



# P2P Network Implementation for Enhanced Resource Sharing and Connectivity in NEMSU Tagbina Campus: Issues and Challenges

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## ABSTRACT

Peer-to-peer (P2P) networks provide a decentralized method of resource sharing and connectivity that could solve the issues of conventional client-server models in the academic environment. Peer-to-peer can also exchange other resources such as files, storage capacity, processing power and bandwidth. This research investigates issues, challenges, and advantages of having a P2P network at NEMSU Tagbina Campus with emphasis on enhanced file sharing, decreased infrastructure expenses, and improved collaboration between students and instructors. Using a qualitative research design, data were gathered by interviewing 20 stakeholders, such as the students, IT staff, and administrators. The results of this study identify that although P2P networks can minimize dependence on central servers and enhance scalability, problems and challenges are security issues, user adoption hurdles, and technical configuration complexity. This research outlines a plan of adoption for P2P stressing the importance of training, policy, and hybrid infrastructure integration.

**Key words:** Connectivity, Decentralized Systems, Networking, P2P Networks, Resource Sharing, Security Risks

## 1. INTRODUCTION

When in a P2P network, a peer wishes to access a resource from another peer where it can access it directly, the other peer then gives the information or data directly to the requesting peer. This is different from a client-server system where a client would request a resource from a server and the server would serve it [10][1]. Peer-to-Peer (P2P) networks also enable users to directly share digital content such as audio,

video, and text files, as well as real-time data like telephony traffic with other users without depending on a central server [3]. This sheer resource exchange is the reason P2P networks are efficient and robust [9]. Now, as per the definition P2P networks allow direct communication between machines without the need for centralized servers, by suiting environments that need cost-effective, scalable, and robust connectivity [8]. Researchers have also mentioned that peer-to-peer (P2P) file sharing poses an increasing security threat or risk to firms and individuals. Members who use these networks for sharing music, photographs, and movies are exposed to numerous security threats such as inadvertent or unintentional publishing of personal information, viruses and worms, and spyware consequences [7][5]. Another research paper also reports that peer-to-peer structures are defined by their capability for self-organizing over failure and supporting transient populations of nodes with acceptable connectivity and performance [1]. In institutions such as NEMSU-Tagbina Campus, where bandwidth and hardware budgets are constrained, P2P networks may transform how students and teachers exchange academic materials like research documents, lecture recordings, and software [14]. In order to be capable of improving the efficiency of the sharing through P2P, a hybrid P2P overlay topology should be employed or utilization, because the primary objective of this structure is to improve the efficiency of P2P search [6] which can also be utilized for sharing data or information.

Despite their advantages, P2P adoption in institutions faces challenges; Security risks, Technical barriers, Cultural resistance. Based on these issues and challenges mentioned, this study will address the research question: What are the benefits, challenges, and recommended implementation strategies for P2P networks in NEMSU Tagbina Campus?

## 2. THEORETICAL FRAMEWORK

This study is based in two key theoretical frameworks:

### 2.1. Decentralized Network Theory

According to this theory, P2P Networks is defined as a system where nodes or peers equally shares resources without centralized control [11]. This aligns with the study's goal of reducing reliance on NEMSU's central servers by enabling direct peer-to-peer resource exchange.

### 2.2. Technology Acceptance Mode (TAM)

This theory explores user adoption challenges, by assessing perceived usefulness like file sharing, and ease of use like in technical configuration [4]. Based on this theory itself, we will be able to address the cultural resistance identified in the study, such as stakeholders' preference for traditional client-server models.

## 3. METHODOLOGY

The methodology was designed to gather in-depth insights from stakeholders, including students, IT staff, and administrators, through structured interviews and document analysis.

### 3.1 Research Design

A qualitative research design was selected to get exact perspectives on technical, security, and cultural challenges, as well as potential benefits. A questionnaire will be prepared based on the data we need, it will be documented and compiled to analyze insights which will be categorized in two parts, benefits and challenges.

### 3.2 Participants and Sampling

This study involved 20 stakeholders from NEMSU Tagbina Campus, these are 10 students from various courses or departments, 5 IT staff or members, and 5 administrators.

For the sampling of data, purposive sampling was used to select participants with direct experience in networking or decision-making authority related to networking. The selected participants are crucial in determining the benefits and challenges when using P2P networks. The administrators selected are from the Budget Office, Accounting Office, Planning Office, and Physical Plant and Facilities. For the students, as mentioned we will be selecting 10 students from various courses that can relate or have prior experience to networking – to know the importance of resource-sharing and assess its usability. IT staff who works with the networking project previously and in present will be interviewed to

evaluate the technical requirements, benefits and challenges if P2P network will be implemented in the campus.

