Characterization of TVAnts: Scaling Analysis of a P2P IPTV Traffic

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I. Introduction

P2P live streaming applications like P2P IPTV are emerging on the Internet and will be massively used in the future. There is only a few studies about these kinds of applications. Hei et. al [1] gave some insights about PPLive, a very popular application on the Internet, while our previous works [2] compare the most popular P2P IPTV applications trying to highlight their similarities and differences. However, comprehensive characterization of P2P IPTV network traffic is still missing. It is therefore important to study P2P IPTV traffic and to characterize its properties.
The characterization of P2P IPTV traffic will allow to understand its impact on the network. P2P IPTV applications have stringent QoS constraints (bandwidth, delay, jitter) and their traffic characterization will make possible to understand their exact needs in network resources. The knowledge of the traffic properties enable the development of synthetic traffic generation models that are key input parameters when modeling or simulating these systems. From a traffic engineering point of view, well understanding P2P IPTV traffic is essential for Internet service providers to forecast their internal traffic and enssure a good provisioning of their network. And last but not least, global knowledge of the traffic properties will highlight some drawbacks of the application and will make it possible to improve the design of new P2P IPTV architectures.

During the FIFA World Cup 2006, we measured network traffic generated by several P2P IPTV applications. In this paper, we present a complete multiscale analysis of the structure of the traffic generated by a single application TVAnts [3]. In the rest of this extended abstract, we will present the P2P IPTV traffic measurement acquisition method and architecture and the TVAnts application (§ II). We will introduce our analysis methodology (§ III) and the multiscale analysis tool, LDestimate [4] (§ IV). Then, we will show our characterization of TVAnts traffic (§ V). Finally, we conclude the paper and give perspectives (§ VI).

II. Experiments

A. Measurement Experiments Platform

Our measurement experiments take place during the FIFA World Cup 2006. We chose the most famous P2P IPTV applications and measured their network traffic. Our measurement experiment set up is described on Fig. 1. We used

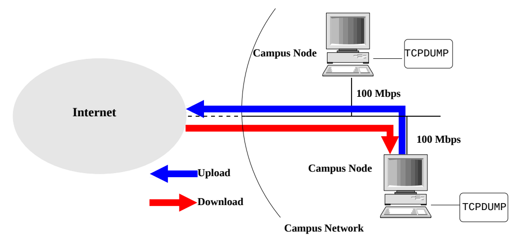


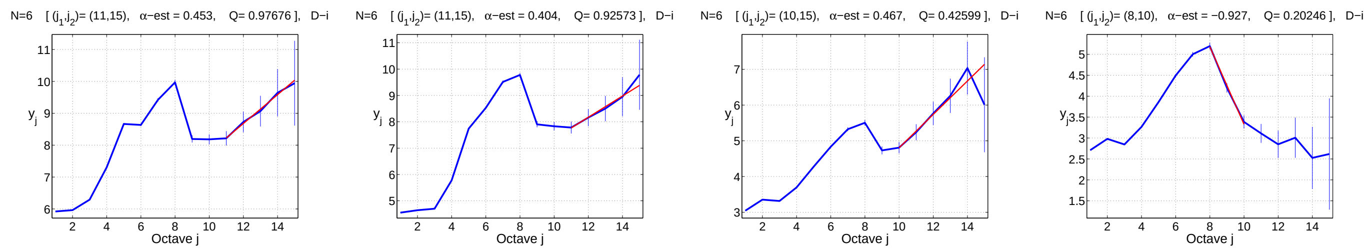
Fig. 1. Measurement experiments platform. Each node is a common PC directly connected to the Internet via campus network

personal computers with 1.8GHz CPU and common graphic card capabilities. The operating system running on the PCs was `Windows XP`. Some PCs (*nodes*) were situated in our campus network and were directly connected to the Internet with 100Mbps `Ethernet` access. Some other nodes were connected to the Internet through residential DSL access with 20 Mbps or 512 Kbps. During a game, each node was running a P2P IPTV applications and we used `windump` on each measuring node to collect all the packets. For all the experiments, nodes were watching CCTV5, a Chinese TV channel available for all the measured applications. At the end of our experiments, we collected packet traces from almost all the FIFA World Cup games with different measuring points and/or applications. In this extended abstract, we will only present the first traffic analysis results obtained with TVAnts running on one of our campus node with high-speed access during a soccer game. The trace (3.9GBytes) has been collected from friday June 30 at 20:22:56 to Saturday July 1st at 00:05:34.

