Announcing the Final Examination of Mukundan Iyengar for the degree of Doctor of Philosophy

Time & Location: May 31, 2011 at 12:00 PM in HEC Engg. III 356
Title: Measuring and Improving Internet Video Quality of Experience

Streaming multimedia content over the IP-network is poised to be the dominant Internet traffic for the coming decade, predicted to account for more than 91% of all consumer traffic in the coming years. Streaming multimedia content ranges from Internet television (IPTV), video on demand (VoD), peer-to-peer streaming, and 3D television over IP to name a few. Widespread acceptance, growth, and subscriber retention are contingent upon network providers assuring superior Quality of Experience (QoE) on top of today's Internet.

This work presents the first empirical understanding of Internet's video-QoE capabilities, and tools and protocols to efficiently infer and improve them. To infer video-QoE at arbitrary nodes in the Internet, we design and implement MintMOS: a lightweight, real-time, no-reference framework for capturing perceptual quality. We demonstrate that MintMOS's projections closely match with subjective surveys in accessing perceptual quality. We use MintMOS to characterize Internet video-QoE both at the link level and end-to-end path level. As an input to our study, we use extensive measurements from a large number of Internet paths obtained from various measurement overlays deployed using PlanetLab.

Link level degradations of intra- and inter-ISP Internet links are studied to create an empirical understanding of their shortcomings and ways to overcome them. Our studies show that intra-ISP links are often poorly engineered compared to peering links, and that degradations are induced due to transient network load imbalance within an ISP. Initial results also indicate that overlay networks could be a promising way to avoid such ISPs in times of degradations.

A large number of end-to-end Internet paths are probed and we measure delay, jitter, and loss rates. The measurement data is analyzed offline to identify ways to enable a source to select alternate paths in an overlay network to improve video-QoE, without the need for background monitoring or apriori knowledge of path characteristics. We establish that for any unstructured overlay of N nodes, it is sufficient to reroute key frames using a random subset of k nodes in the overlay, where k is bounded by $O(\ln N)$. We analyze various properties of such random subsets to derive simple, scalable, and an efficient path selection strategy that results in a k-fold increase in path options for any source-destination pair; options that consistently outperform Internet path selection.

Finally, we design a prototype called source initiated frame restoration (SIFR) that employs random subsets to derive alternate paths and demonstrate its effectiveness in improving Internet video-QoE.

Major: Computer Engineering

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Approved for distribution by Mainak Chatterjee, Committee Chair, on May 13, 2011.

The public is welcome to attend.