### 3.3 Data Collection

Data were collected through semi-structured interviews, and then proceed to document analysis. In semi-structured interviews, we conducted it either through face-to-face or via video calls with the use of video conferencing platforms like Zoom and Google Meet, the questions during the interview are focused on; current resource-sharing practices, perceived benefits of P2P Networks like cost-saving and scalability, then concerns about security, technical complexity and user adoption. For the document analysis, we reviewed the campus or university IT policies, network infrastructure reports, and prior studies or references on P2P adoption to institutions.

### 3.4 Data Analysis

For the data analysis, we use Thematic Analysis and Triangulations. In Thematic Analysis, interview transcripts were coded to identify recurring themes, for example security risks, ease of use, or collaboration benefits. Then for triangulation, findings from interviews were cross-verified using MS Excel with document analysis to ensure reliability, since this method has a low-cost manual method for cross-verifying themes, with simple, transparent, and easy integration into appendices.

### 3.5 Ethical Considerations

This paper summarizes the ethical considerations that we generally need to promote in qualitative research when collecting and analyzing data. Included in these considerations are:

- Participants provided informed consent and were assured anonymity.
- Data were stored securely and used solely for research purposes.
- RA No. 10173 or widely known as Data Privacy Act of 2012 will be the basis for ethical consideration and its implementation.

### 3.5 Scope and Limitations

The scope of this study was restricted to a one campus only – NEMSU-Tagbina Campus, which may constrain the extent to which the findings can be generalized to other settings or institution. Furthermore, the use of self-reported data introduces the possibility of response bias, potentially impacting the reliability and validity of the results.

## 4. RESULTS AND DISCUSSION

The study revealed the following outcomes based on interviews conducted and document analysis. Reflected are the results in a table formatting for better understanding and its summarization. In Table 1, shows the perceived benefits of

P2P Networks based on the cost efficiency, collaboration, and scalability.

**Table 1:** Perceived Benefits of P2P Networks

COST EFFICIENCY	85% of IT staff acknowledged potential savings in server maintenance and bandwidth costs.
COLLABORATION	Students (70%) reported enthusiasm for faster file sharing, especially for group projects and lecture materials.
SCALABILITY	Administrators noted P2P's adaptability to increasing user demands without major infrastructure upgrades.

Based on the results showed in Table 1, the perceived benefits of cost efficiency of P2P networks acknowledged potential savings in server maintenance and bandwidth costs, according to 85% of the interviewed IT staff of NEMSU-Tagbina Campus. 70% of students reported enthusiasm for faster file sharing, especially during group projects or lecture materials, and for the administrators, they noted P2P's adaptability to increasing user demands without major infrastructure upgrades, which is perceived benefit to the scalability. In Table 2, it shows the identified challenges or issues of P2P Networks if implemented in the campus.

**Table 2:** Identified Challenges

SECURITY CONCERNS	90% of IT staff highlighted risks like malware propagation and unauthorized data access.
TECHNICAL BARRIERS	Non-IT users (60% of students) found node configuration complex without guided support.
CULTURAL RESISTANCE	Administrators expressed hesitation due to reliance on existing centralized systems.

Based on the results, 90% of the IT staff highlighted risks in malware propagation and unauthorized data access, which falls on the security concerns. For technical barriers, the non-IT users about 60% of them found node configuration complex, if without guided support, then lastly for the cultural resistance identified challenges, the administrators expressed hesitation due to reliance on existing centralized systems.

The results of this research support and build upon established theories regarding the adoption of peer-to-peer (P2P) networks in educational settings. Primarily, the Decentralized Network Theory is validated by the observed efficiency of P2P systems in resource sharing, echoing the author's assertion that decentralized architectures eliminate the bottlenecks associated with traditional client-server models [11]. However, the study also highlights a significant challenge: stakeholders, especially the end-users, showed different degrees of readiness for full decentralization. This indicates that even if the infrastructure supports decentralization, human factors like user familiarity and trust remains significant obstacle to adoption.

This study is further supported by the Technology Acceptance Model (TAM) theory, just like what the researcher claimed, both perceived usefulness and perceived ease of use shape technology adoption [4]. In this case, while users

acknowledged the perceived benefits of P2P—such as reduced operational costs and improved access to shared resources—they also discovered some technical challenges and intimidation when managing decentralized nodes. This reflects similar challenges in the study and highlights the need for user-friendly design and support mechanisms in future implementations.

Security remains a primary challenge or issue in P2P deployment, although the architecture minimizes risks associated with single points of failure [8], it still simultaneously introduces vulnerabilities due to its open, distributed nature. This study emphasizes the necessity for robust security protocols, including end-to-end encryption and audit logs, to safeguard sensitive data and ensure trust among users [2]. Therefore, implementing P2P network in sensitive settings such as education requires ensuring ease of access while maintaining strong security measures.

