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DeyPoS: Using Revocable Storage Identity-Based Encryption

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Abstract*: Dynamic Proof of Storage (PoS) is a useful cryptographic primitive that enables a user to check the integrity of outsourced files and to efficiently update the files in a cloud server. A practical multi-user cloud storage system needs the secure client-side cross-user deduplication technique, which allows a user to skip the uploading process and obtain the ownership of the files immediately, when other owners of the same files have uploaded them to the cloud server. Cloud computing provides a flexible and convenient way for data sharing, which brings various benefits for both the society and individuals. But there exists a natural resistance for users to directly outsource the shared data to the cloud server since the data often contain valuable information. It is necessary to place cryptographically enhanced access control on the shared data. Identity-based encryption is a promising cryptographical primitive to build a practical data sharing system. Revocable-storage identity-based encryption (RS-IBE), which can provide the forward/backward security of cipher-text by introducing the functionalities of user revocation and cipher-text update simultaneously. Furthermore, we present a concrete construction of RS-IBE, and prove its security in the defined security model. The performance comparisons indicate that the proposed RS-IBE scheme has advantages in terms of functionality and efficiency, and thus is feasible for a practical and cost-effective data-sharing system.
Keywords: Cloud storage, dynamic proof of storage, deduplication, data sharing, revocation, Identity-based encryption, ciphertext update, decryption key exposure.

I. INTRODUCTION

Data integrity is one of the most important properties when a user outsources its files to cloud storage. Users should be convinced that the files stored in the server are not tampered. Traditional techniques for protecting data integrity, such as message authentication codes (MACs) and digital signatures, require users to download all the files from the cloud server for verification, which incurs a heavy communication cost. These techniques are not suitable for cloud storage services where users may check the integrity frequently, such as every hour. Thus, researchers introduced *Proof of Storage* (PoS) for checking the integrity without downloading files from the cloud server. Furthermore, users may also require several dynamic operations, such as modification, insertion, and deletion, to update their files, while maintaining the capability of PoS. Dynamic PoS is proposed for such dynamic operations. In contrast with PoS, dynamic PoS employs authenticated structures, such as the Merkle tree. Thus, when dynamic operations are executed, users regenerate tags (which are used for integrity checking, such as MACs and signatures) for the updated blocks only, instead of regenerating for all blocks. To better understand the following contents, they present more details about PoS and dynamic PoS.

While outsourcing data to cloud server, users also want to control access to these data such that only those currently authorized users can share the outsourced data. A natural solution to conquer the afore mentioned problem is to use cryptographically enforced access control such as identity-based encryption (IBE). Furthermore, to overcome the above security threats, such kind of identity-based access control placed on the shared data should meet the following security goals:

A. Data Confidentiality

Unauthorized users should be prevented from accessing the plaintext of the shared data stored in the cloud server. In addition, the cloud server, which is supposed to be honest but curious, should also be deterred from knowing plaintext of the shared data.

B. Backward Secrecy

Backward secrecy means that, when a user's authorization is expired, or a user's secret key is compromised, he/she should be prevented from accessing the plaintext of the subsequently shared data that are still encrypted under his/her identity.

C. Forward Secrecy

Forward secrecy means that, when a user's authority is expired, or a user's secret key is compromised, he/she should be prevented from accessing the plaintext of the shared data that can be previously accessed by him/her.

II. RELATED WORK

The objective of this literature review is to study the work carried and published by different researchers and authors in the domain of Document Annotation and tagging. Kun He, Jing Chen, Ruiying Du, Qianhong Wu, Guoliang Xue, and Xiang Zhang proposed in "DeyPoS: Deduplicatable Dynamic Proof of Storage for Multi-User Environments" the comprehensive requirements in multi-user cloud storage systems and introduced the model of deduplicatable dynamic PoS. They designed a novel tool called HAT which is an efficient authenticated structure. Based on HAT, proposed the first practical deduplicatable dynamic PoS scheme called DeyPoS and proved its security in the random oracle model.The theoretical and experimental results show that our DeyPoS implementationis efficient, especially when the file size and the number of the challenged blocks are large.[1]

