

QoS Provisioning for Video Streaming Over SP-Driven P2P Networks Using Admission Control

Mubashar Mushtaq and Toufik Ahmed
CNRS LaBRI Lab. – University of Bordeaux 1, France
{mushtaq,tad}@labri.fr

Abstract—In this paper, we present an admission control mechanism for video streaming driven by Service Provider (SP) over P2P networks. SP-driven P2P network is a network in which service provider has a comprehensive control over contracted resources utilisation. SP assures the coordination and the creation of overlay P2P network and it is responsible for admission control and resource allocation among others. Our proposed Quality-of-Service (QoS) provisioning mechanism employs video traffic descriptor (i.e. traffic specification) for performing admission control. The proposed mechanism is evaluated using ns2 simulator and the results show the significance of admission control mechanism for QoS provisioning.

Index Terms—SP-Driven P2P Network, QoS, Admission Control, Real-Time Video Streaming

I. INTRODUCTION

CURRENT Internet is dominated by the P2P applications that widely used for the video sharing among communities. In this scenario, many stakeholders co-operate to offer value-added services and applications to content consumers (CCs). Content providers (CPs), service providers (SPs), and network providers (NPs) have different roles and requirements for providing these services. Recent measurement studies have shown that traffic generated by P2P applications has started dominating the bandwidth consumption on Internet access links. In this massive growth of P2P, the abovementioned stakeholders are missing opportunities for future revenue growth. The prevailing use of P2P applications is a major driving force for the adoption of broadband access, which is a significant source of revenue. A successful strategy to manage P2P traffic must address both the stakeholder perspective of costs and the content consumer perspective of quality of service (QoS). The problem is that SPs have no rules over the structure of the P2P networks and P2P systems have no knowledge of the underlying network. This situation is frustrating to both SPs as well as P2P users. We believe that SP-driven P2P system will constitute the next generation P2P system that is willing to provide better QoS performance to CCs whilst enhancing revenue growth for different actors involved in the delivery chain. Explicit communication for cooperative control between P2P and providers has been recently the subject of a working group called P4P [1]. P4P designs a set of business practices and integrated network topology awareness models to optimize network resources and to enable P2P-based content delivery.

In this paper, we focus on the SP-driven P2P networking architecture and we present a QoS provisioning mechanism for video streaming over SP-driven P2P networks using admission control.

II. SP-DRIVEN P2P ARCHITECTURE

The different entities involved in the content distribution chain that provide end-to-end (e2e) service delivery with high QoS has a significant role for delivering the requested service along the end-to-end QoS-enabled path. In case of unicast service, CCs request the service directly to SP. SP later establishes a QoS-enabled e2e path over aggregate pipes for real-time media content delivery [2]. However, QoS provision across P2P networks is more challenging not only because of the presence of many paths between CC and potential CPs but also due to the heterogeneity and dynamicity of peers. P2P system provides better scalability for enabling QoS service provision. To ensure smooth service delivery in SP-driven P2P system, the service provider has to monitor the network resources regularly (service level monitoring) and/or to perform admission control before service invocation.

Our proposed mechanism is based on admission control that provides QoS for the video streaming applications across P2P networks and it enable efficient utilization of available resources by preventing the unauthorized peers to access the SP-driven P2P overlays. This mechanism is based on the traffic descriptor admission control (TDAC) [3] where traffic descriptions of the video are provided by the sender peer prior to the connection establishments. SP establishes the e2e aggregated pipes on the basis of these traffic descriptor (or traffic specification) and on the basis of its traffic forecast matrix.

SP manages different blocks that have distinguished role in overall service planning and efficient service delivery. Traffic forecast matrix provides a global view of available network resources. Network monitoring is performed to observe the network conditions and further used for the resource provisioning. The SLS repository keeps information of all the service-level negotiations among different entities. The admission control mechanism is implemented to prevent unauthorized access of network by admitting or rejecting traffic flows over certain network links. SPs coordination block is responsible for the negotiations among different SPs through explicit communication for efficient utilization of shared resources.

