Chapter 6
Quality Guaranteed Media Delivery over Advanced Network

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ABSTRACT

Moving large quantities of data between distributed parties is a frequently invoked process in data intensive applications, such as collaborative digital media development. These transfers often have high quality requirements on the network services, especially when they involve user interactions or require real time processing on large volumes of data. The best effort services provided by IP-routed networks give limited guarantee on the delivery performance. Advanced networks such as hybrid networks make it feasible for high level applications, such as workflows, to request network paths and service provisioning. However, the quality of network services has so far rarely been considered in composing and executing workflow processes; applications tune the execution quality selecting only optimal software services and computing resources, and neglecting the network components. In this chapter, the authors provide an overview on this research domain, and introduce a system called NEtWork QoS Planner (NEWQoSPlanner) to provide support for including network services in high level workflow applications.

DOI: 10.4018/978-1-4666-1794-0.ch006

1. INTRODUCTION

The development of a large multi-media application involves raw material acquired from different sources and is often a collaborative effort among several parties. Moving large quantities of semi-finished material between distributed locations is a frequently invoked process during the development phase. IP-routed paths in the Internet are not the most suitable way to transfer high-quality digital media. Streaming content in 4K-format (4096 pixels of horizontal resolutions) or higher formats has two basic requirements: sufficient network capacity and quality of experience for the end user. Uncompressed 4K content requires a network bandwidth of more than 7Gbps. This can be accomplished by ensuring that the whole end-to-end path, from source to destination, is provisioned over a 10Gbps channel. Nowadays this is technically feasible, but it cannot be a priori guaranteed in the Internet where there is very limited control over the segments the data will be routed through. Furthermore, packet loss, reordering and varying jitter cannot be avoided in a best-effort environment as the Internet. These performance hiccups cause severe degradation of the viewing performance.

To investigate solutions to these problems, several research initiatives have started. Notably, a group of researchers and industrial partners started in 2006 the CineGrid collaboration (http://www.cinegrid.org). CineGrid is a non-profit organization whose members form an interdisciplinary community focused on the research, development, and demonstration of networked collaborative tools to enable the production, use and exchange of very-high-quality digital media over photonic networks. The basic idea of CineGrid is that network circuits implemented over photonic networks provide the proper guarantees of bandwidth and quality of service for media delivery applications. A challenge is to integrate the network in the overall delivery framework, where also computing nodes and many types of software components play an important role. The techniques used for digital content delivery are easily ported to support content-delivery networks (CDNs), such as (Fortino, Russo, Mastroianni, Palau, & Esteve, 2007). It is our opinion that these types of networks could fully utilize the advanced network services exposed by the network providers and that they could integrate the workflow planning techniques in their optimizations.

We shall highlight our research focuses: modeling the meta information of network resources and media material, managing operation sequences of data access and movement sequences, and using advanced network infrastructure to provide quality guaranteed connections for moving large quantity data. Workflows are the natural way to address this resource selection and composition problem and they are playing an important role in the daily operations and use of grid and cloud infrastructures. Particularly, in the scientific community workflow systems have gained popularity among researchers to support complex experiments (Zhao, Belloum, & Bubak, 2009). Still the application of workflows to media delivery scenarios is fairly new. The inclusion of network information in the workflow planning phase and the use of a continuous feedback regarding the current status of the network resources during workflow execution are the two main novel aspects of our work.

This chapter is about using these technologies in digital content delivery. First, we will introduce the background for our work, and review the state of the art. We then introduce a system called NEWQoSPlanner, and we discuss how it can be used to enhance the resource description, discovery, network path selection and provisioning for content delivery.

2. BACKGROUND

Advanced network architectures can provide quality guaranteed services for data intensive applications, such as content delivery, which have