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Internet Path Selection on Video QoE Analysis and Improvements

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Abstract— Systematically study a large number of Internet paths between popular video destinations and clients to create an empirical understanding of the location, existence, and repetition of failures. Finding ways to lower a providers costs for real-time, Internet protocol television services through a Internet protocol television architecture and through intelligent destination-shifting of selected services investigate ways to recover from Quality of Experience degradation. Using Live Television and Video on Demand as examples, we can take advantage of the different deadlines associated with each service to effectively obtain these services. Designing and implementing a prototype packet forwarding module called source initiated frame restoration. We implemented source initiated frame restoration on nodes and compared the performance of source initiated frame restoration to the default Internet routing. We found that source initiated frame restoration outperforms IP path selection by providing higher on-screen perceptual quality. These failures are mapped to the desired video quality in need by reconstructing video clips and by conducting user surveys. We can then examine ways to recover from Quality of Experience degradation by choosing one hop detour paths that preserve application specific policies. Path ranking methodology is used to find the path which contain high quality videos with low cost and occupies very low memory space. By ranking videos according to their quality, size, and cost, the top ranking videos can be retrieved by the client.

Index Terms— Detour Paths, Internet Protocol Television, Quality Of Experience, Source Initiated Frame Restoration, Video On Demand.

1 INTRODUCTION

Multimedia content is poised to dominate all Internet traffic in the coming decade. More people today opt for video-conferencing, live Internet television, and video-on-demand services than they did a decade ago. The Internet has evolved from being a platform for hosting web pages to be a playground for multimedia content. As customers spend more and more time watching videos online, they are increasingly becoming unsatisfied by low bit rate videos and are embracing high-definition (HD) streaming services. Providing high quality video streaming services over a best-effort and shared infrastructure such as the Internet, however, is non-trivial. It is increasingly observed that existing Internet Quality of Service (QoS) is insufficient at ensuring consistent consumer experience. As Internet based multimedia competes with traditional cable-based streaming, an ever increasing load is placed on network elements on the Internet to delive streaming content with high perceptual quality, including content delivery networks (CDNs), overlay networks, VoD and IPTV infrastructures.

To succeed, network service providers need to infer, predict and improve perceptual video quality on the Internet. Service providers are hence trying to characterize a video stream in terms of Quality of Experience (QoE) rather than QoS. Internet QoS has long attempted to assure Statistical service guarantees for parameters like bandwidth, delay, loss, and jitter . However, QoS lacks an important element in characterizing video streams, that of human perception.

For a given loss rate, the perceptual degradation caused by a network outage can vary dramatically depending on the type of frame impacted, the motion complexity inherent in the clip, and the encoding bit rate of the clip, to name a few. For example, a 1% loss on an MPEG-2 transport stream can either result in a minor glitch that is barely noticeable, or can severely degrade playout for an entire second depending on the a foresaid factors Inferring perceptual quality of a video stream continues to be an open problem. Existing perceptual quality evaluation frameworks are often complex, computationally intensive, or require specialized information.

Inferring QoE apart, understanding present day Internet QoE and improving it are even harder. Internet architectures and protocols are highly optimized for elastic content like http, ftp and e-mail. For these applications, time-to-deliver is less important than message integrity. Given the diversity and size of the Internet, degradations at the link level and end-to-end path level that effect video QoE are not well understood. Quality of Experience (QoE) describes how well a service performs in meeting user expectations. It is a rating of performance from the users' perspective. For Internet based streaming to compete with existing cable based infrastructure, QoE delivered by streaming services has to match or outperform QoE from cable based streaming.

Both technical and economic reasons are there to expect that

Internet routing is non-optimal. Currently wide-area routing protocols are primarily concerned with the exchange of connectivity information and do not concern about measures of round-trip time or loss rate into their decisions. Economic considerations can also limit to the routing options. Some parts of the Internet refuse to carry traffic without a contractual agreement. By sending the next set of key frames of multiple paths, we maximize the chances of at least one of the paths to deliver the frames that helps restore quality. Traditionally QoS aims to enable streaming services to provide high quality videos to the end users.

2 RELATED WORK

In general, there is an extensive literature on measuring the Heterogeneous Earliest-Finish-Time (HEFT) Algorithm which selects the task with the highest upward rank at each step. This section reviews some related work in order to explore the strengths and limitations of previous methods. A task prioritization phase for computing task priorities. And a processor selection phase for selecting the best processor for executing the current task. A policy search algorithm is devised to handle the resource transfer problem. An action in this algorithm represents transferring a resource to a neighbor. Scheduling in Multi hop Wireless Networks Without Back-Pressure may be able to combine the scheduling and routing functions together. The algorithm assigns a weight to each possible destination. Broadcasters is not efficient to provide the quality of services to the client. In traditional method quality monitoring happens. Human inspects each channel to make sure the service is operating normally in every end or provider location. Due to delay of delivery of the packet content to clients, packet loss, congestion happen on network, time delay to reach the client. These are the common drawbacks are occurred while video packet transmission. All the above mentioned techniques obviously would have the following drawbacks

