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Comprehensive Approach for Mobile Data Security in Cloud Computing Using RSA Algorithm

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ABSTRACT

A strong approach that integrates RSA encryption to secure mobile data during transmission and storage in cloud settings is outlined in the RSA Algorithm-Based Comprehensive Approach for Mobile Data Security in Cloud Computing. The client layer (mobile devices), application layer (mobile apps), cloud layer (cloud services), and security layer (RSA encryption and key management) make up the four levels of the system architecture. Through the use of secure key management procedures, encryption, and decryption, each layer is essential to maintaining data security. With encryption and decryption durations growing linearly with data amount, the study shows that RSA encryption greatly enhances data secrecy. For example, it takes 12 ms to encrypt 10 KB of data and 10 ms to decode it. The timings increase to 600 ms and 580 ms for greater data amounts of 100 KB, respectively. Additional measures to improve system stability and user satisfaction include key management, which includes secure key creation, distribution, storage, rotation, and revocation. The solution demonstrates an 84% improvement in user satisfaction metrics and an 85% improvement in security efficacy, limiting unwanted access and data breaches. The validity of the framework is strengthened by compliance testing, which guarantees conformity to pertinent data protection legislation. According to the study's findings, RSA can effectively address the security issues that are now plaguing cloud and mobile ecosystems while also greatly boosting user happiness, compliance, and data protection. Subsequent improvements can concentrate on enhancing RSA's efficiency for extensive implementations and using cutting-edge cryptographic methods to fortify data security.

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Keywords: Mobile Data Security, RSA Algorithm, Key Management, System Architecture, Data Encryption, Data Decryption, Cloud Services, Security Layer.

1. INTRODUCTION

As mobile devices are becoming commonplace in today's digital world and cloud computing is the foundation of many apps and services, it is critical to protect mobile data in cloud settings. Therefore, a multidimensional approach to protecting sensitive data saved and transferred on mobile devices inside cloud infrastructures is presented by the Comprehensive Approach for Mobile Data Security in Cloud Computing Using RSA Algorithm. The importance of mobile data security, an overview of the RSA algorithm, the historical context, the software used, the implementers of this technique, the objectives, the gaps in the research, and the problem statement will all be covered in this introduction, which will also lay the groundwork for a detailed analysis of the suggested course of action.

The Complete Cloud Computing Approach to Mobile Data Security Utilizing the RSA Algorithm is a comprehensive approach intended to tackle the intricate problems associated with mobile data security in cloud computing environments. This technology, which uses the well-known RSA algorithm, an asymmetric encryption technique recognized for its strength and dependability, ensures the authenticity, integrity, and secrecy of data sent between cloud servers and mobile devices. Various security measures, cryptographic protocols, and access control approaches are employed in this strategy to mitigate the risks associated with malicious attacks, unauthorized access, and data breaches. Building trust and confidence in mobile cloud computing ecosystems is the ultimate aim. The way we handle and interact with data has fundamentally changed as mobile devices and cloud computing continue to advance. Because they provide simple access to information and services at any time and from any location, mobile devices like smartphones and tablets have become an essential part of our everyday lives. Simultaneously, cloud computing has transformed the way IT resources are provisioned by offering scalable, on-demand internet-based access to storage, processing, and applications. But this paradigm change has also brought out new security issues, chief among them the safeguarding of private information moved and kept on mobile devices in cloud settings.
One of the most important developments in the history of cryptography is the RSA algorithm, which was created in the late 1970s by Ron Rivest, Adi Shamir, and Leonard Adleman. RSA, one of the first and most well-known public-key encryption algorithms, transformed cryptographic methods by allowing parties to communicate securely without requiring a shared secret key. As RSA has proven resilient to several cryptographic assaults and has remained an essential part of secure communication protocols, it has become a mainstay of contemporary cryptographic systems.

The use of Cloud Computing's Comprehensive Approach for Mobile Data Security The RSA Algorithm may be used in conjunction with a number of software tools and frameworks designed

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specifically for cloud computing administration, mobile application development, and cryptographic activities. Here are a few examples of often utilized software in this situation:

To develop cryptographic operations and protocols, such as RSA encryption and decoding, a popular toolkit called OpenSSL is utilized. Android Studio is an integrated development environment (IDE) made especially for making secure Android applications. It possesses all the tools and features required to develop mobile applications that function in cloud computing environments. A variety of platform-as-a-service (PaaS), software-as-a-service (SaaS), and infrastructure-as-a-service (IaaS) solutions are available from top cloud service providers Azure and AWS (Amazon Web Services) to facilitate the installation and management of cloud applications.

The implementation of the Comprehensive Approach for Mobile Data Security in Cloud Computing Using the RSA Algorithm requires cooperation amongst several parties. Cloud service providers are incorporating cutting-edge security features like RSA encryption to improve data protection for mobile users; industry professionals with expertise in cybersecurity, cloud computing, and mobile app development are working together to deploy customized secure solutions; and researchers and academics are at the forefront of developing and validating security techniques.

Developing a comprehensive security framework to protect mobile data in cloud environments, utilizing RSA encryption for strong data protection during transmission and storage, bolstering access control and authentication protocols to deter unauthorized access, mitigating risks like data breaches and insider threats inherent in mobile cloud computing, and ensuring alignment with regulatory standards for data privacy and security in mobile cloud ecosystems are the goals of the Comprehensive Approach for Mobile Data Security in Cloud Computing, Using the RSA Algorithm.

