Impact of Differentiated Service Billing on the Quality of Service of an IP Network

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ABSTRACT

There is an exponential rise in awareness, reliance and usage of the Internet protocol (IP) network. The advent of multimedia applications on the IP network, such as, voice over IP, streaming audio and video, etc, has contributed immensely to the congestion on the broadband network. The increase in the number of users who rely on peer to peer (P2P) protocols to allow transfer of very large files and applications has also added to the congestion experienced by users of the IP network. Quality of service (QoS), bandwidth management or IP service control are all general terms given to a broad range of techniques employed to control and shape traffic on this network. Some works tried to control the IP traffic by introducing billing; however, most billing techniques in literature did not seriously consider the overall QoS of the network. In this work we present a new billing scheme termed differentiated service billing (DSB), which controlled congestion by checking user behavior with respect to type of application used on the network. It thus improves the overall QoS perceived by users of 'relevant' applications. The DSB is an improved variant of usage billing. It effectively checks the usage of bandwidth-intensive applications, especially for a campus network. Our results clearly showed an improved network link performance when this billing scheme was compared with the traditional flat billing and usage billing schemes.

I. INTRODUCTION

Modern digital technology allows different sectors, e.g. telecom, datacom, radio and television that deal with information carriage over the public network to be merged together. This phenomena, known as convergence, is only possible because at the centre of this process, forming the backbone and making convergence possible, is IP-based network. The Internet protocol suite consists primarily of the internet protocol (IP) and the Transmission Control Protocol (TCP); consequently, the term TCP/IP.

It is apparent that the IP network is the new engine of modern telecommunication that will initially augment, and latter supplant, the circuit-switched network. Using IP to build networks, carriers are faced with a number of challenges. One of such challenges is the increase in awareness, reliance and diversified use of the IP network. This diversification of the Internet has brought about link congestion and drop in quality of service (QoS) of the public IP network. Thus, there exits a need for managing public IP network resources such as bandwidth, so as to improve user perceived QoS.

Bandwidth management, IP service control, or QoS are the general terms given to a broad range of techniques designed to control and shape traffic flow on an IP network. QoS gives a measure of the network performance. It is determined by any of the following metrics; bandwidth (throughput), delay, delay jitter and packet loss rate. In the past decades, researchers focused their energy on technological development that would allow the availability of a wide variety of services on an IP network. However, little effort was given towards developing an appropriate billing system. In recent years, the need to cover expansion costs and the possibility of using charging methods to influence user's behaviour in order to avoid congestion, has greatly increased interest on the topic of billing.

The increasing demand for QoS has induced the need for the development and implementation of a better billing mechanism which will discriminate each kind of traffic on an IP network, thereby stimulating users to choose according to their personal needs the most appropriate kind of traffic. Before now routers offered only best-effort services. Today the need for a better QoS has brought about differentiated services on the IP network. These differentiated services include admission control, resource reservation setup protocol (RSVP), queuing management, and fair scheduling. This work implements differentiated service to billing on the IP network using OPNET modeler.

The rest of this work is organized as follows; Section II gives the problem background; Section III describes existing billing methods on the IP network; Section IV describes the DSB - our new billing scheme; Section V presents simulation results and discussions and Section VI concludes the work.

II. PROBLEM BACKGROUND

The increase in broadband awareness and utilization has brought about congestion in the frequency spectrum most especially for wireless network. This congestion is brought about mostly by abusive use of public connections. The effective delivery of information over the internet requires that bandwidth be managed. Managing bandwidth involves controlling and removing unnecessary traffic. It also levies traffic based on resource usage. Without a proactive management, network capacity gets saturated with inappropriate traffic so that connection becomes ineffective and user perceived QoS drops.

Many institutions are finding out that they still do not have reliable, usable Internet access for their students and staff despite considerable investment. A recent Bio Med Central survey of health journal access programme found that logging into some databases took so long that connections often timed out entirely due to network congestion [1]. A typical Internet connection involves huge investment on the part of the institution; two examples are the University of Ghana and Makerere University in Ghana, which spent roughly $10,200 and $27,045 per month for 1Mbps of bandwidth respectively [2]. The Internet is one area a

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