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Secure and Scalable Peer-to-Peer File Distribution for Smart Campus Laboratories

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Abstract: *In the context of modern web-based communication systems, efficient and secure file sharing remains a significant challenge due to the limitations of centralized server-dependent architectures. Traditional file transfer mechanisms often suffer from high latency, bandwidth overhead, storage dependency, and increased security risks, especially when handling large files in real-time environments. Conventional client-server models are increasingly inadequate to meet the growing demand for fast, private, and scalable data exchange. This study presents a secure peer-to-peer file sharing system based on WebRTC technology, enabling direct browser-to-browser file transfers without relying on intermediate server storage. Real-time signaling and session coordination are achieved using Socket.io, while encrypted WebRTC data channels ensure secure and reliable transmission. The system incorporates role-based authentication and access control using JSON Web Tokens to enhance security and user management. Furthermore, real-time user presence tracking, administrative broadcast functionality, and transfer history logging are implemented to improve system usability and monitoring. The proposed approach demonstrates improved performance, reduced latency, and enhanced security compared to traditional file sharing techniques.*

Keywords: Peer-to-peer file sharing, WebRTC, Real-time communication, Secure data transfer, Socket.io, Browser-based systems

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