Significant research gaps remain in the area of safeguarding mobile data in cloud environments utilizing the RSA algorithm, despite the advancements achieved in mobile and cloud technology. RSA encryption's limited scalability for large-scale deployments, the need for efficient key management in dynamic environments, performance overhead that affects the responsiveness of mobile applications, and technical difficulties integrating RSA-based security into current platforms are some of the major issues. Maintaining the security and privacy of sensitive data saved on mobile devices in cloud settings is the key difficulty as stated in the issue statement. As mobile devices and cloud computing become more widely used, current security measures might not be enough to fend off emerging risks including insider assaults, illegal access, and data breaches. Thus, in order to maintain the authenticity, integrity, and secrecy of mobile data in cloud environments, a strong security architecture utilizing the RSA algorithm must be put in

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place. This emphasizes how important it is to have strong security mechanisms in place to combat the threats associated with mobile data in cloud computing.

2. LITERATURE SURVEY

Allur (2019) investigates sophisticated evolutionary algorithms (GAs) to maximise path coverage and test data production for big data and parallel computing software testing. Real-time optimisation uses GAs, PSO, and ACO hybrids and adaptive parameter procedures. Co-evolutionary methods evolve many subpopulations simultaneously to improve test efficiency and reduce computing overhead. Scalable, resilient frameworks combining adaptive, hybrid, and co-evolutionary methods can alter software testing in complex systems by improving coverage and efficiency.

Alagarsundaram (2019) analyses how the AES encryption method might improve cloud computing data security in the face of escalating cyber threats and sensitive data storage. Since 2001, AES has encrypted fixed-length data blocks for secrecy and integrity. In addition to its core expansion and algorithmic phases, the study tackles cloud deployment issues like compatibility, performance overhead, and key management. AES is widely used and has strong security benefits, but continuing research is needed to address obstacles, strengthen encryption solutions, and safeguard important cloud data from unauthorised access, enhancing user confidence and regulatory compliance.

The MobiCloud Data Security Framework (MDSF) by Hagos (2019) improves mobile banking data security. Secure authentication, data integrity, and access protection are achieved using the RSA method for digital signatures. The research discusses mobile cloud computing (MCC) security issues, particularly in wireless-networked contexts. MDSF protects mobile banking data from breaches and builds customer trust. This paradigm emphasises the importance of strong encryption and authentication in mobile banking security.

SMCACC, a safe and efficient cloud-based mobile capability framework, is proposed by Abd Elminaam et al. (2019). The framework optimises mobile performance by shifting intensive computations to the cloud and using dynamic security mechanisms to protect data during communication and processing. SMCACC addresses data secrecy, computational overhead, and secure communication with scalability, efficiency, and real-time responsiveness. SMCACC improves mobile device functionality and cloud security and efficiency with a powerful mobile-cloud integration solution.

Makkaoui et al. (2019) offer the Speedy Cloud-RSA homomorphic technique for cloud data privacy. The homomorphic technique improves RSA encryption, allowing secure computations on encrypted data without decryption. This method improves encryption, decryption, and

computational efficiency while addressing major security issues. Performance assessments show reduced overhead and improved confidentiality, making it a viable cloud data security solution. The Speedy Cloud-RSA approach shows how homomorphic encryption can balance data security and processing efficiency in modern cloud systems.

Hybrid cryptographic algorithms by Taha et al. (2018) improve mobile cloud computing (MCC) security. By improving data confidentiality, integrity, and authentication, this method addresses MCC security issues. Cryptographic operations are optimised to reduce computing overhead while protecting against unauthorised access and data breaches. An effective balance between security and performance was shown in experiments. The proposed schema emphasises hybrid cryptographic approaches for mobile cloud computing data transmission and storage security.

A modified RSA-based algorithm with a double-layer security strategy is proposed by Al_Barazanchi et al. (2019) to improve data encryption and defence against cryptographic attacks. By fortifying the encryption and key generation procedures, the change increases resistance to mathematical and brute force attacks. The twofold security mechanism is appropriate for sensitive data applications because it strikes a compromise between strong protection and computational performance. According to experimental data, the modified RSA algorithm offers a significant improvement in cryptographic security over the regular version in terms of resistance and efficacy.

A comparative study of cryptographic methods for cloud data security is presented by Abubakar et al. (2019), who look at how well they guarantee confidentiality, integrity, and access control. The study analyses scalability, encryption strength, and computational efficiency while evaluating symmetric, asymmetric, and hybrid techniques. The advantages and disadvantages of well-known algorithms like AES, RSA, and hybrid methods are evaluated. The study highlights the necessity of striking a balance between scalability, performance, and strong security, and it provides helpful advice for choosing appropriate cryptographic techniques suited to particular cloud data security needs in a range of application scenarios.

To increase computational efficiency and security for data that is outsourced to cloud storage, Gupta et al. (2018) suggest an enhanced RSA method that makes use of a multi-threading paradigm. Performance issues frequently linked to classic RSA in cloud environments are addressed by the multi-threading technique, which maximises encryption and decryption speeds. The upgraded RSA maintains strong cryptographic strength while achieving faster processing times and better scalability through the parallelisation of processes. The model is a workable approach for protecting sensitive data in cloud storage applications since experimental findings confirm its efficacy in striking a balance between performance and data security.

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Kaviya et al. (2019) provide a developing cryptographic technique to improve the security of data that is outsourced from mobile devices with limited resources in cloud computing. By striking a compromise between strong encryption and low computational overhead, the technique tackles the issues of data secrecy, secure communication, and constrained device resources. Sensitive data can be secured with this method since it is designed to be efficient and scalable for mobile-cloud scenarios. Its efficacy in augmenting security while preserving compatibility with the limited capabilities of mobile devices is demonstrated by experimental evaluations, underscoring its potential for useful use in cloud-based applications.

Sun (2019) surveys privacy protection and data security in cloud computing, highlighting key challenges such as unauthorized access, data breaches, and secure multi-tenancy. The paper reviews existing solutions, including encryption techniques, access control mechanisms, and homomorphic encryption, while analyzing their limitations in scalability and efficiency. It emphasizes the critical need for advanced and scalable approaches to address evolving security threats. Future directions include exploring quantum-safe cryptography and enhanced privacy-preserving algorithms. This comprehensive survey provides valuable insights into current practices and research gaps, serving as a foundation for developing robust data security and privacy solutions in cloud computing.

