Term Project: Phase II Report

CSE 434- Computer Networks

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**Hypothesis/Research Question**

The iMPACT research team's current implementation of a web proxy provides an optimized form of image trans-coding for use with mobile devices. The current research indicates that the system performs very quickly, with the current bottleneck in the area of TCP handshaking. We are attempting to verify these previous findings as well as determine the system tradeoffs between performance versus power consumption and thermal outputs. Also, we will attempt to verify that the current web proxy design functions within acceptable levels of power consumption and thermal output.

**Literature Review:**

***A QoS-based Service Composition for Content Adaptation***

In *A QoS-based Service Composition for Content Adaptation* by K. El-Khatib, G. Bochmann, and A. El-Saddik, the issue of heterogeneity on today's internet is addressed, focusing specifically on the way content can be delivered to various different types of end systems (from small, simple systems to large, complex systems) using service composition in order to support multimedia applications which are widely distributed. It is made clear that there are many issues which affect the end system's diversity - including what can be displayed on the device, how much data can be stored, its processing power, and finally its network connectivity, all of which must be taken into account when delivering multimedia over the Internet. In the modern Internet, it is no longer possible for most content providers to create multimedia, which is accessible by all end systems, and thus solutions must be implemented to allow access to this multimedia by all users.

The paper focuses on content adaptation (also known as trans-coding) as a means of effectively delivering this multimedia to all types of devices, being a large improvement over the alternate methods by which content providers create multiple types of content for different devices, known as static content adaptation, as well as over the method of dynamic content adaptation, in which the client is responsible for trans-coding. This method of content adaptation in which web proxies are responsible for the trans-coding allows for effective adaptation of content to fit the capabilities of the end system quickly and effectively. Discussed are the various methods of implementing these content adapters, including currently available adaptation methods as well as hardware implementations and trans-coding chaining.

The individual focus of this paper is creating a Quality of Service (QoS) selection algorithm for providing personalized content. This algorithm finds the best trans-coding chain from those available to be applied to data as it is delivered to the end system, reasoning that trans-coding chains allow for fast, reliable trans-coding as the individual components are simpler overall and can be replicated across a network. Trans-coding chaining is the process by which content is trans-coded a bit at a time by multiple trans-coding components (who perform different types of trans-coding) resulting in a final trans-coded multimedia, which is appropriate for the specifications of the end system. This Quality of Service selection algorithm takes into account user preferences, media types, the capabilities of the device, the network profile, and the capabilities of intermediate devices across the network connection. This algorithm is considered effective based on end user's satisfaction with the content delivery, as well as speed and reliability of the adaptation. It can be concluded from this paper that content adaptation is an effective solution to the problem of heterogeneity in content delivered across the Internet and that QoS path selection algorithms can be used as a method to properly implement this content adaptation.

***JPEG Compression Metric as a Quality Aware Image Transcoding***

In *JPEG Compression Metric as a Quality Aware Image Transcoding* by S. Chandra and C. Ellis, the tradeoff of quality versus size of JPEG images during trans-coding is discussed, presenting various techniques on how to quantify these characteristics. The paper addresses how to perform informed trans-coding using JPEG compression metric, as well as how to predict the computational cost of this trans-coding and the space benefits achieved. Obviously, this issue has relevance to any trans-coding taking place, as the goal is to improve speed and performance of these methods to allow for timely delivery to all types of end systems.

Addressed are the multiple types of trans-coding, including static, streamed, and store-and-forward methods, focusing on how we can determine the effectiveness of transcoding based on how much information is lost vs. how much is gained from the actual trans-coding. This understanding is necessary in order to determine when trans-coding should be done and to what extent to be appropriate for end devices. The motivation here is to eliminate guesswork from the process of trans-coding these images. This understanding is obtained by evaluating the user's perception of the quality of an image and the computational cost of the trans-coding itself, making it easy to predict the outcome of a possible trans-coding. This allows systems to determine if a trans-coding will be worthwhile, saving time in cases when it is not worthwhile to trans-code. The paper describes the method by which a created JPEG Quality Factor predictor estimates a user's perception of the quality of a JPEG, establishing a method by which systems can quantify this measurement - a necessary task in order to correctly analyze a possible trans-coding. Additionally presented is a method by which the computation cost of this trans-coding is quantified. Once these values are quantified, the paper presents results of analyzing images for quality loss and image size vs. computational power tradeoffs using this new metric. These methods of quantifying this process ultimately are intended to improve the effectiveness of the technique of trans-coding.

