Optimization of Internet quality of experience in home networks

Mots clés : Array

- Directeur de thèse : Renata Teixeira
- Co-encadrant(s) :
- Unité de recherche : INRIA-Paris
- Ecole doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal: Sciences et technologies de l'information et de la communication

Résumé du projet de recherche (Langue 1)
Despite the steady increase in home broadband speeds, simple tasks such as watching a video streamed over the Internet or having a Skype call can still be a frustrating experience. Overloaded servers, network congestion, and poor home WiFi quality are just a few of the potential root causes that can hamper users’ Internet Quality of Experience (QoE) [1]. Without the knowledge of where the problems might be located and in the hope of improving their experience, users often opt to pay higher fees to their residential Internet provider for increased access capacities. Yet, access link capacity is only one of the many potential bottlenecks impairing Internet quality. The key question to improve Internet QoE is: what is the root cause of Internet QoE impairments? Answering this question is challenging. No single entity (user, access ISP, content provider) has all the information to fully diagnose poor Internet QoE: the content provider can track QoE impairments, but it cannot directly identify the root causes within the network; ISPs have more information about in network issues, but no direct knowledge of Internet QoE.

To identify the root causes of Internet QoE impairments, we have developed a novel lightweight system that runs at the home gateway. This vantage point is ideal for distinguishing issues within the user’s home versus the access link [3]. Unfortunately, more and more content providers that rely on encryption (HTTPS/QUIC), which prevents our system from using deep-packet inspection to infer Internet QoE [2]. We current have a system that focuses on tracking video quality, which overcome this constraint by relying on DNS requests to identify video flows within network traffic and then tracks traffic patterns to infer key video QoE metrics such as average bitrate and re-buffering events. Moreover, the system exploits novel algorithms that use simple probing techniques, i.e. lightweight pings and traceroutes, to take advantage of the home network vantage point to pinpoint where potential root causes hampering the streaming process might be located.

The goal of this thesis is to broaden this system for tracking Internet QoE for a variety of applications instead of just video and then to develop methods to improve Internet QoE. In other words, when we detect that Internet QoE is poor, can we bypass this problem to improve Internet QoE? This thesis must answer a number of challenging research questions. First, how to infer Internet QoE from the noisy and often encrypted network traffic? We envision leveraging the HostView [4] end-host monitoring tools developed in our group to obtain Internet traffic annotated with the user QoE. Second, how to improve Internet QoE with limited control points? We assume that it is possible to develop methods at the home gateway and at most a few servers within the Internet (for example, by relying on cloud services). We must develop strategies that optimize QoE under these limitations.

References:


Informations complémentaires (Langue 1)

The candidate should have a strong background in computer networks (TCP/IP and application layer protocols, HTTP(S), in particular) and computer systems performance measurement. The candidate should have knowledge of data analysis techniques (statistics, data mining, machine learning) and some related tools such as Matlab or gnu R.

The candidate should be able to write (scientific writing) and communicate fluently in English.