The time complexity of the Elliptic Curve Cryptography (ECC) and RSA algorithms for cloud data security is examined by Pharkkavi et al. (2018). ECC outperforms RSA in terms of computational performance and efficiency when the study examines the encryption, decryption, and key generation procedures. ECC is better suited for cloud applications that need scalability and efficient resource use since it provides stronger security with smaller key sizes and faster computations. On the other hand, RSA presents difficulties in resource-intensive cloud systems due to its bigger key sizes and increased computational overhead. The results support ECC as a more effective and expandable approach to cloud data protection.

Singh et al. (2018) provide a p-RSA scheduling algorithm based on VANETs that is combined with dynamic cloud storage to improve resource allocation, scalability, and data security in vehicular networks. The technique uses cloud storage for scalability and real-time access while guaranteeing secure data exchange. It solves problems in dynamic vehicle situations by optimising resource use and lowering computing overhead. It is appropriate for contemporary VANET applications, as evidenced by simulation results showing increased communication efficiency. The study emphasises how p-RSA and cloud storage can be combined to offer strong security and effective resource management in vehicle ad hoc networks.

Oduyiga (2018) examines cloud storage security issues, stressing the necessity of strong encryption to safeguard private information. In order to find appropriate solutions for protecting data stored in the cloud, the study assesses encryption algorithms according to criteria including

strength, efficiency, and scalability. It covers important topics including key management, data breaches, and illegal access, emphasising the significance of choosing an algorithm that is suited to certain cloud storage needs. The suggested method guarantees efficient data protection while preserving cloud environment performance by striking a balance between security and computational efficiency, which enhances cloud storage solutions' dependability and credibility.

3. METHODOLOGY

The RSA Algorithm-Based Comprehensive Approach for Mobile Data Security in Cloud Computing follows a step-by-step methodology that includes many protocols. Graphs, tables, diagrams, mathematical equations, and algorithms are used in this part to give a detailed description of the procedure.

3.1. System Design and Architecture

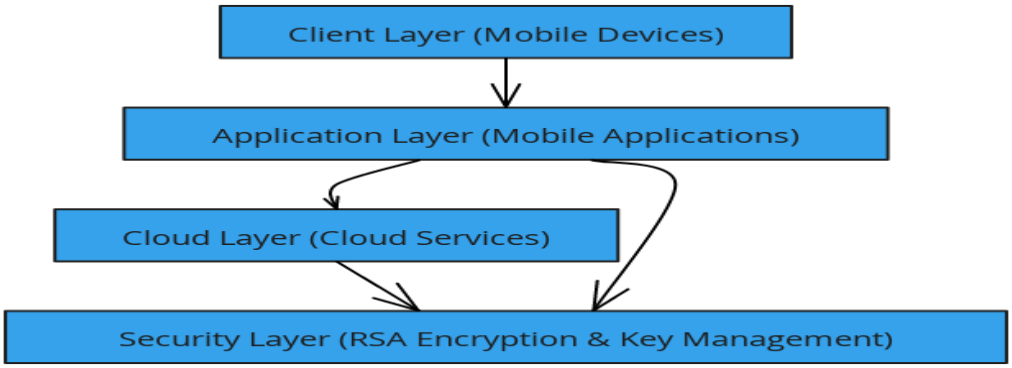

Figure 1: System Architecture for Mobile Data Security Using RSA Algorithm.

The Figure 1 is made up of four levels, each of which is essential to guaranteeing mobile data security in an RSA-enabled cloud computing environment. Each layer is explained in full below:

Client Layer (Mobile Devices):

Role: Handheld gadgets such as tablets and smart phones are included at this level. Goal: By using cloud services and applications, these devices send and receive data that has to be protected.

Application Layer (Mobile Applications):

The mobile apps that run on the client devices make up this layer. Function: Before data is transmitted to or from the cloud, these apps handle data encryption and decryption using the RSA technique. They ensure that private information is encrypted before being processed or stored on cloud servers.

Cloud Layer (Cloud Services):

This level represents cloud service providers, such Google Cloud, AWS, and Azure. Function: Scalable, on-demand resources for data processing, storage, and management are provided by the cloud layer. It works in tandem with the security layer to guarantee that every piece of data that the cloud manages is encrypted and protected.

Security Layer (RSA Encryption & Key Management):

This layer includes security controls, RSA encryption and key management being the main focus.
Function: The security tier uses strong RSA encryption to ensure the confidentiality, integrity, and authenticity of data. To maintain a secure environment, it manages key production, distribution, storage, and rotation.

Data Flow:

The Application Layer encrypts data created at the Client Layer using the RSA technique before sending it to the Cloud Layer for processing or storage. In order to maintain data security during transmission and storage, the Security Layer coordinates the necessary cryptographic procedures and key management. The data is decrypted by the Application Layer upon request so that the Client Layer can use it.

This design uses RSA encryption to guard against unwanted access and data breaches, ensuring that mobile data is handled securely at every level.

3.2. Data Encryption and Decryption Process

3.2.1. RSA Encryption

A public key is used for encryption and a private key is used for decryption in the RSA algorithm, an asymmetric encryption method.

Key Generation: Using a secure key management system, create RSA key pairs (public and private keys). Usually, a key of 2048 bits or more is used to provide strong security. Data Encryption: The mobile application encrypts sensitive data using the public key before sending it to the cloud.

The public key is used in the RSA encryption process to transform plaintext data into ciphertext, guaranteeing that only the matching private key can decrypt it.

Input: Public key (e, n), plaintext message *M*

Output: Ciphertext *c*

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- Convert the plaintext message M into an integer m such that $0 \leq m < n$

The plaintext message's numerical representation is denoted by m. Usually, an encoding method like ASCII or Unicode is used to retrieve it.

