

An analytical framework for evaluating peer-to-peer business models

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Abstract

While existing research on peer-to-peer (P2P) file-sharing services has increased our understanding in many respects, it has not yet supplied a comprehensive theoretical framework that explains business failures of P2P file-sharing network service models. We develop such an analytical model and base it on seven specific market constraints – technical, economic, structural, legal, political, cognitive, and cultural – that are specifically relevant for P2P services. We show how our model can be used as a tool for strategic analysis of P2P business model performance using Napster as a particular case of study. We show also how P2P file-sharing networks have migrated through a series of system typologies by incorporating technological innovations in response to market constraints. Finally, we offer a new theoretical conceptualization that views P2P file-sharing networks as electronic markets.

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1. Introduction

Millions of consumers are routinely trading digital content files over peer-to-peer networks. Traded content includes images, audio files, software, music, tv shows, games, movies, and other documents. Peer-to-peer (P2P) file-sharing networks such as Napster, Kazaa, Grokster, BitTorrent and Grouper to name just a few from among dozens, have since 1999 drawn increasing interest from users, and also from innovative businesses exploring ways to use them commercially, as well as from governance and judicial institutions with the responsibility of regulating the new file-sharing activities. There is clearly strong demand for P2P services from consumers in 2006, but no business has so far succeeded in finding a sustainable

legitimate and profitable P2P business model that delivers what consumers want. While existing research on P2P file-sharing has increased our understanding in many respects, it has not developed a comprehensive theoretical framework that explains business failures of P2P file-sharing network service models. The present paper aims to address this gap.

It is clear that P2P systems, under various conditions, can both destroy and create value as huge amounts of content are distributed, including previously available as well as derivative and new original content. It is also clear that huge amounts of copyrighted material are traded without permission from its owners. Much less clear, however, is how to best distribute and share the value that is created by these new trading networks, and how to design incentives that would entice everyone in the value chain to productively participate in the operation of these networks. Traditional corporate content providers are threatened with loss of control over distribution and quite possibly profits. Some consumers feel legally insecure about sharing

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content, while others perceive existing P2P file-sharing services as too limited, technically immature, or difficult to use. Some original content creators worry whether they will be able to collect proper rewards for their creative output. Lack of trust and economic risk have seriously undermined the development of consumer-friendly P2P business initiatives, as the content industry largely opposes the use of P2P file-sharing technology. A better outcome for all market participants would be possible if P2P networks for sharing information goods comprehensively addressed the concerns of all stakeholders. Clearly, this is not yet the case with P2P file-sharing services. Hence, there is a need to devise methods that allow us to (a) analytically diagnose service failures and (b) develop better business models for P2P file-sharing. These are the two main research questions that we are addressing in this paper.

The IS literature presents P2P file-sharing primarily as an IT application system [1]. In the present paper, however, we take a different, novel approach and view them more broadly as electronic markets. We argue that P2P systems implement all roles and functions of electronic markets. Through an extended analysis of the P2P research literature in the information systems area we develop an analytical framework based on seven constraints – technical, economic, cognitive, structural, legal, political, and cultural – and perform a comprehensive diagnosis of P2P business models. Using the well-known original Napster case, we first demonstrate how our model can be applied *ex post* to determine the feasibility of specific P2P service and business models. Next, we apply the model to analyze the evolution of P2P services in general. We also discuss the possibility of extending our new analytical framework beyond P2P environments to other electronic market configurations.

This paper makes several contributions. First, it offers a new theoretical lens for studying the performance P2P services by conceptualizing them as electronic markets. Second, it develops a new analytical framework for *ex post* performance analysis of P2P business models. And third, it lays the groundwork for developing a business management tool that can be employed to support strategic decision-making.

The remainder of the paper is organized as follows. The following section will give an overview of the functions and technical implementation of P2P file-sharing networks. Section 3 uses literature analysis to derive specific conceptual constraints that lay the foundation for our analytical model framework for evaluating P2P business models. Section 4 applies the analytical model to the case of Napster, and Section 5 applies the evolution of P2P service models in general. Section 6 will explain why viewing P2P networks as electronic markets rather than just IT applications puts us in a better position to gain insights for performance analysis of P2P business models. Section 7 will outline an implementation of our constraint framework as a business management tool and provide some additional discussion and conclusions.

2. P2P file-sharing networks: a brief review of the underlying technology

In technical terms, a *P2P file-sharing system* is a network whose nodes communicate directly for the purpose of exchanging content files, with no centralized governing node as a necessary intermediary [2]. Each participant in the network can behave either as a client, receiving files, or as a server, sending files, or both. P2P file-sharing systems are virtual networks operating over the Internet TCP/IP infrastructure, thus allowing users to exchange digital content directly between themselves. Participants in the network are users who are running a specific P2P application on their local computers. The best-known systems to date are music file-sharing networks such as the original Napster or Kazaa, but there are dozens more operating (e.g., BitTorrent, Limewire, Soulseek, Poison, e-Donkey, and others), and more in development. These systems are being used to exchange not only music, but also virtually anything else that can be digitized.

The extent to which different file-sharing networks employ direct P2P communication capabilities varies. In the original Napster (which is an example of Generation I in Table 1), for example, content discovery was conducted through a single central server index, while the actual file transfer itself was carried out between individual user nodes. One consequence of this design was the emergence of long queues (managed by the P2P network software), as users attempting to obtain a particular file waited in first-come first-serve queues for their turn to receive a download. The hybrid structure of Napster was abandoned by the second generation of P2P networks, which implemented distributed file indexing through the use of, most notably, the Gnutella engine, which powered Kazaa and other P2P file-sharing networks. Distributed file indexing obviated the need for a powerful central server farm, but also limited the reach of the system, because user queries only traversed parts of the network. The third generation of P2P innovation reduced the problem of long queues and subsequent waits for content due to single-server downloads by allowing simultaneous downloading from multiple sources (e.g., the BitTorrent engine), a technical innovation that made the sharing of very large content files practicable. Consequently, it was at this stage that significant amounts of video content, which make very large files even when compressed, began to appear on P2P networks. A fourth generation saw the first development of P2P file-sharing systems that can be organized as small-scale virtual private networks, to which access is limited and controlled by membership and passwords. Applications on this level include file-sharers who are unwilling to share content openly with large Internet communities, but also businesses that exchange internal documents for various purposes. Currently, a fifth generation is emerging that is aimed at P2P users who want to migrate to less visible and more difficult to track niches of the Internet for file-sharing activities, such as Usenet and IRC chat. Table 1 summarizes

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