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Secure Data Sharing for Dynamic Groups in the Cloud

Pottappa Kasanna[1], G. K.V. Narasimha Reddy [2]

[1]PG Scholar,Dept of CSE, St. Johns College of Engineering & Technology, Kurnool, Andhra Pradesh

[2]Associate Professor,Dept of CSE, St. Johns College of Engineering & Technology, Kurnool, Andhra Pradesh

In this paper we propose the Secure Data Sharing for Dynamic Groups in the Cloud. Cloud computing provides an economical and efficient solution for sharing group resource among cloud users. Unfortunately, sharing data in a multi-owner manner while preserving data and identity privacy from an un trusted cloud is still a challenging issue, due to the frequent change of the membership. In this paper, we propose a secure Data sharing scheme, for dynamic groups in the cloud. By leveraging group signature and dynamic broadcast encryption techniques, any cloud user can anonymously share data with others. Meanwhile, the storage overhead and encryption computation cost of our scheme are independent with the number of revoked users. In addition, we analyze the security of our scheme with rigorous proofs, and demonstrate the efficiency of our scheme in experiments.

Keywords—Cloud computing, data sharing, privacy-preserving, access control, dynamic groups

1. INTRODUCTION

CLOUD computing is recognized as an alternative to traditional information technology [1] due to its intrinsic resource-sharing and low-maintenance characteristics. In cloud computing, the cloud service providers (CSPs), such as Amazon, are able to deliver various services to cloud users with the help of powerful data canters. By migrating the local data management systems into cloud servers, users can enjoy high-quality services and save significant investments on their local infrastructures. The cloud servers managed by cloud providers are not fully trusted by users while the data files stored in the cloud may be sensitive and confidential, such as business plans. To preserve data privacy, a basic solution is to encrypt data files, and then upload the encrypted data into the cloud [2]. First, identity privacy is one of the most significant obstacles for the wide deployment of cloud computing.

Without the guarantee of identity privacy, users may be unwilling to join in cloud computing systems because their real identities could be easily disclosed to cloud providers and attackers. Second, it is highly recommended that any member in a group should be able to fully enjoy the data storing and sharing services provided by the cloud, which is defined as

The multiple-owner manner. Compared with the single-owner manner [3], where only the group manager can store and modify data in the cloud, the multiple-owner manner is more

Flexible in practical applications. Last but not least, groups are normally dynamic in practice, e.g., new staff participation and current employee revocation in a company. The changes of membership make secure data sharing extremely difficult. The main contributions of this paper include:

1. We propose a secure multi-owner data sharing scheme. It implies that any user in the group can securely share data with others by the untrusted cloud.
2. Our proposed scheme is able to support dynamic groups efficiently. Specifically, new granted users can directly decrypt data files uploaded before their participation without contacting with data owners. User revocation can be easily achieved through a novel revocation list without updating the secret keys of the remaining users. The size and computation overhead of encryption are constant and independent with the number of revoked users.
3. We provide secure and privacy-preserving access control to users, which guarantees any member in a group to anonymously utilize the cloud resource. Moreover, the real identities of data owners can be revealed by the group manager when disputes occur.
4. We provide rigorous security analysis, and perform extensive simulations to demonstrate the efficiency of our scheme in terms of storage and computational overhead

2. RELATED WORKS

In [4], Kallahalla et al. proposed a cryptographic storage system that enables secure file sharing on untrusted servers, named Plutus. By dividing files into file groups and encrypting
each file group with a unique file-block key, the data owner can share the file groups with others through delivering the corresponding lockbox key, where the lockbox key is used to encrypt the file-block keys. However, it brings about a heavy key distribution overhead for large-scale file sharing. Additionally, the file-block key needs to be updated and distributed again for a user revocation.

1. The encryption complexity and size of cipher texts are independent with the number of revoked users in the system.
2. User revocation can be achieved without updating the private keys of the remaining users.
3. A new user can directly decrypt the files stored in the cloud before his participation.

3. SYSTEM MODEL AND DESIGN GOALS

We consider a cloud computing architecture by combining with an example that a company uses a cloud to enable its staffs in the same group or department to share files. The system model consists of three different entities: the cloud, a group manager (i.e., the company manager), and a large number of group members (i.e., the staffs)

Cloud is operated by CSPs and provides priced abundant storage services. However, the cloud is not fully trusted by users since the CSPs are very likely to be outside of the cloud users' trusted domain. Similar to [3], [7], we assume that the cloud server is honest but curious. That is, the cloud server will not maliciously delete or modify user data due to the protection of data auditing schemes [8], [9], but will try to learn the content of the stored data and the identities of cloud users.
Group manager takes charge of system parameters generation, user registration, user revocation, and revealing the real identity of a dispute data owner. In the given example, the group manager is acted by the administrator of the company. Therefore, we assume that the

Group manager is fully trusted by the other parties. Group members are a set of registered users that will store their private data into the cloud server and share them with others in the group. In our example, the staffs play the role of group members. Note that, the group membership is dynamically changed, due to the staff resignation and new employee participation in the company

3.1 Design Goals

We describe the main design goals of the proposed scheme including access control, data confidentiality, anonymity and traceability, and efficiency as follows:

Access control: The requirement of access control is twofold. First, group members are able to use the cloud resource for data operations. Second, unauthorized users cannot access the cloud resource at any time, and revoked users will be incapable of using the cloud again once they are revoked.

Data confidentiality: Data confidentiality requires that unauthorized users including the cloud are incapable of learning the content of the stored data. An important and challenging issue for data confidentiality is to maintain its availability for dynamic groups. Specifically, new users should decrypt the data stored in the cloud before their participation, and revoked users are unable to decrypt the data moved into the cloud after the revocation.

Anonymity and traceability: Anonymity guarantees that group members can access the cloud without revealing the real identity. Although anonymity represents an effective protection for user identity, it also poses a potential inside attack risk to the system. For example, an inside attacker may store and share a mendacious information to derive substantial benefit. Thus, to tackle the inside attack, the group manager should have the ability to reveal the real identities of data owners.

Efficiency: The efficiency is defined as follows: Any group member can store and share data files with others in the group by the cloud. User revocation can be achieved without involving the remaining users. That is, the remaining users do not need to update their private keys or re encryption operations. New granted users can learn all the content data files stored before his participation without contacting with the data owner.

4. Conclusion and Future Enhancement

In this paper, we design a secure data sharing scheme, for dynamic groups in an untrusted cloud. In dynamic sharing, a user is able to share data with others in the group without revealing identity privacy to the cloud. Additionally, dynamic storing supports efficient user revocation and new user joining. More specially, efficient user revocation can be achieved through a public revocation list without updating the private keys of the remaining users, and new users can directly decrypt files stored in the cloud before their Participation. Moreover, the storage overhead and the encryption computation cost are constant. Extensive analyses show that our proposed scheme satisfies the desired security requirements and guarantees efficiency as well.

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Author Profile

POTTAPPA KASANNA, he is pursuing M.Tech post graduate of Computer Science From St. Johns College of Engineering & Technology, Kurnool, In Department of Computer Science Engineering, JNTU Anantapur.

G. K.V. NARASIMHA REDDY. He is working as Associate Professor, Department of Computer Science Engineering, St. Johns College of Engineering & Technology, Kurnool, A.P. India.