A Review on Impact of Peer-To-Peer Networks on Digital Piracy

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Abstract
Peer-to-peer (P2P) networks have revolutionized online content sharing through facilitating direct file exchange between users without the use of go-betweens that are centrally located. Although the technology has diverse legitimate uses, it has also been utilized to facilitate digital piracy. This paper explains the complex influences of P2P networks on digital piracy, following the dynamics of illegal content sharing, the plight of rights holders, and the efficiency of different countermeasures. Through conducting a thorough analysis of case studies and literature, we seek to present a balanced perspective of the impact of P2P networks on digital piracy and the measures taken to counter it.

Keywords
Peer-to-peer networks, Digital piracy, Copyright Infringement, Intellectual property, File sharing.

1. Introduction

Peer-to-peer (P2P) networks have changed the way people can access and share digital content, and this has had catastrophic problems with digital piracy. Consumers can distribute identical copies of digital goods on P2P networks, which frequently bypass normal buying mechanisms. Content providers lost enormous sums of money simply because the majority of consumers prefer free pirated content to legal purchases. The resulting substitution effect has been a foremost topic in the public debate, questioning the sustainability of content production during the pandemic [6][10].

Server-based networks are more prone to failure as a single point of distribution, and they are also easier to identify if they are being used for illegal distribution. P2P networks eliminate the need for a central server by using files that are sent directly between users and decentralized caches [9]. The industries, on their part, have had a mostly "detect-and-punish" approach, i.e., legal proceedings against individual file-sharers and collaboration with Internet Service Providers to limit piracy [10].

This might, however, miss the bigger picture of P2P networks. Besides facilitating piracy easily, these networks facilitate discovery processes for content too—experimentation and trial

with new genres—and, in some cases, lead to legal sales. Studies by Brynjolfsson et al. and Oberholzer & Strumpf show that file-sharing can create extra sales with improved discovery mechanisms, even reversing the negative effect of piracy under certain conditions [10][11][13].

This dual role of P2P networks points to the necessity of novel schemes to stop digital piracy. Novel business models, like crowdfunding platforms like Sellaband and reward-based platforms like Popcuts, attempt to harmonize consumer exploration patterns with incentives for producers rather than being solely anti-piracy [5][10]. One needs to understand such dynamics in developing long-term initiatives with a balance of consumer exploration and profitability.

DOI: https://doi.org/10.5281/zenodo.15486410

2. Literature Review

The influence of peer-to-peer (P2P) networks on online content has been the focus of close examination, with initial research mainly concentrating on the substitution effect, whereby pirated downloads substitute for legitimate buys. This viewpoint has resulted in "detect-and-punish" approaches, as seen in the case of the Recording Industry Association of America (RIAA), which has taken legal action against individual file-sharers. This approach has been attacked as oversimplifying the workings of P2P networks.

2.1 Substitution Effect and Industry Impact

Early research focused on the replacement effect, in which pirated content downloaded from P2P networks substituted for legitimate sales. Goel, Miesing, and Chandra (2010) [6] examined the economic effects of illegal file sharing and found that media sectors lost significant revenues due to digital piracy. Casadesus-Masanell and Hervas-Drane (2010) [5] also researched the effects of the market created through P2P networks, focusing on how unauthorized dissemination reduced content creators' incentive to produce new content. Jain (2008) [11] conducted a competitive analysis of internet piracy, describing how market gamed unauthorized sharing driven by piracy and influenced pricing behaviour. These studies espoused a "detect-and-punish" approach, such as that of the Recording Industry Association of America (RIAA), attempting to suppress piracy through law as a depository.

2.2 Content Discovery Role and Consumer Behaviour

Rather than the substitution hypothesis, further work emphasized P2P networks' discovery capability. Brynjolfsson et al. (2006) contrasted paper catalogue and internet retail website sales records to show that internet-based sales channels facilitated by far more convenient access to special material, which in turn could be improved further through P2P networks.

Laskowski et al. (2009) [10] then built on this by looking at economic models of content discovery and suggesting that P2P networks could potentially lead to increased demand for lesser works and redefine usual market assumptions.

Oberholzer-Gee and Strumpf (2007) [12] considered the impact of file-sharing on legal music sales and concluded that any impact on sales due to file-sharing is statistically indistinguishable from zero. Grounded on empirical evidence, they had determined that the impact of piracy on music sales was zero because losses were offset by sampling and learning effects. Smith and Telang (2009) [8] had also offered more evidence to this opinion, establishing that exposure to media, even after piracy, could generate consumer confidence and translate into legal purchases.

2.3 Privacy, Security, and Legal Issues

Privacy concerns in P2P networks were studied by Suvanto (2005) [13], and weaknesses were found to make the users vulnerable to attacks in terms of unauthorized surveillance and leakage of information. Scanlon and Shen (2014) [4] conducted a critical analysis of BitTorrent cross- swarm membership that revealed the geographical positions of the file sharers and mapped the challenges in regulating digital piracy globally.