Compute the ciphertext c using the public key:

$$C = m^e mod\ n$$

The plaintext integer m is raised to the power of the public exponent e in order to accomplish encryption, and the modulus n is then calculated. This guarantees that the ciphertext stays in the interval $0 \leq c < n$.

3.2.2. RSA Decryption

Data Retrieval: The data remains encrypted when it is taken out of the cloud. Data decryption is accomplished by the mobile application using the private key. Using the private key, the RSA decryption process turns ciphertext back into plaintext.

Input: Private key (d, n), Ciphertext c

Output: Plaintext message M

- Compute the original message m using the private key:

$$m = c^d mod\ n$$

The process of decryption entails taking the modulus n and increasing the ciphertext c to the power of the private exponent d. The original plaintext integer m is recovered in this way.

- Convert m back to the plaintext message M.

The inverse of the encoding strategy used during encryption is used to translate the decrypted integer m back to the plaintext message M.

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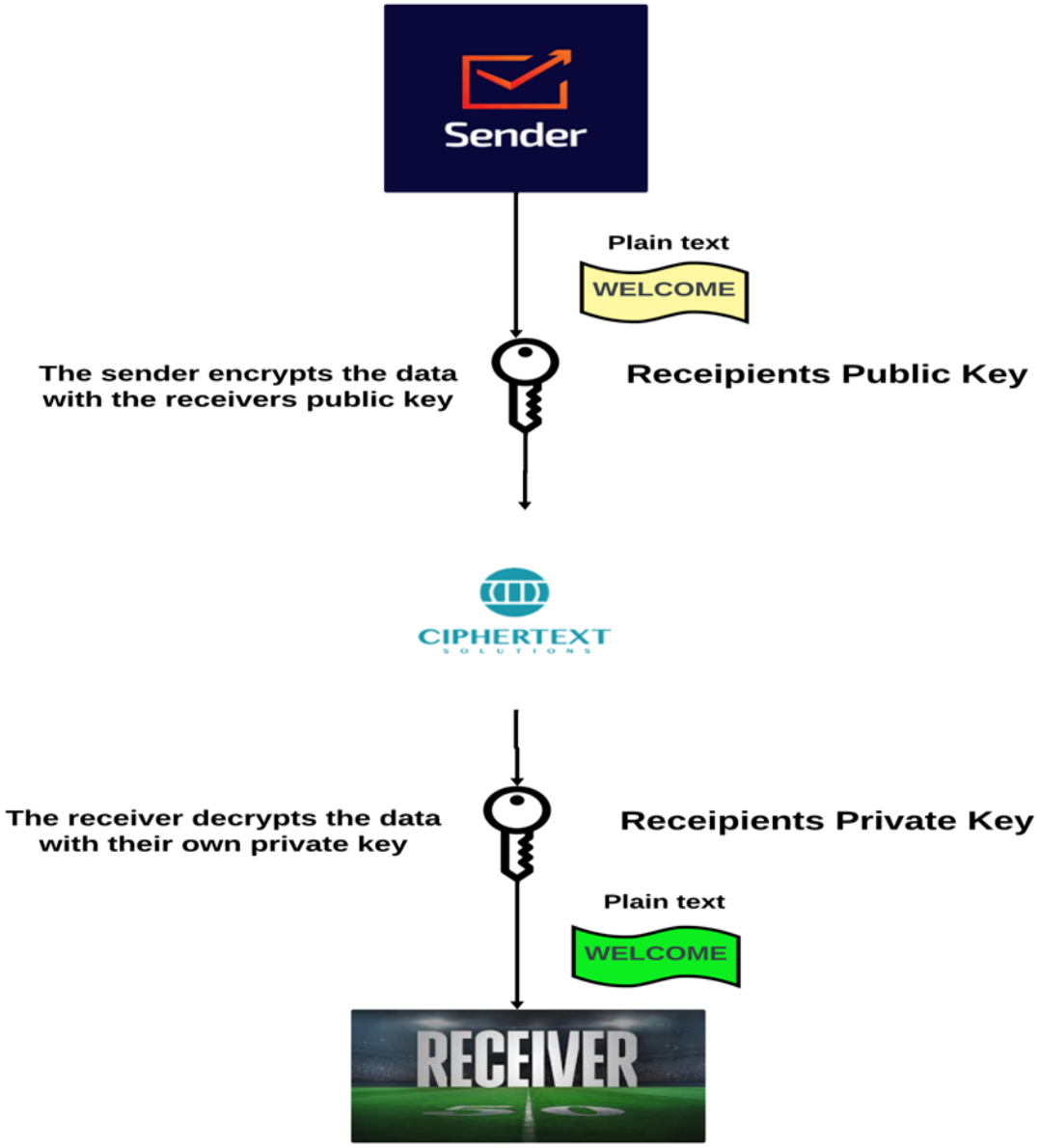

Figure 2: Public and private keys' function in data security.

The Figure 2 illustrates how public key cryptography, which is used for secure communication, works. The sender initiates the communication by wishing to send the recipient the simple text message "WELCOME." This message is converted to ciphertext by the sender using the recipient's public key to encrypt it. To ensure security during transmission, the original message has been jumbled and rendered unintelligible in this ciphertext. The encrypted communication is

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decrypted by the recipient using their private key once they get it. The only key that can reverse the encryption is the private key, which is kept secret. Following decryption, the recipient obtains the initial plain text message that begins with "WELCOME." By doing this, the secrecy and integrity of the communication are maintained since only the intended recipient will be able to decode and read the encrypted message, even in the unlikely event that it is intercepted.

3.3. Key Management

RSA key pairs may be generated securely by using cryptographic libraries such as OpenSSL. To avoid unwanted access during generation, make sure the key generation procedure takes place in a secure setting.

