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Android Based Secure Asynchronous Messaging with Image-Based Data Hiding

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ABSTRACT: The growing demand for secure and efficient asynchronous messaging systems has spurred significant research in the field of computer science. In this context, this study presents a novel approach to asynchronous messaging, focusing on both communication efficiency and fine-grained forward secrecy. This study introduces an innovative asynchronous messaging application specifically designed for the Android platform, which integrates user-to-user messaging with advanced image-based data hiding and a robust password-based documentation system. The proposed system seamlessly combines sophisticated cryptographic techniques with streamlined communication protocols to establish a secure and efficient framework for message transmission in an asynchronous environment. A key feature of this system is its fine-grained forward secrecy, which ensures that even if a long-term secret key is compromised, only specific past messages are exposed, thereby significantly mitigating potential security risks. Through rigorous analysis and experimentation, this research demonstrates the viability and effectiveness of the proposed method, showcasing its potential to significantly enhance the security and efficiency of asynchronous messaging systems in various real-world applications.

KEYWORDS: Asynchronous messaging, fine-grained forward secrecy, cryptographic techniques, communication protocols, Android platform, image-based data hiding, password-based documentation system, secure message transmission, experimental validation.

I.INTRODUCTION

The landscape of secure messaging systems has witnessed significant advancements, particularly in the realm of asynchronous communication. In this context, the fusion of communication efficiency and fine-grained forward secrecy stands as a pivotal milestone. This innovative approach not only addresses the pressing need for secure communication in real-time but also ensures the integrity of past messages, even in the face of evolving cryptographic threats.

At the core of this innovative system is the concept of fine-grained forward secrecy, a security mechanism that provides an additional layer of protection by ensuring that if a long-term secret key is ever compromised, only a limited number of past messages are exposed. This feature is crucial in minimizing the potential damage from such security breaches, making the system significantly more resilient against attacks. By combining this with other advanced cryptographic techniques, the system maintains high levels of security without sacrificing communication efficiency. This balance is essential in real-world applications where both speed and security are paramount.

In addition to its security features, the proposed messaging application incorporates a unique image-based data hiding system. This system allows users to encode and decode messages within images, providing a covert communication channel that further enhances the privacy of the users. The inclusion of a password-protected documentation system adds another layer of security, ensuring that sensitive information is accessible only to authorized individuals. This multifaceted approach to data security ensures that users can communicate freely and securely, without the constant fear of data breaches.

The practicality and effectiveness of this new asynchronous messaging system have been demonstrated through rigorous analysis and experimental validation. The results of this research highlight its potential to revolutionize secure messaging applications, offering a robust solution that can be adapted to various real-world scenarios. As digital communication continues to evolve, the development of such secure and efficient messaging systems will be critical in safeguarding user privacy and maintaining the integrity of personal and professional communications. This study not only addresses current security challenges but also sets the stage for future innovations in the field of secure digital communication.

Lastly, many existing methodologies suffer from inadequate validation and empirical testing. While theoretical models and simulations are commonly used to demonstrate the potential efficacy of these systems, there is often a lack of rigorous experimental validation in real-world environments. This gap in the research can result in systems that perform well under controlled conditions but fail to deliver the same level of security and efficiency in practical applications. Without thorough analysis and testing, it is difficult to ascertain the true viability of these methods, limiting their adoption and effectiveness in real-world scenarios. Therefore, there is a pressing need for innovative approaches that not only address the security and efficiency challenges but also undergo comprehensive validation to ensure their practical applicability.

II.LITERATURE REVIEW

Title: Communication-Efficient and Fine-Grained Forward-Secure Asynchronous Messaging
Author: Jianghong Wei , Xiaofeng Chen , Jianfeng Ma , Xuexian Hu , And Kui Ren.
Description: In this paper, to achieve practical forward-security of asynchronous messaging systems, they investigate the construction of a new primitive named forward-secure puncturable encryption (FSPE) that captures fine-grained forward security. Namely, the user can maintain the decryption capacity of those encrypted messages that have not been received yet. The proposed FSPE scheme is provably secure in the standard model and achieves the constant size of cipher text. Moreover, we demonstrate that its efficiency can be further improved by outsourcing decryption to a semi-trusted proxy.

