step 9 will be completed.

5 Future Work:

Similar simulations can be tried on audio and video data. Especially, MPEG like formats have layering capability, which means a picture frame is represented by several layers. These layers can be sent to user separately according to quality requirement of user. In lower quality, you don't need to send all the layers to user.

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