The Design of Piconet Pervasive System Architecture for Video Streaming Applications

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Abstract—**The development of mobile phone technology, facilities and its features are currently growing rapidly. Bluetooth is one of mobile phone feature that implement wireless technology which can connect different devices through the ISM band. Bluetooth can be used as a media network for streaming video from computers to mobile phones. The research aims to analyze the influence of video bit rate in video streaming over Bluetooth network. In this research we proposed a design and implementation of Bluetooth connection from computer to mobile phones including the selection of videos and video parameter combination corresponding to stream on Bluetooth network. Based on research results, streaming from computers to mobile phones can be performed with the help of Gnubox and AnalogX Proxy. While based on preliminary research the obtained values for the video bit rate that can be delivered are 8 kbps, 12 kbps, 16 kbps, 20 kbps, and 24 kilobits per second. Results from measurements obtained best value for the parameter of packet loss that is equal to 6.14% at 24 kbps video bit. Although this value is outside the video streaming quality of service based on Cisco, where packet loss value must be less than 5%, but streaming video is a delay-sensitive not a packet loss-sensitive then they still be tolerated. The delay in compliance QoS video streaming is obtained ranged from 0.225 – 0.240 millisecond which qualified Cisco QoS (4 – 5 second).**

Index Terms—**Streaming, video, Bluetooth, mobile**

I. INTRODUCTION

Thedevelopment of mobile phone technology and its features are growing rapidly. Currently mobile phone is not just a tool to communicate or to send a message. Mobile phone has evolved into a multifunctional device that has a line with additional features such as cameras, infrared, bluetooth, video and music player, GPS (global positioning system), voice recorder, that can facilitate the users.

Bluetooth is one of mobile phone feature that implement wireless technology which can connect different devices through the ISM band. Wang [1]. Catania and Zammit [2] have done video streaming testing using bluetooth network to stream video clips and real time video from cell phones to computers and from computers to cell phones. The operating system used on computers is based on Linux.

One way to overcome the weaknesses in bluetooth network is using the appropriate protocol and video compression. The choice of suitable video compression will affect the quality of the video because they relate to the size of the video bit rate. Wang [1] explained that the video format H.263 is video format that suitable to streaming video via bluetooth. H.263 format is built for low-quality video streaming over a small bandwidth that is from 20 to 64 kbps.

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Wang [1] also mentioned that video compression is a field of research that are still extensive, but still rare article that raised this topic. Video compression is a key element in video streaming using bluetooth.

Catania and Zammit [2] in its examination found that L2CAP protocol is better than RFCOMM protocol when doing high-quality streaming video. Based on this research Razavi, Fleury, and Ghanbari [3] found that the default settings of bluetooth not suitable for video streams except to maximize the size of packages and repacking the bitstream dynamically into the package.

The contribution of this research in terms of giving an alternative system architectures by utilizing existing tools. The originality of this research is taking a particular technique and applying it in a new area, also applying existing ideas to new areas of study which is a part of criteria originality concept as mentioned in an article developing originality [4].

II. SYSTEM DESIGN

A. System Requirements

At this stage we identify the piconet system requirements, as follow :

- Server-side development environment: Genuine Intel (R) CPU GHz T2300@1.66, 2:49 GB RAM, Operating System Microsoft Windows XP Service Pack 3 (Home Edition), Bluetooth USB Generic.
- Client side environment: Mobile phone with Symbian OS version 2 Serie 60, Bluetooth v1.1 Additional software used is open source software is called Darwin Streaming Server, GnuBox, AnalogX, and MP4Box-0.4.6-dev_20091013 that was used to hint track video.

B. Prototype Design

The stages in the designing prototype of Bluetooth connection from computer to cell phone for streaming video are, Pre-process, server configuration, and client configuration. In the pre-process, the original video which will be stream will experience three stages of the process such is compression, conversion, and the hint track. Compression process is to minimize the bit rate video. The size of the video bit rate used are 8, 12, 16, 20 and 24 kbps, while other parameters kept constant.

The next process is the conversion, where the video compression format converted into 3gp format sizes for each parameter that was maintained constant (Table 1). The last stage is a hint track process. The video that has been compressed

and converted into 3gp format will be preceding hint track so that the video can be recognize in the network. The process was carried out using Mp4Box hint tracks that will produce a video that is ready to stream. The total bandwidth that can be stream to the client equal to 28 kbps.