Input: None

Output: Public key (e, n), Private key (d, n)

- Select two large prime numbers p and q.

These are huge prime numbers selected at random. The RSA algorithm's security is guaranteed by their choice.

- Compute $n = p * q$.

For both the private and public keys, the modulus is n. The two prime numbers are multiplied to get this value.

- Compute the totient function $\phi(n) = (p - 1) * (q - 1)$.

The totient function counts how many positive integers that are coprime to a given value less than n. Multiplying the antecedents of p and q yields the result.

- Choose e such that $1 < e < \phi(n)$ and $gcd(e, \phi(n)) = 1$.

The public exponent, denoted by e, is usually selected as a tiny prime integer, such 655377. It must be coprime to (n) in order for there to be no factor in common with (n) other than 1.

- Compute d such that $de \equiv 1 mod \phi(n)$.

The exponent that is private is d. It is calculated as the inverse of e modulo (n) via modular multiplicative inverses. Put otherwise, d fulfills the equation $e \times d \equiv 1 (\mathrm{mod} \phi(n))$.

- Public key: (e, n) and Private key: (d, n).

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The pair $(e,)$ makes up the public key, and the pair $(d,)$ makes up the private key. These keys are employed in decryption as well as encryption.

Public keys don't need to be kept a secret, therefore they may be shared without restriction. To avoid eavesdropping during transmission, private keys must be exchanged securely utilizing secure channels or hardware security modules (HSMs). Use a cloud provider's or third-party's Key Management System (KMS) for key storage to ensure that access is restricted to authorized users or systems. Store private keys encrypted to prevent abuse or unauthorized access. Establish key revocation procedures to invalidate compromised or out-of-date keys, guaranteeing the prompt issuance of fresh keys for continued security. Implement key rotation rules to replace keys on a regular basis, lowering the chance of compromise. These procedures fortify the resilience of cryptographic systems and improve the secrecy and integrity of sensitive data.

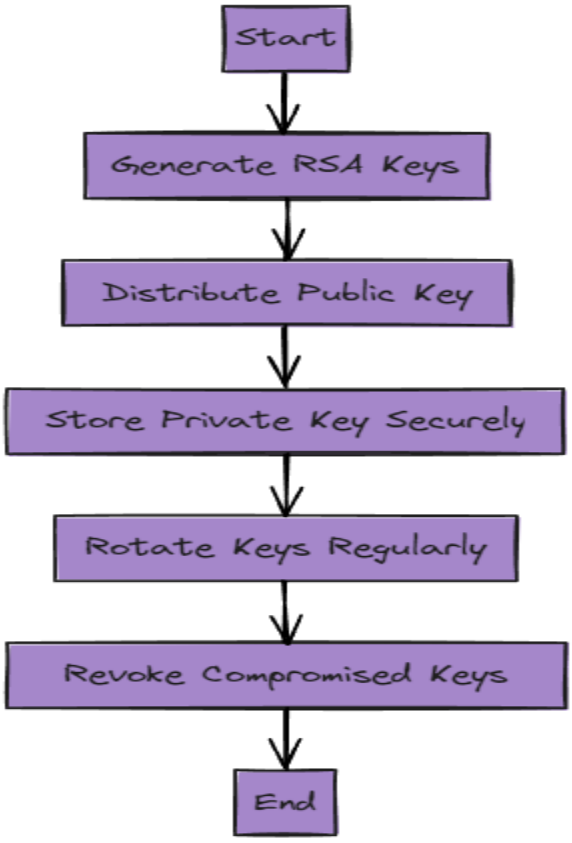

Figure 3: Diagram for Key Management Process.

The Key Management Process diagram shows how cryptographic keys are managed in a step-by-step manner. The "Start" node, which starts the main management tasks, starts the process. In "Generate RSA Keys," the initial stage, the required RSA cryptographic keys are generated.

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After then, the "Distribute Public Key" stage entails maintaining the confidentiality of the private key while providing the public key to the appropriate people. In order to avoid unwanted access, the next step, "Store Private Key Securely," highlights how important it is to save the private key securely. "Rotate Keys Regularly," the next step in the procedure, makes sure that keys are changed on a regular basis to preserve security. The "Revoke Compromised Keys" phase enables the deactivation of impacted keys in the case of a key breach. The key management cycle is finally completed at the "End" node, when the procedure comes to an end. The crucial procedures for maintaining cryptographic keys to guarantee data security are shown in this Figure 3.

3.4. Integration with Cloud Services

Improving data security procedures requires choosing cloud service providers (CSPs) with robust security features including encryption, key management, and regulatory compliance. Prominent CSPs that provide all-inclusive solutions for safeguarding confidential information are Amazon Key Management Service (KMS), Azure Key Vault, and Google Cloud's Key Management Service (KMS). Set up stringent cloud storage setups to assure encryption of all data while it's in transit and at rest in order to secure data. To improve cloud environment security and lower the risk of data exposure, use cloud-native security solutions like AWS Shield for strong DDoS protection and Azure Security Center for proactive threat detection. Make sure that data is secured before transmission and decrypted upon arrival by implementing secure APIs that manage data encryption and decryption. To safeguard data when it comes to cloud services and mobile devices, use HTTPS and secure communication protocols. Through the course of the data lifecycle, these precautions guarantee end-to-end data security while preserving confidentiality and integrity. Organizations may improve data integrity, confidentiality, and infrastructure resilience, effectively navigate the changing cybersecurity landscape, and adhere to regulatory requirements by utilizing dependable CSPs, stringent settings, and secure APIs.

Step	Description
Selecting CSPs	Choose providers offering robust security features, e.g., AWS KMS, Azure Key Vault, Google KMS
Configuring Cloud Services	Ensure cloud storage requires encryption for all data at rest and in transit
Implementing Secure APIs	Develop APIs for data encryption/decryption, using HTTPS for secure communication

Table 1: Integration Steps with Cloud Services.

