Chapter XXXI
P2P File Sharing:
The Life and Death of Gnutella

Danny Hughes
Lancaster University, UK

James Walkerdine
Lancaster University, UK

ABSTRACT

Peer-to-peer file sharing exploded into the public consciousness with the release of Napster in 1999. Napster sparked a revolution in computer-mediated communication and within a few years, peer-to-peer had replaced client-server as the dominant communications paradigm of the Internet. Peer-to-peer has also redefined the role of home users, empowering them to produce and distribute content free from control or censorship by third parties. The importance of the peer-to-peer revolution has been reflected by significant research and business activity, although considerable technical and socio-technical problems still remain. This chapter discusses the emergence of peer-to-peer systems as a medium for computer-mediated communication and how these systems have evolved to tackle new challenges. This is done in the context of a case-study of Gnutella, one of today's most significant peer-to-peer file sharing systems.

INTRODUCTION

The most widely accepted definition of peer-to-peer (P2P) systems is that given by Clay Shirky, of the Accelerator Group (Shirky, 2001).

"Peer-to-peer is a class of applications that takes advantage of resources—storage, cycles, content, human presence—available at the edges of the Internet. Because accessing these decentralized resources means operating in an environment of unstable connectivity and unpredictable IP ad-
dresses, peer-to-peer nodes must operate outside the DNS and have significant or total autonomy from central servers."
—A Definition of P2P Systems, Clay Shirky, the Accelerator Group

The widespread use of peer-to-peer to support computer-mediated communication began in mid 1999, following the release of Napster (Merriden, 2001) and Seti@Home (UC Berkeley, 2007). Both applications made use of resources available at the edge of the network, on home or office PCs,

to allow users to communicate and provide services. Napster allowed users to become part of an online community where music files could be shared with one another, while Seti@Home used the spare power of edge computers to implement a 'collaborative' supercomputer dedicated to searching for signals of extraterrestrial origin. Both applications were phenomenally successful. Napster quickly attracted a user community numbering in the millions (Juniper Media Matrix, 2001), while Seti@Home allowed users to become part of the world's most powerful super-computer (UC Berkeley, 2007). Their success brought with it a revolution in the way that users could communicate with one another, allowing them to join and contribute to communities that spanned the globe. However the scale of this success begs a question: Why did this approach to communication remain untapped for so long? The answer lies in the origin and evolution of the Internet.

The progenitor of the Internet, ARPANET (DARPA, 1981) was constructed by the U.S. Department of Defense beginning in the late 1960s. Conceived at the height of the cold war, ARPANET was designed to be resilient to both attack and failure and, as such, was largely decentralized, being composed of peers capable of both providing and using services. As ARPANET evolved into today's commercial Internet, there was an influx of home and small-business users on slow connections. These users had neither the desire nor capacity to provide their own services and this necessitated a specialization of roles: highly-specified servers were used to provide services while less powerful clients consumed them. Thus, client-server became the dominant communications paradigm of the Internet.

While the number and power of networked home computers increased exponentially, the Internet remained largely client-server. This dichotomy resulted in a significant and growing pool of untapped resources available at the edge of the Internet on home and business PCs. It was these resources that Napster and Seti@

Home were to exploit so successfully upon their release in 1999.

Less than nine months after the release of Napster, a study of campus traffic at the University of Madison Wisconsin (Plonka, 2000) found that Napster was already generating more traffic than the Web at 23 percent of the whole. By 2002, a study by the University of Washington on their campus network (Saroiu et al., 2002) found that P2P traffic outstripped Web traffic by a factor of three at 43 percent. Today, due to an explosion in the number of P2P technologies, and a migration of users to more anonymous systems (Karagiannis et al.,2004), it is hard to accurately estimate current traffic levels, however, it is widely accepted that P2P applications are responsible for the vast majority of Internet traffic. P2P technology has predominantly been used to support two application domains of interest in the context of computer-mediated communication; instant messaging and file-sharing, of which the latter is by far the most popular and significant in terms of traffic generation. Aside from its sheer scale, the emergence of P2P file sharing is particularly significant, in that, for the first time it allowed end-users to distribute content without the need for hosting provided by a separate authority.

Despite the dramatic successes of P2P, it is still very much an evolving medium, which has been forced to adapt to the various technical, socio-technical and legal challenges. In this chapter we discuss this evolution, focusing on file sharing systems and using the case-study of Gnutella, one of the most popular and long-lived P2P file sharing networks, as an illustrative example.

BACKGROUND

The initial generation of P2P systems, best symbolized by Napster and Seti@Home, suffered from technical and, in the case of Napster, legal issues (RIAA, 2001). As these systems represented the first attempt to re-introduce decentralization

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