Table I
SIZE OF COMPRESSION AND CONVERSION VIDEO

No	Parameter	Compress	Convert
1	Frame size (pixel)	320x240	176x144
2	Frame rate (fps)	10	
3	Codec	H.264	H.263
4	Rate control	Use CBR	
5	Audio Bit rate (kbps)	24	7.95
6	Sample rate (Hz)	44100	8000
7	Audio Codec		libamr_nb
8	Chanels	Mono	Mono

III. SYSTEM IMPLEMENTATION

System to be implemented consists of two main components that are the server and the client which are connected to in a network piconet.

A. Server Configuration

The Server Configuration is consists of software and hardware. Configuration of the hardware consists of a computer and Bluetooth devices, while the software part consists of the Darwin Streaming Server, and AnalogX proxy. Bluetooth stack used is the Bluetooth stack from Microsoft with the configuration used to follow the standard rules.

Server configuration is done by making a new connection using a modem. The modem that used is connected via COM port client Bluetooth devices that have been detected. Then in the network connection, a new connection is created by selecting the connection cable Communications Between two computers. For DSS and the AnalogX Proxy configuration follow the default configuration.

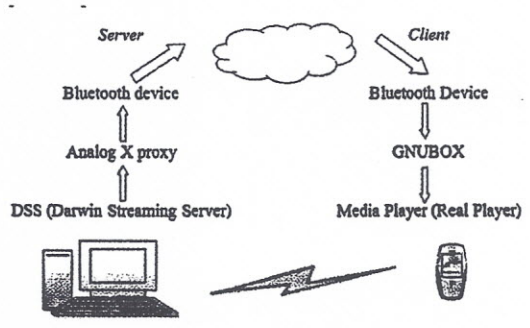

Figure 1. Configuring client and server on the network piconet

B. Client Configuration

Client configuration consists of several stages, which is Gnubox software installation, configuration access point and configuration of media player. After the configuration is successful then the server and client can connect and communicate. The purpose of the software Gnubox is to make new access point mobile phone so that cell phones can access the computer through a Bluetooth network.

In this study Gnubox function is used to stream video using Gnubox ways of 'working. The presence Gnubox make cell phones that connect to the network as part of a computer because cell phones have a one-class IP Address on the computer network.

To view streaming video on the client is by entering the IP address of the server address and name of the video to be played on media player client. For example, to display video foto1 on the command line URL media player enter the IP address, typed the following address: rtsp://192.168.1.200/foto1.3gp

IV. SYSTEM PERFORMANCE MEASUREMENT

Performance measurement is done using software that serves as the Wireshark protocol analyzer to obtain the parameter values that have been determined. The Tests conducted at two different distances of 5 meters and 10 meters distance. The parameters used are throughput, delay, jitter, and packet loss ratio which refer to the quality of service (QoS), streaming video from CISCO.

A. Throughput Measurement

The value throughput of Video 5 meters is higher than the video 10 meters. This occurs because a longer distance then the piconet system requires greater resources in establishing a connection between server and client.

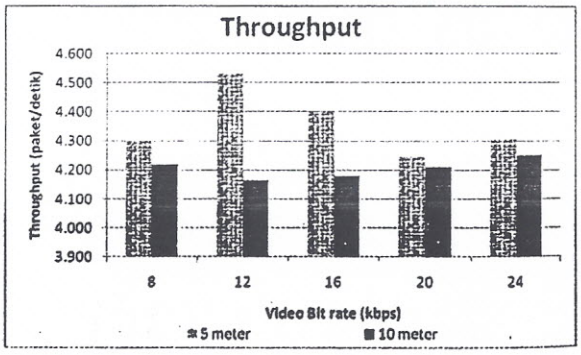

Figure 2. Comparison of average values for each bit rate throughput

Behavioral description that better reflect the value of network throughput based on Figure 2 is a video that is 10 meters, where patterns are formed to give a picture that the larger the size of the bit rate, then the value will be even greater throughput.

B. Delay Measurement

For the delay parameters of both the video has almost the same delay value, ranging from 0225-0240 ms. Graphical comparison of delay for the size of the video bit rate and different distances can be seen in Figure 3. Delay parameters obtained for the entire video that has met the criteria measured QoS video streaming.

The Video delay parameter value for the relative distance of 10 meters is higher than the video 5 meters. As seen in Figure 3, the pattern formed is the opposite of the pattern parameters throughput. The value delay of video 10 meters is decreases while the size of bit rate increasing .