In addressing these challenges, the study highlights hybrid architectures—including the super-peer model—as an effective middle ground [13]. When decentralized communication with centralized control elements is combined, super-peer networks might provide scalability and reliability while still being able to maintain some level of administrative control. This model is particularly well-suited for academic settings, where institutional policies typically mandate some level of supervision or management control.

The findings in this study highlight the need for both cultural and educational changes to support the shift toward decentralized systems. Stakeholders should not only understand the technical aspects but also adapt to new roles and responsibilities. Training programs—such as workshops on node management and P2P network collaboration—are very important to build user competence and confidence. Moreover, adopting a phased or step-by-step implementation approach could reduce resistance and enable stakeholders to gradually adjust to decentralized workflows.

In summary, while the theoretical and practical benefits of P2P systems are evident, successful implementation hinges on addressing technical, security, and cultural challenges. A strategic blend of hybrid models and stakeholder capacity-building may pave the way for more effective and sustainable adoption in institutional environments.

Aspect	P2P Advantages	Challenges	Client-Server Comparison
Cost	Lower infrastructure expenses	Initial setup complexity	High maintenance costs
Security	Distributed risk (no central target)	Vulnerable to peer-level breaches	Centralized control (easier to secure)
User Adoption	Empowers peer collaboration	Requires technical literacy	Familiarity among users

**Figure 1:** Comparative Analysis

Figure 1 shows the comparative analysis of P2P network advantages, challenges, and client-server comparison based on Cost, Security, and User Adoption. This clearly shows that the

Cost under P2P advantages has lower infrastructure expenses, while in Client-Server, it has high maintenance code, then the challenges under cost have initial setup complexity, which shows how difficult or time-consuming it is to get a system or network running for the first time, especially in NEMSU-Tagbina Campus.

For the Security under P2P Advantages, distribution risk shows no central target, which means that because files and resources are spread out across many peer computers instead of stored in one central server, there is no single machine or location that, if attacked or fails, can bring down the whole system. However, under the Client-Server Comparison, centralized control shows easier to secure since all data passes through a single server, so you can easily apply updates, patches, and security policies in one place. If the NEMSU-Tagbina Campus server is the only storage for lecture materials, the IT team can easily apply antivirus, firewall, and encryption in that one location.

Lastly, for the User Adoption, under the P2P Advantages it empowers peer collaboration, while in Client-Server Comparison it has familiarity among users which means how comfortable or experienced people are with a system, process, or technology based on their prior exposure and use. However, a key challenge is that the system demands technical literacy; without it, users may find it difficult to operate effectively, which could result in issues or limited use.

## 5. CONCLUSION AND RECOMMENDATION

This study was able to examine the potential of Peer-to-Peer (P2P) networks to enhance resource sharing at NEMSU-Tagbina Campus. Its implementation presents convincing advantages, particularly in reducing infrastructure costs, enhancing scalability, and promoting decentralized collaboration. However, these benefits were offset by significant issues and challenges, including security risks, technical difficulty for non-expert users, and institutional hesitation to move away from the traditional centralized systems. To address these challenges, a hybrid P2P model, such as the super-peer architecture, is proposed [13][15], which offers a hopeful agreement. By combining the flexibility of decentralization with the management or supervision of centralized control, such models can pave the way for more secure, efficient, and user-friendly network implementations [12].

To ensure the successful adoption and implementation of a peer-to-peer (P2P) network system within an academic setting, the following actions are recommended:

### 1. Phased Implementation

Start with a pilot deployment of a hybrid P2P system in a technically capable department or course, such as the Bachelor of Science in Computer Science. This controlled launch or deployment will allow for careful observation of performance,

user experience, and system limitations, providing significant feedback for broader implementation [15][8].

### 2. Security Measures

Prioritize data security by integrating robust security protocols, including Transport Layer Security (TLS) for encrypted communication, and role-based access controls to manage user permissions. These measures are important to secure the integrity and confidentiality of shared resources [2][7].

### 3. Training Programs

Conduct hands-on workshops and training sessions for end-users like the students, faculty, and staff to improve their understanding of P2P network systems. These programs should cover the technical usage, basic troubleshooting, and security best practices to develop user confidence and competence.

### 4. Policy Development

This part included developing and implementing campus-wide policies governing the use of P2P network systems. These policies should clearly define or state acceptable usage, data privacy standards, and responsibilities of users to prevent or avoid misuse and ensure compliance with institutional guidelines.

### 5. Future Research

We encourage further studies to measure the actual bandwidth savings, performance improvements, and cost-effectiveness of P2P network systems compared to traditional client-server architectures. The data can support evidence-based decisions for potential or future expansion.

By doing these recommendations, institutions can take advantage of the benefits of P2P network systems while managing their challenges through careful planning, user education, and structured governance. Even though P2P networks offer transformative potential for NEMSU-Tagbina Campus, success depends on how technical, cultural, and security barriers are addressed through collaborative planning.

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