

Wireless Video Conferencing Proposal

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1. Problem Statement

Video conferencing between mobile phones presents unique challenges. Mobile devices have limited processing power and battery power to work with, and must communicate over a wireless medium, making video conferencing between mobile devices more difficult than between hard-wired devices.

We plan to implement video conferencing between Nokia N95 mobile phones over a Wifi network. We plan to transmit the video and audio feed from the secondary camera and microphone on the N95 between clients using the Real-time Transport Protocol. This involves both an RTP server/sender and a receiver implementation. This should allow compatibility of our implementation with other video conferencing applications.

Our application will be implemented in Java ME. We plan to use Java ME over Symbian C++ due to the ease of implementation. Initial investigation into the media APIs of Java ME indicates that it should be possible to implement video chat. Java ME should provide sufficient control over the integrated camera and network. We would like to allow ourselves two weeks in the beginning of the implementation phase during which we can assess the feasibility of the project.

Since the camera cannot be emulated in the development environment, we will require at least one phone to record and stream video. The receiver should be able to be emulated initially. Bi-directional communication, our ultimate goal, will require two phones.

If we accomplish video conferencing between two Nokia N95 phones, we plan to do testing and

possible optimization with regard to power consumption.

2. Related Work

Our implementation will be based on RTP. The specifications for RTP and other associated protocols, RTCP and RTSP, are documented online at [1].

There are a number of different compression schemes used for video streaming. If the video format we initially get does not lend itself to being transmitted wirelessly, we will look into different options. One example is H.264, described in [2].

Sagetong et al researched techniques to improve performance over wireless networks [3]. They found that variable bit rate formats, such as H.264, are less suitable for noisy wireless links. This is caused by the fact the video encoder output does not match the physical layer's payload size. Explicit Bit Rate video compression is proposed to solve this problem to match the encoder's output to the fixed channel rate. This resulted in improved error resilience, reduced latency, and improved efficiency. We may want to consider such a technique with regard to power consumption.

Van Antwerpen et al investigated factors that affect energy consumption in wireless devices [4]. This paper focused mainly on hardware factors. For instance, they discovered that CPU power consumption does not vary significantly based on video quality. However, caches have a major affect on power consumption due to their affect on memory access. They also formalized what they call "user satisfaction" of streaming video that can be applied to the application layer. This is based on delay, video quality level, and residual energy of the

device. This formulation ensures that too much performance is not sacrificed for power savings.

Finally, [5] performed a non-technical study on how users experience with video conferencing. This study found that video conferencing is most useful to complement other forms of communication, such as audio or text messaging, due to their respective advantages and disadvantages. For example, video conferencing is less suitable in public areas due to its private nature, but is more suitable for special occasions. Overall, this study reveals the usefulness of video conferencing.

3. Timeline and Milestones

We want to allow ourselves time to confirm that this project is indeed possible. Our first milestone will be to confirm this by testing enough of the features.

Overall, we plan on this timeline to accomplish the following goals:

- Oct. 3rd: Become familiar with the phone and development environment. Be able to transfer a custom application to the phone.
 - Oct. 10th: Confirm video conferencing is possible on the N95. This will include recording from the camera and playback on a single phone. We will also do some investigation into the RTSP implementation on the N95 to see if built-in playback is supported. Also, we need to test the wireless transmission, and work on sending information from one phone to another.
 - Oct. 24th: Video codec investigation. Determine the format of video for wireless transfer. Implementation for encoding and decoding should be finished. This will depend on what is supported by the phone. This will also include audio. It may be the case that we do not need to encode the video at all, if the format of the video is compressed enough for transmission.
 - Nov. 7th: Implementation of the RTSP streaming server. One phone should now be able to stream video to another phone.
 - Nov. 21st: Bi-directional streaming and receiving so video conferencing is possible.
- Dec. 5th: Test and improve power consumption. This will probably involve altering video quality and reducing throughput.

These milestones are possibly too ambitious and may change as the project progresses. In particular, the more advanced milestones may not occur as planned. For instance, testing and improving power consumption may not happen at all if the earlier milestones are delayed.

4. Deliverables

Our implementation can be done in the above stages that will produce these tangible results (in order). We anticipate the tangible milestone deliverables of our project will include the following, culminating in the final goal of full video conferencing.

- 1) The ability to record from the secondary camera and display the result on the screen.
- 2) Communication between two phones. This will be something simple such as sending a string from one phone to another.
- 3) Video streaming (including audio) from one phone to another.
- 4) Full video conferencing.

5. References

- [1] RTP, Real-time Transport Protocol. <http://www.networksorcery.com/enp/protocol/rtp.htm>.
- [2] RTP Payload Format for H.264 Video <http://www.javvin.com/protocol/rfc3984.pdf>.
- [3] Sagetong, Phoom. Garudadri, Harinath. Nanda, Sanjiv. "Video Transport Over Wireless Networks." MM '04. October 10-16, 2005. New York.
- [4] Van Antwerpen et al. "Energy-Aware System Design for Wireless Multimedia." Proceedings of the Design, Automation and Test in Europe Conference and Exhibition. 2004.
- [5] O'Hara, Kenton. Black, Alison. Lipson, Matthew. "Everyday Practices with Mobile Video Telephony." CHI 2006.