Chapter 15
Flow-Based Networking Architectures under Mixed Internet and Grid Traffic

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ABSTRACT

Quality-of-Service (QoS) is a key issue for grid services provisioning. QoS architectures originally developed for the Internet such as DiffServ (DS) have been tested in grid environment. We present in this chapter the investigation on the potentialities of a new innovative Internet QoS architecture known as Flow-Aware Networking (FAN). FAN is a flow-based networking architecture and it appears as the most promising alternative to DS for QoS provisioning in IP networks. DS proceeds to traffic differentiation and QoS provisioning through IP packet marking whereas FAN consists in implicit IP flow differentiation and a flow-based admission control. A grid traffic session may be seen as a succession of parallel TCP flows with voluminous data transfers (e.g. GridFTP). In this chapter, we compare by means of computer simulations the performance of FAN and DS architectures under the mix traffic composed by Internet and grid services.

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INTRODUCTION

Grid networks consist in large-scale distributed hardware and software resources (computing, storage, information, network components, equipment, sensors, etc.) that provide flexible, pervasive, and cost-effective services to the users. The "Grid" term has been adopted in analogy with the power Grid. Furthermore, by sharing distributed resources on-demand, grid networks enable the creation of virtual organizations (utility computing, utility storage, etc.) (Foster & Kesselman, 2003). Grid networks are progressively deployed over IP (Internet Protocol) networks. Several IP access router architectures have been proposed for QoS provisioning in IP-based Grid networks. Some of them are inspired from the DS architecture: GARA (Foster, Roy, & Sander, 2000), NRSE (Bhatti et al., 2003), G-QoSM (Al-Ali et al., 2004), and GNRB (Adami et al., 2006). Nevertheless, none of these proposals has been widely adopted. QoS provisioning for IP-based Grid networks remains today a big challenge because of the distributed nature of physical components and network resources. To solve this problem, several investigations referring to DS have been carried out (Sander et al., 2000), (Foster et al., 2004), (Leigh et al., 2000), (Rio et al., 2003). Moreover, new QoS concepts and architectures have been tested in experimental platforms: Equivalent Differentiated Services (EDS) (Vicat-Blanc, Echantillac, & Goutelle, 2005), programmable networks (Vicat-Blanc & Chanussot, 2004), active networks (Lefevre et al., 2001), DiffServ-IntServ approach (Yang et al., 2003). This work proposes the evaluation of a new promising approach for QoS provisioning in Grid networks called Flow-Aware Networking (FAN) (Oueslati & Roberts, 2005). Whereas DS-based approaches proceed to per-packet traffic control, FAN relies on per-flow traffic control mechanisms. Compared with packet-based router, the FAN architecture offers enhanced performance in terms of packet processing (Park et al., 2006). Our previous work (Cárdenas et al., 2007; Cárdenas et al., 2008; Cárdenas & Gagnaire, 2008; Cárdenas et al., 2009; Cárdenas & Gagnaire, 2009) has shown that the second generation of FAN (2G-FAN) confirms the superiority of FAN over DS under Grid traffic only, even if flow parallelization of Grid sessions tends to reduce this benefit. In this work we extend our previous analysis by introducing Internet traffic and Grid traffic. The traffic load of the Grid services is increased assuming that in future years this kind of traffic will increase. Internet traffic modeled at the flow level can be represented by two types of flows: elastic and streaming. Elastic flows are legacy file transfers and Web traffic while streaming flows are Voice over IP services. Two metrics are adopted: the average transit delay and the average goodput of a Grid session in an IP access router.

This chapter is organized as follows. In following section, we briefly recall the basic characteristics and objectives the DS architecture and its application to the grid environment through several QoS provisioning architectures. Here, we describe the GARA architecture (Foster, Roy, & Sander, 2000) that aims to extend the DS functionalities for the Grid environment and is the most important proposal. The section of Flow-Aware Networking (FAN) Architecture is dedicated to the description of the second generation FAN (2GFAN) architecture. Initially designed for traditional IP networks, we show how the 2GFAN architecture may be adapted to the grid environment. In next section, we compare by means of computer simulations the performance of DS and 2GFAN architectures applied to IP access routers in the context of Grid and Internet traffic. We describe and conclude this chapter in the two final sections.