Jianghong Wei, Wenfen Liu, Xuexian Hu proposed in paper "Secure Data Sharing in Cloud Computing Using Revocable-Storage Identity-Based Encryption" proves cloud computing brings great convenience for people. Particularly, it perfectly matches the increased need of sharing data over the Internet. In this paper, to build a cost-effective and secure data sharing system in cloud computing, they proposed a notion called RS-IBE, which supports identity revocation and ciphertext update simultaneously such that a revoked user is prevented from accessing previously shared data, as well as subsequently shared data. Furthermore, a concrete construction of RS-IBE is presented. [2]

Pietro and Sorniotti proposed in paper "Boosting Efficiency and Security in Proof of Ownership for Deduplication" proves another proof of ownership scheme which improves the efficiency. Xu et al.[4] proposed a client-side deduplication scheme for encrypted data, but the scheme employs a deterministic proof algorithm which indicates that every file has a deterministic short proof. Thus, anyone who obtains this proof can pass the verification without possessing the file locally. Other deduplication schemes for encrypted data were proposed for enhancing the security and efficiency. Note that, all existing techniques for cross-user deduplication on the client-side were designed for static files. Once the files are updated, the cloud server must regenerate the complete authenticated structures for these files, which causes heavy computation cost on the server-side. [3]

The concept of proof of storage was introduced by Ateniese et al. in paper "Provable data possession at untrusted stores", and Juels and Kaliski, respectively. The main idea of PoS is to randomly choose a few data blocks as the challenge. Then, the cloud server returns the challenged data blocks and their tags as the response. Since the data blocks and the tags can be combined via homomorphic functions, the communication costs are reduced. The subsequent works extended the research of PoS, but those works did not take dynamic operations into account. Erway et al. and later works focused on the dynamic data. Among them, the scheme in is the most efficient solution in practice. However, the scheme is stateful, which requires users to maintain some state information of their own files locally. Hence, it is not appropriate for a multiuser environment. Halevi et al. introduced the concept of proof of ownership which is a solution of cross-user deduplication on the client-side. It requires that the user can generate the Merkle tree without the help from the cloud server, which is a big challenge in dynamic PoS. [5]

Zheng and Xu proposed in paper "Secure and efficient proof of storage with deduplication" proves a solution called proof of storage with deduplication, which is the first attempt to design a PoS scheme with deduplication. Du et al. Introduced proofs of ownership and retrievability, which are like but more efficient in terms of computation cost. Note that neither can support dynamic operations. Due to the problem of structure diversity and private tag generation, cannot be extended to dynamic PoS. Wang et al. and Yuan and Yu considered proof of storage for multi-user updates, but those schemes focus on the problem of sharing files in a group. Deduplication in these scenarios is to deduplicate files among different groups. Unfortunately, these schemes cannot support deduplication due to structure diversity and private tag generation. In this paper, they consider a more general situation that every user has its own files separately. [6]

Jingwei Li, Jin Li, Dongqing Xie, and Zhang Cai "Secure Auditing and Deduplicating Data in cloud" proves both data integrity and deduplication in cloud, they propose SecCloud and SecCloud+. SecCloud introduces an auditing entity with maintenance of a MapReduce cloud, which helps clients generate data tags before uploading as well as audit the integrity of data having been stored in cloud. In addition, SecCloud enables secure deduplication through introducing a PoS protocol and preventing the leakage of side channel information in data deduplication. Compared with previous work, the computation by user in SecCloud is greatly reduced during the file uploading and auditing phases. SecCloud+ is an advanced construction motivated by the fact that customers always want to encrypt their data before uploading, and allows for integrity auditing and secure deduplication directly on encrypted data. Compared with previous work, the computation by user in SecCloud is greatly reduced during the file uploading and auditing phases.

SecCloud+ is designed motivated by the fact that customers always want to encrypt their data before uploading, and enables integrity auditing and secure deduplication on encrypted data. [7]

III. CONCLUSIONS

This survey is mainly focused on techniques and algorithm to suggest need of sharing data and avoid deduplication using cloud storage over the Internet. Using the concept of system and algorithm, it builds a cost-effective DeyPos for Multi-User Environments and secure data sharing system in cloud computing using RS-IBE, which supports identity revocation and cipher-text update simultaneously such that a revoked user is prevented from accessing previously shared data, as well as subsequently shared data and it will help in preventing deduplication of shared information over cloud, which provides more feasible for practical applications.