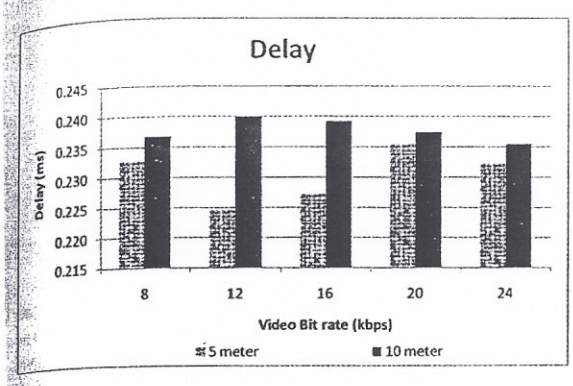

Figure 3. Comparison of average values for each bit rate delay

C. Jitter Measurement

Jitter parameters do not have a basic standard in video streaming based on CISCO, but the jitter information can help to determine the stability of the transmission of data packets in the network. In a video test the pattern of 5 meters jitter parameters is similar with delay but in the video test patterns 10 meters the jitter parameter is different with delay (Figure 4). Jitter parameters have a close connection with the delay, so the behavior of the jitter will follow the behavior delay parameter.

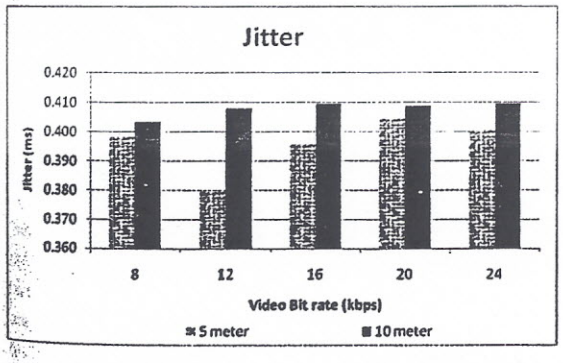

Figure 4. Comparison of average values for each bit rate jitter

D. Packet Loss Ratio Measurement

The Comparison of video packet loss ratio between 10-meter and 5 meters is packet loss ratio value for video distance 10 meters is higher than 5 meter for all sizes. This means that with increasing distance the possibility of a lost package will be larger. When compared with the large size of the video bit rate based on the value of 10 meters, the greater size of the bit rate than the smaller value of packet loss (Figure 5). This is in accordance with the conclusions put forward by Puspitasari [5] that the smaller packet loss ratio, than greater the throughput value, and on this study found that the larger size of the bit rate throughput of greater value.

Packet loss ratio obtained in this study ranged from 6.14 to 13.48%, while the allowable limit packet loss in streaming video QoS is 5%, Szigeti and Hattingh [6]. The best packet loss ratio in this study is 6.14% where this value reach by video with bit rate 24 kbps. This bit rate also the best bit rate size that can use for streaming video from computer to mobile phone in this study.

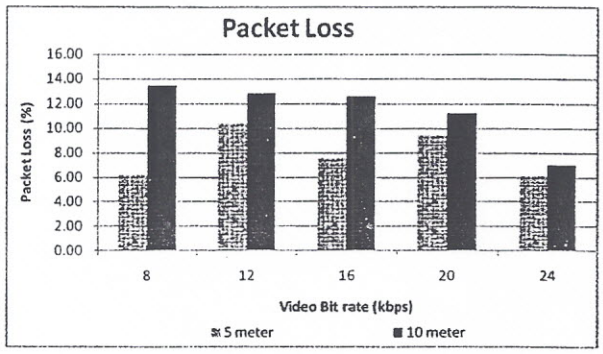

Figure 5. Comparison of average values for each bit rate packet loss ratio

Based on the results of this study show that measurements at a distance of 5 meters do not have a specific pattern, either on the parameters of throughput, delay or packet loss. this is presumably because at a distance of 5 meters there are any interference between the client device with the server, especially on the bluetooth radio wave interference itself. Because of that it is still a certain topic can be discussed further.

V. CONCLUSIONS

1) Video streaming using Bluetooth from the computer network to a cell phone can be done on the Windows operating system using Symbian OS series 60 on the client side
2) This research prove that Gnubox as the tools used to create a new access point on the client side so the client can access the server via Bluetooth proven can be used to stream video from computers to cell phones.
3) The results from measurements obtained value of packet loss ratio for all video compression standards do not meet the Quality of Service streaming video where the smallest value occurs at 24 kbps bit rate of 6,14%. Although packett loss does not meet the standard, but because streaming is delay-sensitive applications and not the packet-loss-sensitive, then they will still be tolerated. And this is shown by the video reception can still be viewed with either (visibility). For the parameters of throughput and delay the entire video compression meets Quality of Service video streaming where the delay value ranging from 0.225-0.240 ms, while the Quality of Service standard for streaming video delay is 4-5 seconds.

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