Multidimensional Assessment of Emerging Technologies: Case of Next Generation Internet and Online Gaming Application

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ABSTRACT

The Internet has changed the world in many ways. Online communications, financial and business-to-business transactions, electronic shopping, banking, and entertainment have become the norm in the digital age. The combined package of technologies that comprise the Internet—the information superhighway—have made all of this possible. Theaging technological infrastructure that supports these webs of interconnected networks is being stressed to its performance limits. Recent advances in the backbone infrastructure that supports the Internet have helped alleviate some of these problems, but more challenges lie ahead for solving technology-related performance bottlenecks for many online applications, including high-definition interactive gaming. In this paper, the authors developed a technology assessment through multiple perspectives. While different components of the technology such as applications, protocols and network components are identified, other impact areas such as market and management are also evaluated. Elements of user behavior are evaluated within the market perspective. Evaluating technologies through these dimensions concurrently provides a balanced assessment among technical, economical, social and political factors.

Keywords: Evaluating Technologies, Multidimensional Assessment, Next Generation Internet, Online Gaming, Technology Assessment

INTRODUCTION

The genesis of the Internet can be traced to the intercommunication of many computers over several networks. A computer network is comprised of a set of nodes and links to connect them to provide the data transport infrastructure. The basic building blocks are routers, switches and circuits. One of the first of these networks was the ARPAnet, developed by the Defense Advanced Research Projects Agency (DARPA). It was used by governments and universities and these institutions soon began to outgrow its limitations. They realized the need for a network that would better support high-performance network applications. In response to these technology needs, the US government launched an initiative called Next Generation
Internet (NGI), intended to examine performance and bandwidth bottlenecks. In response to the goals outlined in the High-Performance Computing Act (HPCA) of 1991, the Office of Technology Assessment (OTA) of the United States Congress published a series of reports that provides an assessment on technology and research requisites, and highlights some of the issues that need to be addressed in order to scale the Internet for high-speed, high-bandwidth applications in various deployment scenarios (US Congress, 1993). Many of the recommendations of these reports have been studied and implemented in government-funded research networks with the expectation that the industry would adopt and diffuse these technological advancements. Indeed, many of the OTA recommendations have been developed, deployed and diffused in recent years. The OTA goals were largely met except for terabit per second networking.

By the early 1990s the Internet had been embraced as the most desired medium of communications not only by government, research and academic institutions but more importantly by a plethora of commercial and computing users worldwide. With the more recent growth in the number of users, particularly as the populations of China and India come online, the issue of Internet performance takes on added importance and urgency. Furthermore, new high-definition content on the web means that the amount of information being placed on the networks is also growing exponentially. The Internet, in its present form, cannot scale to meet the number and nature of performance demands already placed on it, to say nothing of a new generation of more complex interactions. The increasing demand for content-rich media, for example high-definition entertainment—from downloadable movies to interactive games and other such content—is straining network performance, resulting in poor user experience. These and emerging new applications will demand much higher bandwidth and performance than is available today. Some of these applications include real-time interactive gaming, collaborative grid computing, and so on. New technologies and architectures are needed to scale the existing uses to a broader community of users worldwide, and to facilitate new, sophisticated applications that require expansive computation with fast real-time response. All computer networks deploy a variety of technology architectures. For the purposes of this paper, we will anchor on the ISO/OSI seven-layer architecture as a reference point for the three areas of interest highlighted by the OTA report (US Congress, 1993). Figures 1 and 2 in Appendix A depict the ISO/OSI architecture model. In this model, data flows from one system to another through a series of layers. At each layer, the data is encapsulated with protocol and control semantics until it reaches the transmission medium where it is digitally routed to its destination through the network. At the destination, the control information and protocol semantics are removed as the data moves up the protocol stack before it reaches the intended application. As mentioned, numerous technologies come into play in computer networks such as the Internet, and this paper will elaborate on only a few of these technologies. The OTA report identified three areas of focus for the Internet as follows: Applications, Protocols, and Network Components.

For purposes of technology assessment and evaluation, we will map the OTA focus areas of applications, protocols and network components to the Application, Transport/Network and Data Link layers of the ISO/OSI model, respectively (for further clarity, these layers appear in the TCP technology stack as shown in Figure 3 in Appendix A). At the Application layer, the technology object of concern is data, and in the context of this paper the issue is the amount of data and whether there are adequate technologies in place to manage the data for optimal transmission from the origination point to its destination. We will examine data compression technologies and in particular the MPEG-4 compression standard. At the Transport/Network layer, the technology object of concern are protocols and data transmission semantics, and in the context of this paper the issue is whether recent technology acquisitions and diffusions
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