***Information Quality for Mobile Internet Services: A Theoretical Model with Empirical Validation***

In *Information Quality for Mobile Internet Services: A Theoretical Model with Empirical Validation* by M. Chae and J. Kim, the identification of important aspects of information quality is addressed, focusing on an increase in user satisfaction for mobile Internet services. The paper proposes a general model of quality of information with four dimensions constructed from prior research. These four dimensions are then tested with mobile Internet users to determine if they increase customer satisfaction with mobile devices. The four dimensions being considered are those of connection quality, content quality, quality of interaction with mobile services, and quality of the services within the context of the task being performed by the user. The motivation in analyzing the potential returns on improvements in these dimensions is that it can be more easily determined what aspects of mobile services should be focused on specifically.

Using a deployed online data gathering system to collect relevant data, the paper explores the results gathered, building a causal model of information quality. The results are used to empirically demonstrate that the model created is an adequate (to a "fair degree") model for the impacts of quality of information on the satisfaction of end users. The final results indicate that all four different dimensions of quality impact user satisfaction. However, connection quality and interaction quality have larger effects than content quality or contextual quality. This is especially relevant in content trans-coding, as it indicates that users are most likely willing to trade the quality of content for an increase in connection quality as is the case when content is trans-coded.

***Dynamic Adaptation in an Image Transcoding Proxy for Mobile Web Browsing***

In *Dynamic Adaptation in Image Transcoding Proxy for Mobile Web Browsing* by Richard Han, Pravin Bhagwat,, Richard Lamaire, Todd Mummert, Veronique Perret, and Jim Rubas, an analytical framework to a possible solutions for image transcoding for mobile devices in real time with predictions in efficiency of adaptation policy making, transmission time reduction and critical limitations was presented. The paper introduced the idea of store-and-forward transcoding policy and when it should be used to reduce transmission time. With the assumptions that image sizes, network bandwidth between proxy, server and client are known, a formula Dp(S) + S/Bsp (S-Sp(S)) / Bpc < min(DMAX, S/(min(Bpc,Bsp)) can be populated to predict whether an image should be or should not be transcoded before sending it off from the proxy. Bsp and Bpc in this formula stand for the bandwidth between server-proxy, and proxy-client. Often the latter is a bottleneck in real-life network environment, thus the delay of transcoding Dp is well worth of taken consideration when bandwidth of the client is limited.

The paper also introduced an interactive solution for clients to configure and throttle the transcoded compression ratio. Since the policy module generates a set of parameters to control the type of compression performed by the transformation module, a user preference in terms of image quality and response time can be specified by using a slide bar and then communicated to the proxy settings. If the bandwidth between proxy and client exceed a point where transcoding is unnecessary, the proxy will not perform any transformation and will only forward the image to the client.

In the research, automated policy decisions were developed within transcoding HTTP proxy with adaptation of client heterogeneity, image content and user preferences but does not perform prediction of image transcoding delay and output byte size of the transcoded file. The format of the images also made a distinction in the policing making since different formats require different techniques for compression, which result in different transcoding delay. Such formats were evaluated using store-and-forward technique through a Palm Pilot device for testing.

**Methodology**

The purpose of our experimental design is to verify the results of the iMPACT research team's web proxy. In theory, by reproducing the same experiment and collecting data in the same manner as iMPACT's research team we should reach the same conclusions. Namely observing the bottleneck of turnaround time, throughput and response time performance to be within the area of TCP handshaking. The developed web proxy serves as an intermediary between a Client and a Host trascoding images. Therefore there are many potential areas for bottlenecks to occur, this is why verification of a specific bottleneck is crucial to performance constraints. To gain an understanding of how such a system works packets must be sent through multiple layers as depicted in Figure 1.



**Figure 1: Network Topology**

Data is collected via time stamps within the Client, Web Proxy, and Web Server. This allows times to be evaluated from end to end points when viewing the data sequentially. In an effort to collect further the research of practicality and real world performance of the iMPACT research team's web proxy, we are going to collect thermal and power consumption data through different loads and phases as well. With this data we will be able to discuss and evaluate performance to cost figures for real world applications.

In order to observe power consumption we will use a power meter that attaches between the wall and the web proxy's power source. As for thermal measurements, we will going to attempt and use ACPI 1.0 and/or ACPI 2.0 which is built into system's BIOS. If these method isn't practical or interferes with the performance of the web proxy we still have the option of installing a binary sensor package for temperature recording, namely lm\_sensor. Our data will be collected by developing a series of various loads on the web proxy in order to simulate real world possiblies. Each of these loads will be designed to have strong statistical difference from eachother to develop a higher confidience in our conclusions.

The experimental setup for power and thermal will be generated over a fixed time interval, time being the independent variable. The control variable will be load capacity as stated earilier, the load will be simulated by amount of images that need to be transcoded. This load will vary from dimensions of multitude requests as well as variation of image sizes sent to the web proxy to transcode. The dependent variables will be power and thermal readings in comparison to the performance given for that specific test run. Lastly, we will run multiple combinations of these tests to develop an analysis and conclusion of the data gathered.

**Timeline**



**Figure 2: Tentative Project Schedule**

**References:**

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