Advanced Encryption Techniques for Secure Cloud Computing in Educational Institutions

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Abstract:

Cloud computing security has become a critical challenge as traditional encryption methods like RSA and AES face scalability and computational efficiency issues. This study explores the adoption of Elliptic Curve Cryptography (ECC) as an alternative encryption method for securing cloud environments. ECC offers strong encryption with significantly smaller key sizes, reducing computational overhead while maintaining security integrity. The research involves a comparative analysis of AES and ECC, highlighting their performance differences in terms of encryption time, computational efficiency, and scalability. The findings reveal that ECC is better suited for large-scale applications, particularly in cloud computing and IoT-based encryption systems, where security and energy efficiency are crucial. The study also presents a modular system architecture for implementing ECC in cloud environments, ensuring real-time data encryption, secure key management, and authentication protocols. Performance evaluations confirm that ECC effectively balances security and efficiency, making it a future-proof cryptographic standard for

modern cloud infrastructures. Future research could integrate quantum-resistant cryptographic models and adaptive encryption techniques to further enhance cloud security frameworks.

Keywords:

Elliptic Curve Cryptography (ECC), Cloud Security, Encryption Performance, AES vs ECC, Computational Efficiency, IoT Encryption.