- Higher time complexity was observed. More processor power used. The task selection phase of the algorithm is based on a summation of downward and upward ranks.
- Task allocation is very difficult without forming the self organization process. Very difficult to combine the three principles so to achieve the best performance of the particular result will be failed. The three basic principles they are cloning, resource exchange and relation adaptation.
- Scheduling in Multi hop Wireless Networks Without Back-Pressure approach primarily focus on maximizing throughput Do not consider QoS performance. Broad casters is not efficient to provide the quality of services to the client. Due to delay of delivery of the packet content to clients, packet loss, congestion happen on network, time delay to reach the client.

3 PROPOSED ALGORITHM

Here we present the proposed clustering algorithm for grouping of similar videos. First we characterize the use of Path-Rank as a general graph centrality which analyse the path selection on video quality by providing high quality video with low cost and occupies very low memory will be given the highest rank.

We then characterize how Page-Rank can be used within an Expectation and Maximization framework to build up a entire relational clustering algorithm. In this section discusses issues relating to clusters and various other implementation issues. The following are the few algorithms and methodologies like Random K Results, Path Switching with Random 5, Path Ranking, Probing Methodology which includes Failure, Outage, Traceroutes which are used in the implementation.

3.1 Random K Results

Randomly selecting any k intermediate nodes in times of an outage, and simultaneously attempting to transmit the subsequent key frames through them. The first such intermediate node of the chosen k which is loss free and whose RTT is bounded is chosen as the best alternative and we continue streaming via that node. A subsequent failure on that path again triggers the random-k strategy until a new path is found. In case of finding no paths,we re-invoke random-k until we find a suitable intermediary or if the IP-path self repairs.

3.2 Path Switching with Random 5

Path switching is performed when the destination reports a degradation which impairs perceptual quality. We now investigate the following question: how soon should a receiver inform of a degradation, and what are the benefits of switching paths early.

3.3 Path Ranking

Although originally proposed in the context of ranking path for videos , Path Rank can be used more generally to determine the importance of the path in the network. Ranking is used to find the path which contain high quality videos with low cost and occupies very low memory space. Thus, by ranking videos according to their quality,size,cost, the top-ranking videos can then be retrived by the client.

3.4 Probing Methodology

Systematically studied paths between our vantage points and destination sets. We probed the destinations from our vantage points mimicking a fetch operation of streaming content using UDP probes of 1024 bytes. To do this, we timed our probes according to the IP-level trace of a variety of low and high motion clips.

Failure:Even a single packet loss can potentially induce perceptual degradation, we strive to distinguish between short lived congestion drops and a true path outage in this round of study. We declare a path to experience a failure event if three or more consecutive probe packets fail to receive a response.

Outage: When probe response fails, we issue a traceroute from the vantage point to that destination. If the first traceroute after a failure event. Also fails, we declare a destination outage. Upon detecting an

outage, we send a continuous stream of probes to the destination until the path return to normal.

Traceroutes: When a path experiences a failure event, we used TCP traceroutes to determine the possible location of the failure. TCP traceroute return the results faster than the standard ICMP based traceroute to determine failure location within milliseconds of its time. Source side, destination side, last hop,or middle core were the classification of failure location.

4 SYSTEM DESIGN

Fig 1 of the below represented system architecture demonstrate the framework of our proposed approach. The modules in our system constitute of identifying the perceptual degradations, random internet path selection,Reconstructing video clips, and recover from video QoE. We broadly classify failure locations as source side, destination side, last hop,or middle core. Streaming content on the Internet today is most commonly disseminated by VoD/IPTV service providers or by P2P streaming . Hence, we begin by measuring the round-trip path to these destinations from geographically diverse client locations.

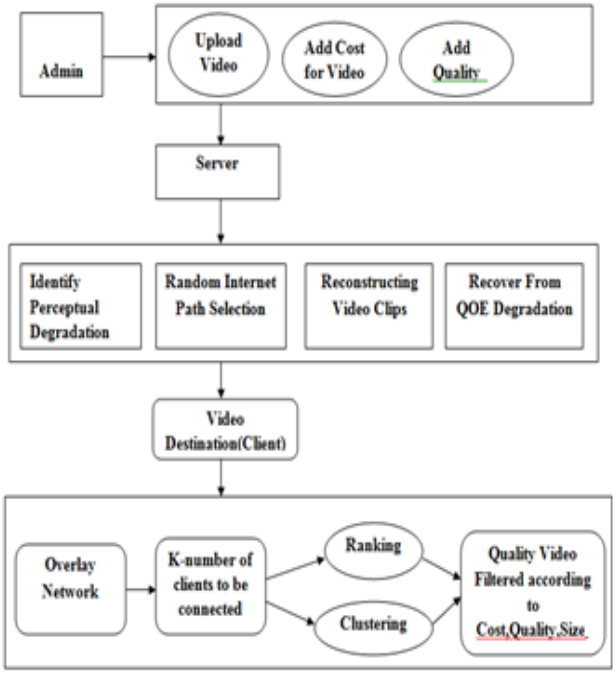

Fig 1. System Architecture.