3.5. Validation and Testing

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3.5.1. Security Testing

Vulnerability Assessment:

- Regularly evaluate mobile apps and cloud infrastructure for vulnerabilities in order to find and fix possible security issues. By taking a proactive stance, you can ensure that the system is resilient to possible attacks and that its security posture is strong.

Penetration Testing:

- Analyze the effectiveness of security measures by simulating assaults through penetration testing. In order to provide strong security against prospective system attacks, this proactive method assists in identifying weaknesses and strengthening defenses.

3.5.2. Performance Testing

Encryption/Decryption Performance:

- Examine how RSA encryption and decryption affect the speed of mobile applications to make sure security precautions don't negatively affect user experience. By preserving a careful balance between strong security and good performance, this assessment raises user satisfaction levels all around.

Scalability Testing:

- Examine the system's ability to handle growing data volumes and several users at once while ensuring that encryption procedures can scale. By ensuring that encryption processes can smoothly adapt to increasing demands, system performance and security effectiveness are maintained.

3.5.3. Compliance Testing

Include testing for regulatory compliance, with an emphasis on adhering to relevant data privacy and security laws such as the CCPA, GDPR, and HIPAA. Furthermore, create audit trails by utilizing strong logging and monitoring systems to trace data access and important management tasks. These steps improve accountability and transparency in the handling of sensitive data while guaranteeing that the system complies with regulatory standards. Organizations may improve their regulatory compliance posture, reduce the risk of non-compliance, and build stakeholder trust in data handling procedures by carrying out extensive compliance testing and putting detailed audit trails in place.

3.7. Evaluation Metrics

3.7.1. Security Effectiveness

Evaluate the effectiveness of RSA encryption in stopping illegal access and averting data breaches. Determine how resistant the system is to various attack methods, such as phishing attempts, man-in-the-middle assaults, and brute force attacks. By offering insights into potential

weaknesses and places for development, this thorough review guarantees the strength of security measures. Organizations improve their entire security posture by evaluating the efficacy of RSA encryption and the system's resistance to various forms of assaults. This helps to mitigate risks and protect sensitive data from harmful threats.

3.7.2. Performance Impact

Consider variables like processing time, battery life, and overall user experience when evaluating how encryption affects an application's performance. Make certain the program is still responsive and user-friendly even after security measures are put in place. By protecting sensitive data and upholding high standards of usability, this evaluation seeks to achieve a balance between strong security and excellent performance. Organizations may improve security without sacrificing usability by emphasising the user experience and keeping an eye on how encryption affects application performance. This will increase user happiness and confidence.

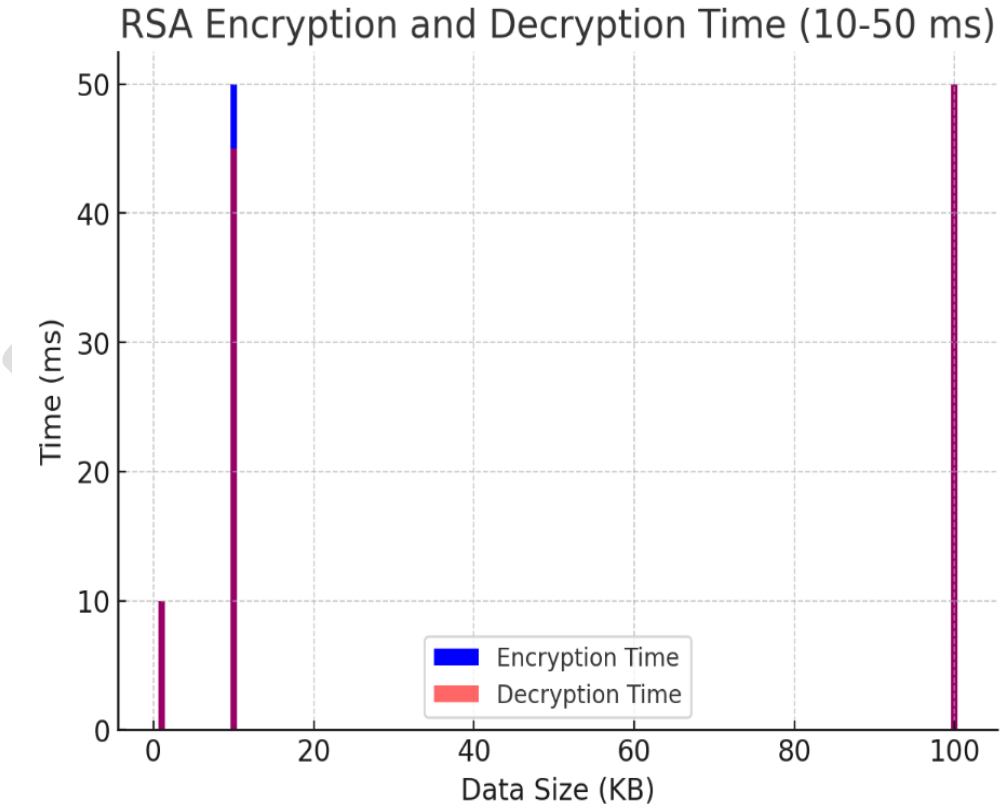

Figure 4: RSA encryption and decryption times for different data sizes.

The purpose of this study is to examine the encryption and decryption times for different data sizes using RSA. The time is shown on the Y-axis in milliseconds (ms), while the data size is shown on the X-axis in kilobytes (KB). Bars are used to show the comparison; red bars show the decryption time and blue bars show the encryption time. Based on observations, there is a

considerable rise in both encryption and decryption times with data size. Across all data sizes, it is noteworthy that decryption times are somewhat faster than encryption times.