Qureshi, Megías, and Rifà-Pous (2016) [3] proposed a collusion-free fingerprinting scheme as a complement to content protection to enable P2P sharing of multimedia content. Their research motivation was the degree to which technology can combat piracy without compromising the advantages of decentralized delivery.

2.4 Digital Piracy Evolution and Business Model Evolution

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There has been evidence suggesting shifting digital piracy patterns. Sadiku et al. (2021) [1] reported an overview of new trends in digital piracy, noting the pattern of streaming-based piracy and the need for innovative countermeasures.

Chodak, Kowalska-Pyzalska, and Maciejowska (2019) [2] conducted a market analysis of e-books using agent-based modelling to investigate the effect of piracy on the consumption pattern of digital content. These findings suggest that businesses must change their strategy to align with consumer behaviour rather than relying on retaliatory measures. Subscription models, DRM improvements, and blockchain-based content authentication are new solutions trying to strike the middle ground between accessibility and copyright protection.

3. Methodology

The paper is guided by a systematic review of empirical research, academic papers, and business reports examining P2P networks and piracy. The paper draws inferences from empirical research on file sharing, economic research that compares the impact of piracy on revenues, and juridical research on copyright infringement. These selected studies provide a variety of perspectives on how P2P networks have shaped digital piracy trends in the markets for music, video, and computer software.

The research approach takes a sequential one where there is systematic searching of peer-reviewed scholarly journals and conference proceedings on the evolution, advantages, and possible drawbacks of P2P networks. Papers were chosen with regard to relevance, empirical research, and intellectual merit towards achieving digital piracy. Industry reports and judicial case studies have also been scanned to look at the evolution of government policies and antipiracy efforts over time.

For studying the technical aspect, Digital Rights Management (DRM) research papers, watermarking, and network monitoring systems were cited to find out how useful they have been for fighting piracy. The paper also compares other business models such as subscription streaming, freemium software business models, and copyright protection through the blockchain to study how companies have fought P2P-facilitated piracy threats.

This review also takes into account quantitative and qualitative research methods applied in previous research. Quantitative research provides statistical data on piracy trends, economic effects, and the effectiveness of anti-piracy measures. Qualitative research provides an overall understanding of user behaviour, motives for accessing pirated material, and ethical and legal consequences of P2P file sharing.

By combining several findings in technical, legal, and economics research, this review aims to provide a general picture of the impact P2P networks exert on digital piracy and examine possible efforts that maintain equilibrium between innovation and copyright protection.

4. P2p Network Mechanisms For Digital Piracy

The mechanism behind P2P networks is through the connection of users who share resources with the distribution of files done without the centralization of a server. While efficient, it presents a problem of managing distribution of copyrights. In recent research, most P2P traffic has been found to be distributed pirated media, i.e., music, movies, shows, and books. For example, a study of BitTorrent swarms showed widespread unauthorized sharing of highly rated TV shows, showing the extent of the problem.

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Furthermore, piracy of digital content in P2P networks is supported by various factors such as user anonymity, ease of access to pirated content, and failure of effective enforcement mechanisms. Using encrypted communication and virtual private networks (VPNs) makes it more difficult to trace and punish copyright infringement. Thus, legal systems are not able to keep up with the evolving dynamic nature of digital piracy. Moreover, the decentralized structure of P2P networks makes it more difficult to eliminate pirated material permanently, since users are able to reproduce and redistribute material immediately even if specific nodes are closed down.

5. P2p-Facilitated Piracy Challenges

P2P systems, being distributed, are tough to suppress cyber piracy. Traditional enforcement methods like attacking central servers are made obsolete here. Finding and prosecuting single infringers is hard for owners of rights and authorities due to user anonymity and geographical dispersion around the world. Technical controls like content filtering are also easily avoided by users who employ encryption and other masking tactics.

Another issue is the legal and ethical ambiguity of certain types of file-sharing. Some nations have liberal copyright laws that allow P2P sharing in specific situations, and it is difficult to have a unified global enforcement policy. Some consumers also rationalize piracy on moral grounds, arguing that high prices and unavailability of legal alternatives drive consumers to unauthorized content. In addition, the fact that it is hard to prosecute individual pirates and the high number

of unauthorized transactions render it an ongoing problem even with countermeasures.

6. Countermeasures and Effectiveness

There are various methods employed in response to combating P2P-based piracy:

6.1 Legal Actions

Legal proceedings against providers and end users of P2P services have been the most common action. Despite its use, the practice has yielded very minimal deterrents with widespread backlash from society. Courts have found it difficult to enforce stern actions because of the challenging task of defining accountability in decentralized systems.

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7.2. Technological Interventions

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Techniques like torrent poisoning, where infected files are seeded into the network, are used to discourage the users looking for pirated material. Although it might limit the availability of infringing material, it might also lower the quality of experience for legitimate material. Other technologies like automated copyright detection and tracking software are being developed more and more to counter the issue.

7.3. Educational Campaigns

Creating awareness regarding legal and ethical implications of piracy efforts to drive user behaviour. They are inclined to be heterogeneous in performance and do not possess measurability. Yet, sustained education campaigns focusing on the advantages of intellectual property rights protection
can bring about a shift in user mentality.

