Methods to Improve the Efficiency of IPTV Services

Alexey Borodinsky
Astrakhan branch of PJSC «Rostelecom»
Astrakhan, Russia
miroshnikov@mail.ru

Abstract

The increasing popularity of multimedia broadband applications, beyond basic triple-play, introduces new challenges in content distribution networks. These next-generation services are not only very bandwidth-intensive and sensitive to the high delays and poor loss properties of today's Internet, they also have to support interactivity from the end user. The current trend is therefore to introduce IP-aware network elements in the aggregation networks to meet the increasing QoS requirements, offering a smooth transition from legacy ATM-based platforms towards more scalable, efficient and intelligent access networks. One of the promising services triggering this evolution is IPTV. This article presents a large scale IPTV service deployment in an IP-aware multiservice access network, supporting broadcast TV, time-shifted TV and pay-per-view services. Transparent proxy caches collaborate providing distributed network storage and user interactivity, while offering an adequate end-to-end quality of experience. As a use case, a time-shifted TV solution is introduced in more detail. We discuss a distributed caching model that makes use of a sliding window concept and calculates the optimal trade-off between bandwidth usage efficiency and storage cost. A prototype implementation of a diskless proxy cache is evaluated through performance measurements.

Index Terms: IPTV, QoS, tsTV, Caching Algorithms, RTP, RTSP.

I. INTRODUCTION

Although telecom operators continue to build out their broadband access networks to improve high-speed Internet access and voice-over-IP (VoIP) services, IPTV services are becoming the highest-priority residential telecom services, creating very promising market opportunities. These bandwidth-intensive IPTV services have a significant impact on the underlying transport network and require more intelligent access network elements to meet the higher QoS requirements. IPTV is therefore considered as an important driver for other advanced network services. As a consequence, the architectural model of access networks has evolved towards multi-service and multi-provider networks during the last few years. Ethernet as well as full IP alternatives have been investigated as viable connectionless successors for the legacy ATM-based platforms. While the introduction of Ethernet up to the edge solves some of the existing access network problems, new ones are created. Per subscriber traffic segregation and the lack of QoS support are the main issues of standard Ethernet. While the introduction of VLANs could alleviate these shortcomings, it can be questioned whether this approach is sufficiently scalable for larger access network deployments. Therefore an IP-aware network model [1] is often considered a valuable alternative.

Depending on the popularity of the content, different IPTV services can be distinguished (Fig. 1). While traditional live TV is broadcast from a central server deeper in the network, video-on-demand (VoD) servers are typically located at the edge of the core network. In order to support interactivity from the end user for live TV or to serve requests for other very popular content, servers in the access network can become beneficial. This approach, however, has important implications for future access network architectures, as discussed further on in this article.

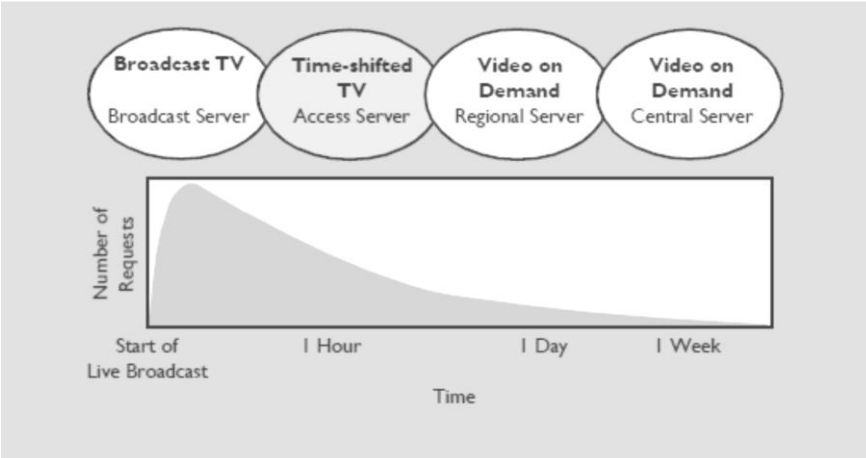

Fig. 1. Delivery mechanisms for IPTV

II. NEXT-GENERATION BROADBAND SERVICES

Next to IPTV services, a wide variety of other value added (interactive) services, such as managed home networking, home automation and security management, multimedia multi-party conferencing and on-line gaming, can be offered by service providers, each setting its own requirements for the underlying network. Different services have highly fluctuating bandwidth requirements. Delay and jitter requirements also differ from service to service. For interactive services a low delay over the network is a critical success factor. When several parties exchange information in an interactive way, the quality of the user experience (QoE) decreases with increasing delay. For instance, a telephone conversation will become very difficult if the network delay exceeds a few 100 milliseconds. Multimedia services are very sensitive to jitter – variation in the delay will drastically degrade audio and video quality – but, in non-interactive cases (e.g. video-on-demand), some delay can be tolerated. Some services, such as firewalls and intrusion detection systems for managed home networking, interact directly with the network layer and could be deployed on a large scale inside the access network. Other services mainly focus on the application layer, but even these services could benefit greatly from enabling technologies in the access network, e.g. a caching system in the access multiplexer supporting multimedia content delivery. However, several shortcomings of operational DSL access networks prevent further generalisation of the Internet and the introduction of such new services.

The connection-oriented approach of current DSL (digital subscriber line) access networks (see Fig. 2) has been identified as a limiting factor, both in terms of access network scalability – all PPP (point-to-point protocol) links are terminated in a single device, the broadband access server (BAS), and obstruct multicast support in the access network – and subscriber terminal autoconfiguration – PPP links cannot be autoconfigured as the link specification is location dependent.