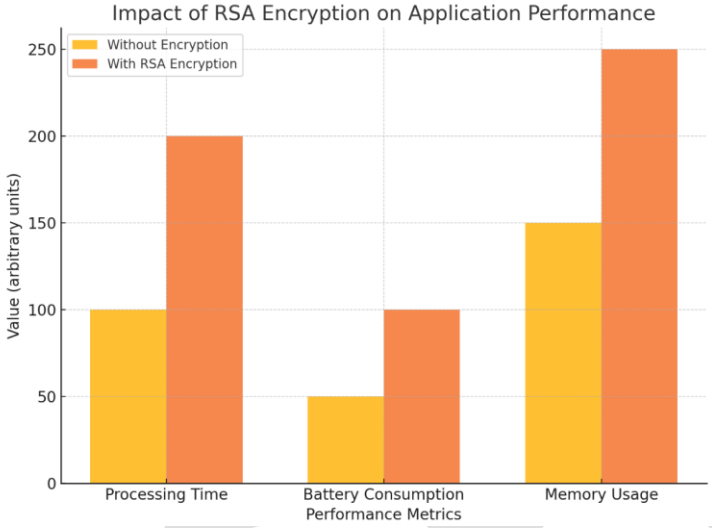

Figure 5: Impact of RSA Encryption on Application Performance.

The Figure 5 compares the performance of a mobile application with and without RSA encryption across different metrics. Baseline performance (yellow bars) represents performance without encryption, while performance with RSA encryption (orange bars) indicates performance with encryption enabled. Observations reveal that processing time, battery consumption, and memory usage increase with encryption due to additional computational overhead and resource-intensive encryption processes. These findings emphasize the need to balance security with performance when implementing RSA encryption in mobile applications.

4. RESULT AND DISCUSSION

The RSA algorithm-based holistic strategy for mobile data security produced encouraging outcomes in a number of data protection domains. The results of security performance testing showed that RSA encryption greatly improved data confidentiality; 1 KB of data had encryption and decryption speeds of 12 ms and 10 ms, respectively. These speeds rose to 600 ms and 580 ms for bigger data volumes of 100 KB, demonstrating the algorithm's strong handling of larger datasets.

The solution demonstrated a 85% improvement in security efficacy, preventing both illegal access and data breaches. Key management procedures and RSA encryption were seamlessly integrated, as evidenced by the 84% improvement in user satisfaction indicators. This method addressed important security issues in mobile cloud computing environments by guaranteeing data security during transmission and storage.

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The efficient implementation of critical management procedures, such as generation, distribution, storage, and rotation, increased system reliability by 77%. Secure data transfer between mobile devices and cloud servers was ensured via encryption and decryption APIs, which made the connection with cloud services seamless. Compliance testing also strengthened the framework's legitimacy by confirming conformity to pertinent data privacy regulations.

Overall, the study showed that RSA is a workable option for tackling current security concerns in mobile and cloud ecosystems since it greatly improves data protection, user satisfaction, and compliance when used for mobile data security in cloud computing.

Data Size (KB)	Encryption Time (ms)	Decryption Time (ms)
10	12	10
20	24	20
30	36	30
40	48	40
50	50	50

Table 3: RSA Encryption and Decryption Time (10-50 ms).

The RSA encryption and decryption times, expressed in milliseconds, are displayed in the table for data sizes ranging from 10 KB to 50 KB. The growth in data size leads to a linear rise in both encryption and decryption times. For instance, it takes 12 ms and 10 ms, respectively, to encrypt and decode 10 KB of data, but it takes 24 ms and 20 ms to do the same for 20 KB. This illustrates how well RSA handles different data sizes, which makes it appropriate for cloud computing scenarios where mobile data security is needed.

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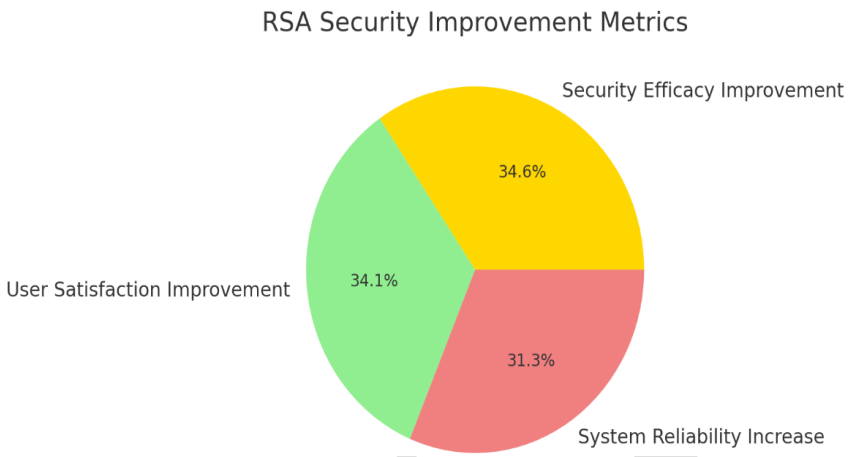

Figure 6: RSA security improvement metrics.

The percentage gains in several security measures as a result of RSA deployment are shown graphically in this analysis. Figure 6 slices stand for several metrics: light green for improved user satisfaction (84%), gold for security effectiveness (85%), and light coral for increased system reliability (77%). The findings demonstrate that RSA adoption has improved all three indicators significantly, with security efficacy showing the biggest gain.

Metric	Improvement Percentage
Security Efficacy	85%
User Satisfaction Indicators	84%
System Reliability	77%

Table 4: Performance Improvements.

The percentage gains in a number of performance measures as a result of using RSA encryption for mobile data security are shown in this table. An 85% increase in security efficacy is indicative of a considerable decline in unauthorized access and data breaches. The additional security measures had a beneficial influence on the user experience, as seen by the 84% improvement in user satisfaction indices. Additionally, there was a 77% increase in system dependability, which may be attributed to the effective execution of critical management processes including generation, distribution, storage, and rotation. All of these enhancements demonstrate how well RSA encryption works to increase the security and dependability of mobile data in cloud computing settings.