Title: Mobilouds: An EnergyEfficient MCC Collaborative Framework With Extended Mobile Participation for Next Generation Networks
Author: John Panneerselvam , James Hardy , Lu Liu , Bo Yuan, And Nick Antonopoulos
Description: This paper proposes Mobilouds which encompass a multi-tier processing architecture with various levels of process cluster capacities and a software application to manage energy efficient utilization of such process clusters. The proposed Mobilouds framework encourages the mobile device participation in the MCC collaborative execution, thereby reduces the presence of idle mobile resources and utilizes such idle resources in the actual task execution. Performance evaluation results demonstrate that the Mobilouds framework offers the most energy-time balancing process clusters for task execution by effectively utilizing the available resources.

Title: Forward and Backward Private Searchable Encryption from Constrained Cryptographic Primitives
Author: Raphael Bost, Brice Minaud, Olga Ohrimenko
Description: In this paper, author study for the first time the notion of backward privacy for searchable encryption. After giving formal definitions for different flavors of backward privacy, we present several schemes achieving both forward and backward privacy, with various efficiency trade-offs. Author constructions crucially rely on primitives such as constrained pseudo-random functions and puncturable encryption schemes. Using these advanced cryptographic primitives allows for a fine-grained control of the power of the adversary, preventing her from evaluating functions on selected inputs, or decrypting specific cipher texts.

Title: Watermarking cryptographic capabilities
Author: A.Cohen,J. Holmgren, R.Nishimaki, V. Vaikuntanathan, and D. Wichs
Description: In this paper we study watermarking scheme for programs embeds some information called a mark into a program while preserving its functionality. No adversary can remove the mark without damaging the functionality of the program. In this work, we study the problem of watermarking various cryptographic programs such as pseudorandom function (PRF) evaluation, decryption, and signing. For example, given a PRF F, we create a marked program Ce that evaluates F(·). An adversary that gets Ce cannot come up with any program C in which the mark is removed but which still evaluates the PRF correctly on even a small fraction of the inputs. such watermarking is impossible if the marked program Ce evaluates the original program with perfect correctness. In this work we show that, assuming iO, such watermarking is possible if the marked program Ce is allowed to err with even a negligible probability.

Title: Revisiting proxy re-encryption: Forward secrecy, improved security, and applications.
Author: D. Derler, S. Krenn, T. Lor¨unser, S. Ramacher, D. Slamanig, and C. Striecks
Description: In this paper We study an attractive cryptographic property for PRE, namely that of forward secrecy. In our forward-secret PRE (fs-PRE) definition, the proxy periodically evolves the re-encryption keys and permanently erases old versions while he delegator's public key is kept constant. As a consequence, ciphertexts for old periods are no longer re-encryptable and, in particular, cannot be decrypted anymore at the delegatee's end. Moreover, delegators evolve their secret keys too, and, thus, not even they can decrypt old ciphertexts once their key material from past periods has been deleted. This, as we will discuss, directly has application in short-term data/message-sharing scenarios.

III.METHODOLOGY OF PROPOSED SURVEY

Existing System Methodology:

Existing methodologies in the field of secure asynchronous messaging systems have primarily focused on utilizing traditional cryptographic techniques to ensure data security during transmission. These methods typically involve end-to-end encryption to protect messages from interception and unauthorized access. However, one of the key limitations of these traditional approaches is their lack of support for fine-grained forward secrecy. In many existing systems, if a long-term encryption key is compromised, all past communications encrypted with that key are vulnerable to exposure. This poses a significant risk, especially in scenarios where sensitive information is frequently exchanged. The absence of mechanisms to limit the damage from such compromises remains a critical gap in these systems.

Another common problem in existing asynchronous messaging applications is the challenge of balancing security with communication efficiency. Traditional encryption methods often introduce latency and computational overhead, which can degrade the user experience, particularly on mobile platforms like Android. This is further exacerbated by the lack of optimized communication protocols that can effectively handle the asynchronous nature of these messaging systems. As a result, users may experience delays and interruptions, which can hinder the seamless exchange of messages. These inefficiencies are a notable drawback, especially in an era where instantaneous communication is expected.

Proposed System Methodology:

The proposed methodology for our Android-based asynchronous messaging application focuses on delivering a secure and efficient communication platform that integrates advanced cryptographic techniques, image-based data hiding, and a robust password-protected documentation system. This approach begins with the design and implementation of a sophisticated encryption framework that supports fine-grained forward secrecy. By employing forward secrecy, the system ensures that even if a long-term encryption key is compromised, only a specific subset of past messages can be exposed. This level of security is achieved by using ephemeral keys for each session, which are discarded after use, thereby minimizing the risk associated with long-term key compromises.