7.4. Alternative Business Models

Providing cheap and low-cost legal alternatives, such as streaming for example, has been observed to have a role in curtailing piracy because it offers cheap legitimate alternatives to consumers. The emergence of services like Netflix and Spotify has immensely reduced illegal downloads in areas where they are available and affordable.

7.5. Case Studies

BitTorrent and Illegal Content Sharing: Experiments that followed BitTorrent swarms identified most of the replicated content as illegal content and highlighted the simplicity of use of P2P networks in illicit distribution.

7.6. ContentPoisoningAsAPreventive Measure

Seeding worthlessorincorrectfiles inP2P networks, referred
to as torrent poisoning, has been used as a prevention measure to combat piracy. It operates through the discouragement of users to access pirated content by making it more probable that they would receive worthless files.

7.7. Legal Streaming Services versus Piracy

The emergence of subscription streaming services like Netflix, Spotify, and Hulu has served as a fair substitute for digital piracy. Research has shown that countries with high penetration of low-cost streaming services have low levels of piracy. This implies that offering convenient, low-cost legal alternatives proves to be a good deterrent to P2P piracy.

8. Conclusion

P2P networks have necessarily been a cause for the common problem of digital piracy through creating a platform for unauthorized distribution of copyrighted work. It is one problem which can be countered by an orchestrated attack involving legal action, technical measures, user education, and offering viable legal alternatives. Constant studies and responsive actions should be adopted to mitigate the effects of P2P-enabled piracy in the dynamic world of the internet. In addition, global cooperation and policy harmonization are required to implement anti-piracy efforts across borders in an effective manner.

9. Future Scope

The future studies will have to look into developing intelligent technology solutions to detect and go around illegal sharing effectively without compromising any user privacy boundaries. Secondly, taking on new customer behaviour-driven business models in the internet era might pay dividends of long-term piracy remedies. There must be an agreement between the stakeholders at the bilateral level, i.e., the owners of the content, the service businesses, the regulators, and the consumers in order to find an equilibrium position such that intellectual property rights are sustained while responding to

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other emergent advances in artificial intelligence and blockchain technology can make it possible for new tracks of tracing and protecting copyrighted works within P2P networks.

References

[1] M. N. O. Sadiku, T. J. Ashaolu, A. Ajayi-Majebi, and S. M. Musa, "Digital piracy", International Journal of Scientific Advances, vol. 2, no. 5, pp. 797–800, 2021.

[2]G. Chodak, A. Kowalska-Pyzalska, and K. Maciejowska, "Impact of digital piracy on the e-book market: insights from an agent-based model," Acta Phys. Pol. B Proc. Suppl., vol. 12, no. 1, pp. 49–72, 2019.

[3]A. Qureshi, D. Megías, and H. Rifà-Po"PSUM:Peer-to-peermultimediacontent distributionusingcollusion-resistant fingerprinting", J. Netw. Comput. Appl., vol. 66, pp. 180–197, 2016.

[4]M. Scanlon and H. Shen, "An analysis of BitTorrent cross-swarm peer participation and geolocational distribution", Proceedings of the 23rd International Conference on Computer Communications and Networks (ICCCN), Shanghai, China, pp. 1–6, 2014.

[6]R. Casadesus-Masanell and A. Hervas-Drane, "Peer-to-peer file sharing and the market for digital information goods", J. Econ. Manag. Strategy, vol. 19, no. 2, pp. 333–373, 2010.

[7]S. Goel, P. Miesing, U. Chandra, "The impact of illegal peer-to-peer file sharing on the media industry", California Management Review, vol. 52, no. 3, pp. 6–33, 2010.

[8]P. J.-J. Herings, R. Peeters, and M. S. Yang, "Competition against peer-to-peer networks", Inf. Econ. Policy, vol. 22, no. 4, pp. 315–331, Dec. 2010.

[9]S. Smith and R. Telang, "The Effect of Piracy on Movie Revenue", Journal of Media Economics, vol. 22, no. 4, pp. 271–288, Dec. 2009

[10]E. S. Kyper and R. H. Blake, "An investigation of the intention to share media files over peer-to-peer networks," in Proc. Americas Conf. Information Systems (AMCIS), San Francisco, CA, USA, Aug. 2009.

[11]P. Laskowski, J. Ubois, D. Marvit, J. Chuang, "Discovering digital content in the age of peer-to-peer", in Proceedings of the Workshop on the Economics of Networks, Systems, and Computation (NetEcon), Stanford, CA, USA, Jul. 2009.

[12]S. Jain, "Digital piracy: A competitive analysis", Marketing Science, vol. 27, no. 4, pp. 610–626, 2008.

[13]F. Oberholzer-Gee and K. Strumpf, "The Effect of File Sharing on Record Sales: An Empirical Analysis", Journal of Political Economy, vol. 115, no. 1, pp. 1–42, Feb. 2007.

[14]M. Suvanto, "Privacy in peer-to-peer networks", Seminar on Internetworking, Helsinki Univ. of Technol., 2005.

DOI: https://doi.org/10.5281/zenodo.15486410