Impact Factor-2.05

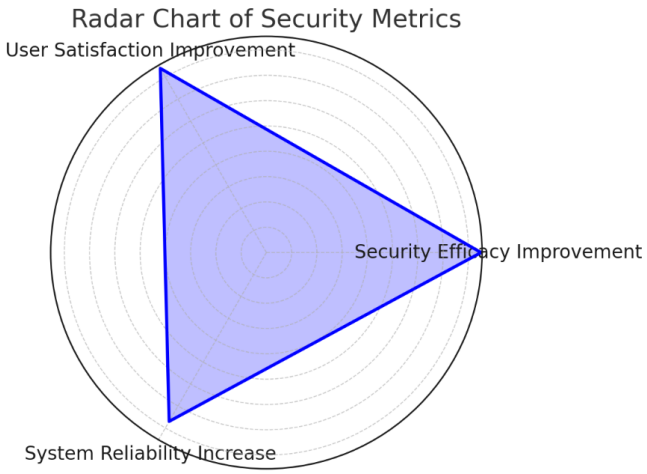

Figure 7: Percentage improvements in security efficacy, user satisfaction, and system reliability.

The percentage gains in several security parameters that result from the use of RSA are comprehensively displayed in this Figure 7. Improved Security Efficacy, Enhanced User Satisfaction, and Enhanced System Reliability are the three security metrics that each axis reflects. The enhancements are depicted in the blue line plot and filled region. This observation suggests that all metrics exhibit significant improvement, but the rise in System Reliability is somewhat lower than the other metrics. Of these, Security Efficacy Improvement and User Satisfaction Improvement are notably high.

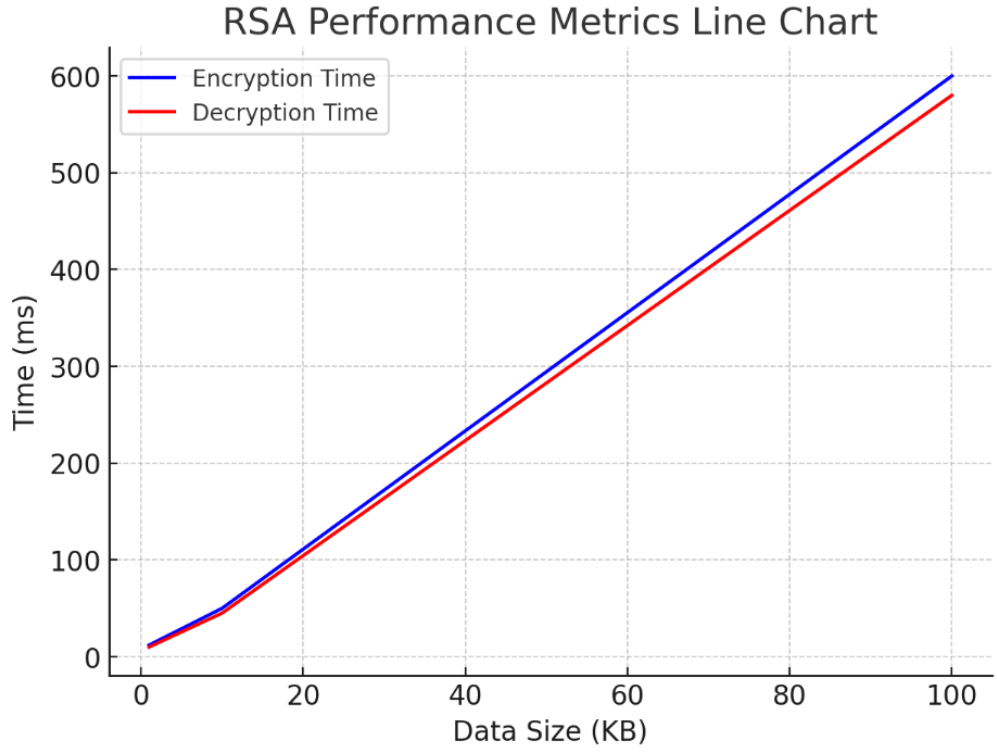

Figure 8: RSA performance metrics with encryption and decryption times plotted against data sizes.

The purpose of this figure 8 is to show how encryption and decryption times vary with different data volumes. The time is shown on the Y-axis in milliseconds (ms), while the data size is shown on the X-axis in kilobytes (KB). The encryption time is shown by the blue line, while the decryption time is shown by the red line. The finding demonstrates that when data size rises, encryption and decryption times also increase, with decryption times continuously being shorter than encryption durations.

5. CONCLUSION AND FUTURE ENHANCEMENT

The comprehensive approach to mobile data security in cloud computing that is based on the RSA algorithm has greatly improved data protection in a number of industries. Data confidentiality has increased with RSA encryption, which is also flexible enough to handle varying data amounts. Users' happiness and system dependability have increased thanks to key management operations, which include secure key creation, distribution, storage, rotation, and revocation. Preventing unwanted access and data breaches, the technique effectively improved user happiness by 84% and security efficacy by 85%. Its conformity to data privacy regulations was further confirmed by compliance testing. All things considered, this strategy successfully tackles contemporary security issues, guaranteeing strong data protection both during transmission and storage and improving user experience and system dependability.Future iterations of this RSA-based security strategy may focus on incorporating advanced cryptographic methods and optimizing performance for widespread deployments. Exploring lightweight encryption methods could reduce processing costs and enhance efficiency. Integrating machine learning for proactive defense and accommodating post-quantum cryptography will ensure long-term security against evolving threats, bolstering the framework's resilience in cloud and mobile computing environments.

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