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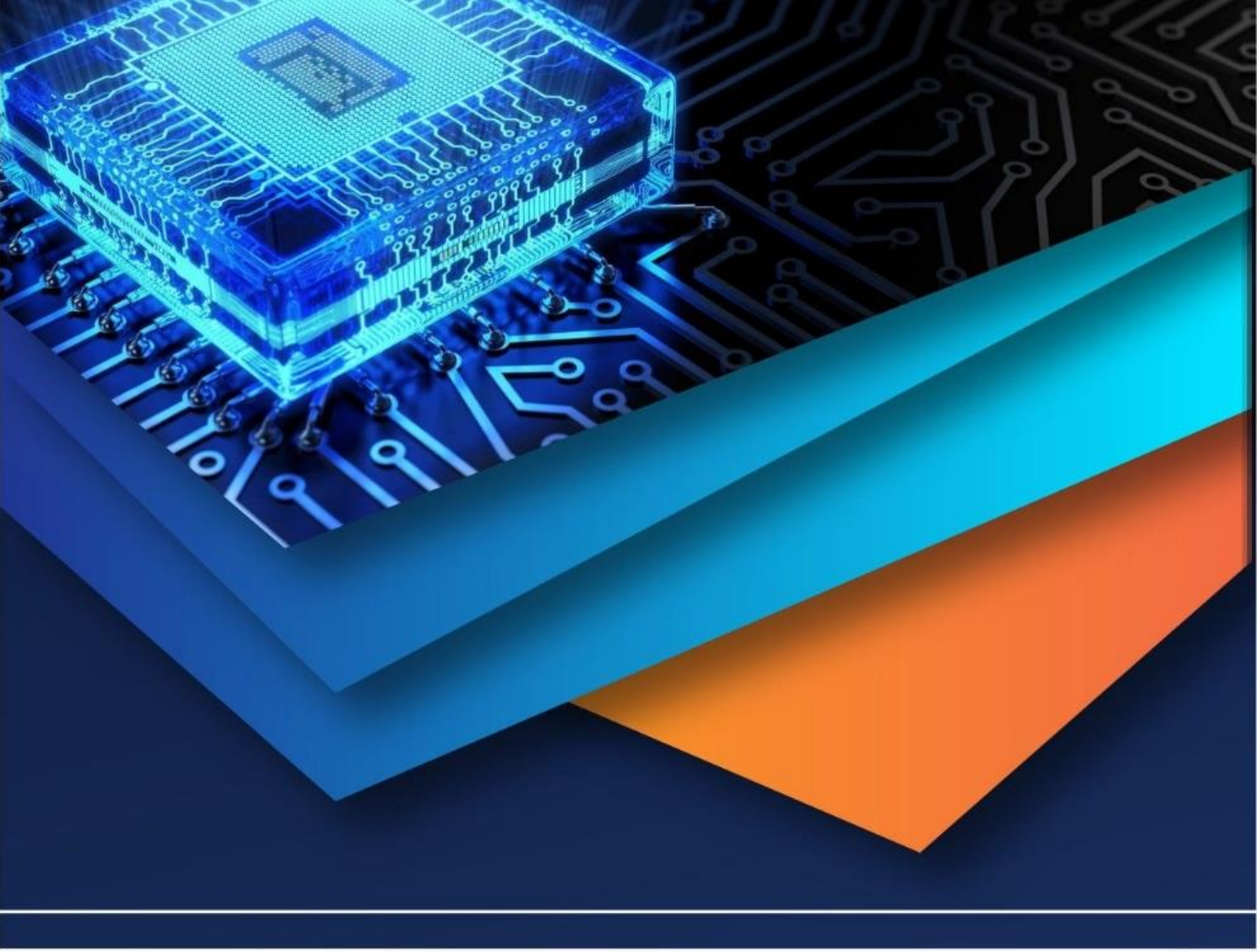

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