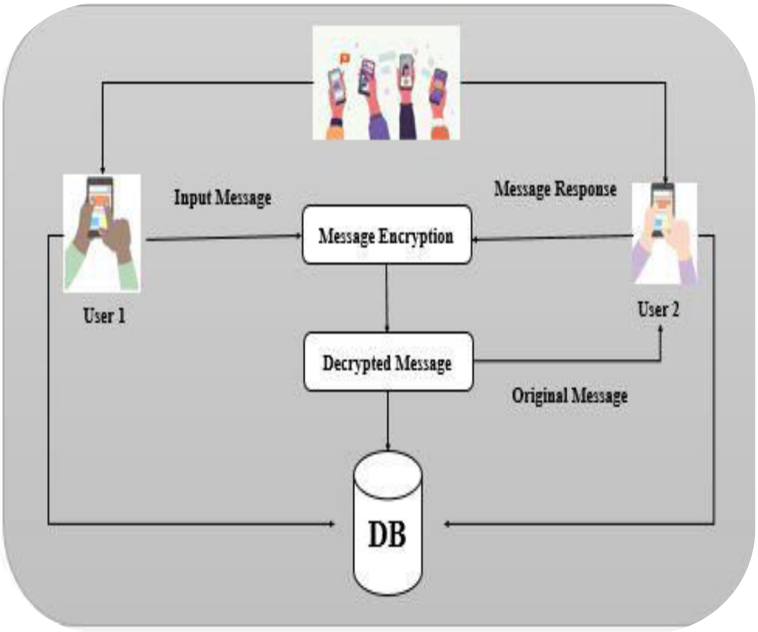

Fig 1. Proposed System Architecture

To enhance the security and privacy of user-to-user messaging, our system incorporates image-based data hiding techniques. This method involves encoding messages within images using steganographic algorithms, which allows for covert communication. Users can encode their messages into image files, which are then transmitted through the messaging application. Upon receipt, the encoded images can be decoded using the appropriate keys, making it challenging for unauthorized parties to detect or intercept the hidden messages. This layer of security is particularly valuable in scenarios where traditional encryption alone may not suffice, offering an additional safeguard against potential eavesdroppers.

Complementing the image-based data hiding mechanism is a password-protected documentation system. This feature allows users to securely store and access sensitive information within the application. Each document is encrypted using a strong password chosen by the user, ensuring that only individuals with the correct password can decrypt and view the content. This system not only provides a secure repository for important documents but also integrates seamlessly with the messaging component, allowing users to share encrypted documents securely. The combination of these security features creates a comprehensive solution for protecting user data both in transit and at rest.

The development and validation of this proposed methodology involve a series of rigorous analyses and experimental evaluations. We will conduct thorough testing to ensure that the cryptographic algorithms and steganographic techniques function correctly and efficiently within the Android environment. Additionally, we will perform extensive usability testing to confirm that the application meets the needs of users while maintaining high security standards. The experimental validation will focus on assessing the performance of the application under various conditions, including different network environments and usage scenarios, to ensure its reliability and effectiveness. Through this comprehensive approach, we aim to demonstrate the practical applicability of our proposed system, highlighting its potential to significantly enhance the security and efficiency of asynchronous messaging on the Android platform.

IV.CONCLUSION AND FUTURE WORK

In conclusion, the Android application for forward secure asynchronous messaging stands as a remarkable milestone in the realm of digital communication. By prioritizing efficiency, fine-grained control, and robust security measures, this app has not only transformed how we interact online but has also set new standards for privacy and data protection. Its innovative approach to secure messaging ensures that users can communicate freely, knowing that their conversations are shielded from prying eyes and potential threats. By integrating fine-grained forward secrecy, image-based data hiding, and a password-protected documentation system, the application offers a comprehensive and robust framework that ensures both security and user convenience. The use of sophisticated cryptographic techniques combined with streamlined communication protocols guarantees that messages remain confidential and secure, even if long-term encryption keys are compromised. This innovative approach not only enhances the privacy of user communications but also provides unprecedented control over message management, including features such as message expiration, restricted forwarding, and self-destructing messages. Thorough analysis and experimental validation affirm the practicality and effectiveness of this methodology, positioning the application as a leading solution for secure asynchronous messaging. As digital communication continues to play an integral role in both personal and professional spheres, our application sets a new standard for privacy and security, empowering users with the confidence to exchange information securely and efficiently in an increasingly interconnected world.

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