Nowadays, TVAnts is one of the most free available P2P IPTV applications on the Internet. TVAnts has been designed by Zheijiang University in China. Whenever TVAnts is a free application, its source code is not open and we have only to infer its transmission mechanisms. As we showed in [2], TVAnts uses both TCP and UDP to transport video and signaling traffic but uses mostly TCP (75%).

III. Analysis Methodology

Our goal is to analyze the measured traffic of TVAnts at different time scales to characterize this kind of traffic. To this end, we analyzed the energy spectrum of the traffic at different time scales. This energy spectrum is calculated with wavelet transform methods.
We split the entire TVAnts packets trace into 20 milliseconds



(a) Upload: overall packet traffic (signaling and video traffic)

(b) Upload: video packet traffic

(c) Download: overall packet traffic (signaling and video traffic)

(d) Download: video packet traffic

Fig. 2. TVAnts packet traffics energy spectra. Bin duration is 20ms. (Ex: Octave $j = 8$ is for scale process at $t = 2^8 * 20ms = 5,12s$).

intervals (20ms bin). In each interval, we counted the number of packet arrivals. Then we used LDestimate [4] to analyze the traffic energy spectrum of TVAnts.

In the studied P2P system, peers exchange video data chunks with each other. They know about available data chunks and other peers by exchanging signaling traffic. Then, there are two different kinds of traffics: signaling traffic and video traffic. By using the heuristic proposed by Hei. [1], we were able to separate video traffic from the overall network traffic composed with signaling and video traffic. The heuristic works as follows: for a session (same IP addresses and ports), we counted the number of packets bigger or equal than 1000 Bytes. If a session had at least 10 large packets, then it was labeled as a video session and we removed small packets ($<$ 1000 Bytes) for this session. At the end, we removed all the non video-sessions from the trace to obtain video traffic. In the following, we will consider the overall traffic generated by TVAnts, and the video traffic without any signaling packet.

IV. Multiscale traffic Analysis

Logscale Diagram Estimate [4] (LDestimate) is based on discrete wavelet transform and allow to analyze the scaling process of the packet traffic. LDestimate produces a logarithmic plot of the data energy spectrum. For all the produced logscale diagrams, the X-axes are the octaves of the traffic, which are the time scales of the packet arrivals. The Y-axes are the data energy spectra. A logscale diagram can be understood as follows: an octave j (X-axes) is a time scale of the packet traffic energy spectrum. Since our bin is 20 ms, the octave $j = 8$ means the scale time $t = 2^8 * 20ms = 5,12s$. In a diagram, a bump in the energy spectrum indicates a possible periodic behavior of the traffic, a constant energy spectrum a possible memoryless process and a linear increase indicates a possible long range dependency of the traffic.

V. Results

Fig. 2 shows the TVAnts energy spectra for all kinds of traffics (overall and video traffics). We also separated the traffic according to the direction: upload and download.

For both upload traffics (Fig. 2(a) and 2(b)), the energy spectra are similar: a bump at the octave $j = 8$ and a linear increase from octaves $j = 11$ to $j = 15$. Differently, the two download traffics do not exhibit similar energy spectra. Moreover, the energy spectra of download traffics do not look like those of upload traffics.

For the four-presented spectra, there is a similar bump around $j = 8, (5,12s)$, which indicates a possible periodic behavior of the traffics. Fig. 2(a), 2(b) and 2(c) show energy spectra relatively constant from about $j = 9$ to $j = 11$, indicating a possible memoryless process in the traffics at these time scales. Then, the three previously mentioned spectra increase linearly from about $j = 11$ to $j = 15$, which indicates possible long range dependencies (LRD) of the traffics at these time scales. By removing signaling traffic from the overall download traffic 2(d), we do not observe a LRD in the energy spectrum. Our campus node has high bandwidth capabilities. Many peers try to get data from our node and send signaling traffic to him (download signaling traffic). In the uplink direction, the signaling traffic is only sent by our campus node to find other peers able to serve the video to him. With the previously used heuristic, we found that upload signaling traffic counts for a small part of the overall upload traffic (7.5%) whereas download signaling traffic counts for a more important part of the overall download traffic (18.6%). The amount of signaling traffic is different depending on the direction and modify the download traffic characteristics.

VI. Conclusion and Future works

We made measurements of network traffic generated by P2P IPTV applications. With the collected data, we will characterize the P2P IPTV traffic, which could help to improve their design. We only show data coming from TVants collected during a single game and we possess data coming from other P2P IPTV applications during many other games, and under different networks environments. These first results show, TVAnts download traffic is different from its upload traffic. The signaling traffic does not have the same impact according to the traffic direction. Currently, we are analyzing the measured traffic from other applications to compare them and to generalize our traffic observations.

Acknowledgments

This work is supported by the European IST Content Project.

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