We analyze outages on these paths, their recurring frequency, as well as their location along the path. We provide upper bounds on the fraction of outages that occur on the last hop, which cannot be recovered by using alternate paths. Overall, results presented in this section are crucial to understanding paths used to disseminate streaming content from popular sites/hosts all over the Internet.

Video QoE is known to be multidimensional, and the overall perceived quality of a service provided depends on parameters that go beyond network efficiency. For each instance of a corrupted frame in a GOP, an artifact is produced. Not all artifacts induce the same user reaction.

4.1 Identify Perceptual Degradation

We probed a large number of popular Internet video destinations from 62 geographically diverse vantage points for seven consecutive days. We discovered a significant number of path outages that led to complete loss in path connectivity. We find that outages occur in various points in a path and vary significantly between paths to servers and P2P hosts. We quantify outage frequency, recurrence, location, and persistence.

To measure the perceptual degradation resulting from these outages, we reconstructed a variety of MPEG video samples using the IP-traces collected from every destination set. These artifacts could range from slicing to freezing toextreme pixelation these artifacts and their on-screen duration depend on the type of frame impacted and encoding bit rate.

4.2 Random Internet Path Selection

The Internet is organized as an interconnection of thousands of ASs. Each AS is under the purview of an Internet service provider (ISP), and neighboring ASs use the Border Gateway Protocol (BGP) to exchange reachability information. Ass apply individual policies in advertising and propagating reachability information to neighboring ASs. In reality, reachability information advertised by an AS is often the result of various provider–customer relationships between the governing ISP and other ISPs. Typically, ISPs are arranged in various tiers, where tier-1 ISPs sell connectivity to other ISPs, while tier-3 ISPs buy connectivity from ISPs in higher tiers while charging consumers. Though the model we present here is overly simplistic, it offers a basic overview of how Internet routing works.

4.3 Reconstructing Video Files

- When a sufficient number of encoded blocks are read from different parents the original segment can be decoded.
- Each parent peer caches N encoded blocks separately from N segments of the video.
- Each parent peer caches an encoded block of segment 1, an encoded block of segment 2, and an encoded block of segment N.
- The child peer only needs to connect to M parent peer to receive M linear independent encoded blocks of any segment and thus are able to recover any particular required segment.

4.4 Recover from QoE degradation

We focus on discovering network induced degradations that are addressable by using alternate paths in the Internet.

Video-QoE is known to be multidimensional, and the overall perceived quality of a service provider depends on parameters that go beyond network efficiency. we focus on discovering network induced degradations that are addressable by using alternate paths in the Internet. We summarize our basic assumptions about QoE that we use for the rest of this paper as follows. For each instance of a corrupted frame in a GOP, an artifact is produced. Not all artifacts induce the same user reaction. For low-motion clips, we mark the I-frame as a key frame. For high-motion clips, we mark both I- and P-frames as key frames. While subjective perception degrades with the loss of key frames, immediate restoration of key frames following degradation induces a "forgiveness" effect.

5 DISCUSSIONS

5.1 Conducting Surveys

Using subjective surveys, we outline application specific policies that can improve perceptual quality. To measure the perceptual degrdation resulting from these outages, we reconstructed a variety of MPEG video samples using the IP-traces collected from every destination set. Network anomalies typically manifest as a video artifact, which is a visible distortion during playout that persists for certain duration. These artifacts could range from slicing to freezing to extreme pixelation these artifacts and their on-screen duration depend on the type of frame impacted and encoding bit rate.

Industry forecasts that the sum of all forms of video on demand, Internet, and peer-to-peer networks constitute global consumer traffic. As multimedia service providers deploy services on top of packet-switched networks that compete with cable-based content providers, there is an ever-growing need to provide superior quality of experience.

6 RESULTS

Thus a large-scale measurement-based study on the effects of Internet path selection on video-QoE and investigates ways to improve it using application-specific policies and redundant Internet paths. Perceptual quality can be raised by path selection strategies in routing overlays that preserve these application-specific policies in times of network outages. We can then examine ways to recover from Quality of Experience degradation by choosing one hop detour paths that preserve application specific policies. Path ranking methodology is used to find the path which contain high quality videos with low cost and occupies very low memory space. By ranking videos according to their quality, size, and cost, the top ranking videos can be retrieved by the client.

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