III. QOS PROVISIONING MECHANISM USING ADMISSION CONTROL

Real-time applications such as video streaming and VoD are highly stringent against fluctuation in network conditions and require certain QoS mechanism to ensure smooth content delivery over P2P networks. So, the incorporation of an appropriate admission control strategy can be helpful to guarantee an acceptable level of QoS for real-time content delivery over P2P networks. This admission control

mechanism is used to control the amount of video traffic injected in each intra-domain and inter-domain links while accepting or rejecting the service requests to ensure QoS. The streaming process is controlled by using a receiver side scheduler which ensures the conformance of the data arrival to the TSPEC model [4]. If the conformance test fails during the content delivery phase, remedial action should be taken either by performing peer/stream switching or by quality adaptation [4][4][5]. NP applies a token bucket model for performing admission control of incoming traffic (video streams) from different CPs using TSPEC. TSPEC model is generally applied for QoS negotiations that are based on the pre-defined parameters including peak data rate (PDR) and committed data rate (CDR). SP maintains and updates its traffic matrix to keep track of all used/available resources over the contracted NP domains.

The targeted streaming mechanism is receiver centric in the sense that the receiver peer orchestrates the streaming mechanism by selecting multiple sender peers. However, QoS provisioning is assured by service provider by implementing a SP-driven Admission Control (SP-AC) mechanism. A receiver side scheduler determines the relative schedules for the each video description according to their priorities that include transmission time, actual playback time. We consider two sets of parameters to apply admission control mechanism for each video tier. First, the transmission of video packet from the sender peer is done according to relative scheduling time and priority. Second, the video packet should arrive at receiver-end before playback deadline (i.e., maximum delay bound). These set of parameters determines the viability of the video packets before putting them in the receiver side buffer. SP allocates end-to-end aggregate pipes for these flows such that $CDR \leq PDR$ where $CDR = \sum x_i / (t_{i+1} - t_i)$ represents the total number of video packets admitted in one interval of time for admission control process administered by receiver peer.

IV. PERFORMANCE EVALUATION

We evaluated the proposed mechanism using ns-2 simulator. We use the SVC based video [6] and the simulations are performed for two scenarios (1) scenario with implementing the admission control mechanism, and (2) scenario without performing any admission control.

We focus to many-to-one streaming mode where a single receiver (CC) intends to receive the real-time video packets from multiple sender peers (CPs). P2P networks are exposed of dynamicity so, to cope with the scenario we implement a peer/stream switching mechanism. The CC requests the media file directly from the service provider. SP has a global view of network condition with explicit communication with network providers and maintains a traffic forecast matrix for the on-going communications and available bandwidth over certain paths. The communication among SPs and NPs are carried by SLA/SLS negotiations. The actual content delivery is carried out by allocation of end-to-end aggregate pipes on the basis of TSPEC (traffic specification) for this mechanism.

Fig. 3 presents the received video throughput in both scenarios along with the expected video quality. Fig. 4 present the packet drops ratio for the received video at receiver-end in both scenario. We notice huge packets loss ratio in the

scenario without applying any admission control based QoS mechanism. The traffic descriptor-based admission control mechanism enables the QoS provision for the streaming application but still it requires more analysis to determine its performance for other parameters SLA/SLS parameters.

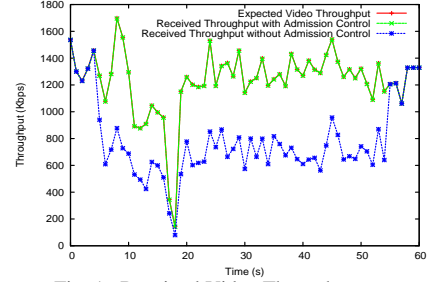


Fig. 1. Received Video Throughput

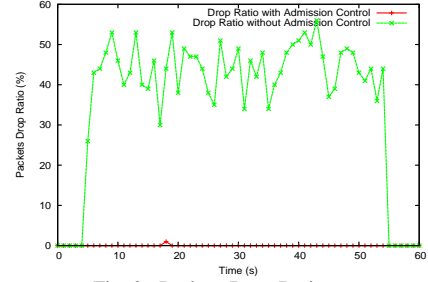


Fig. 2. Packets Drop Ratio

V. CONCLUSION & FUTURE PERSPECTIVE

In this paper, we presented an admission control based QoS provision mechanism for the real-time video streaming over SP-driven P2P environment. The SP-driven approach distinguishes this mechanism to the other available solutions and provides efficient utilization of network resources. The simulation results show a significant improvement in QoS for the received video in terms of improved received video throughput and lower packets drop. In future, we intend to evaluate and implement the proposed mechanism for large scale networks.

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