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An Effective Secure Authorized Deduplication in Hybrid Cloud

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***Abstract* —A challenging task in cloud is To minimize the quantity of space for storing and save bandwidth. That may be extremely done by using adopting some of the primary information compression methods for removing reproduction copies of repeating knowledge known as information de-duplication, and has been broadly utilized in cloud storage to. To guard the confidentiality of touchy data at the same time aiding de-duplication, the convergent encryption technique has been proposed to encrypt the info earlier than outsourcing. To better protect information safety, this paper makes the primary attempt to formally deal with the trouble of authorized information de-duplication. Different from typical de-duplication methods, the differential privileges of users are additional regarded in duplicate check apart from the info itself. We additionally gift a few new de-duplication constructions helping authorized duplicate investigate in a hybrid cloud structure. Protection analysis demonstrates that our scheme is at ease in phrases of the definitions unique within the proposed safety mannequin. As a proof of idea, we put into effect a prototype of our proposed authorized replica check scheme and conduct experiment-bed experiments utilizing our prototype. We exhibit that our proposed licensed replica investigate scheme incurs minimal overhead in comparison with average operations.**

***Keywords* — Deduplication, authorized duplicate check, confidentiality, hybrid cloud**

I. INTRODUCTION

Cloud computing provides apparently indefinite "virtualized" resources to users as services across the whole Internet, while hiding platform and implementation details. Today's cloud service providers offer both highly available storage and massively parallel computing resources at relatively low costs. As cloud computing becomes prevalent, an increasing amount of data is being stored in the cloud and shared by users with specified privileges, which define the access rights of the stored data. One critical challenge of cloud storage services is the management of the ever-increasing volume of data.

To make data management scalable in cloud computing, de-duplication [1] has been a well-known procedure and has attracted more and more awareness recently. Knowledge de-duplication is a specialized information compression system for casting off replica copies of repeating information in storage. The method is used to fortify storage utilization and can be applied to network information transfers to lower the number of bytes that must be dispatched. Rather of keeping a couple of knowledge copies with the identical content material, de-duplication eliminates redundant knowledge by retaining just one physical replica and referring different redundant data to that copy. De duplication can take location at either the file level or the block degree. For file degree de-duplication, it eliminates reproduction copies of the identical file. De duplication can also take situation on the block degree, which eliminates duplicate blocks of knowledge that arise in non-identical files.

Although data de-duplication brings a lot of benefits, security and privacy concerns arise as users' Touchy data are susceptible to each insider and outsider assaults. Traditional encryption, while providing data confidentiality, is incompatible with data de-duplication. Specifically, traditional encryption requires different users to encrypt their data with their own keys. Thus, identical data copies of different users will lead to different ciphertexts, making de-duplication impossible. Convergent encryption [2] has been proposed to put into effect data confidentiality at the same time making de-duplication feasible. It encrypts/decrypts an information reproduction with a convergent key, which is received by way of computing the cryptographic hash price of the content material of the information reproduction. After key generation and information encryption, customers preserve the keys and ship the cipher text to the cloud. Because the encryption operation is deterministic and is derived from the info content material, identical information copies will generate the identical convergent key and therefore the equal cipher text.

To preclude unauthorized entry, a comfortable proof of possession protocol [3] can be needed to furnish the proof that the consumer indeed owns the same file when a reproduction is observed. After the proof, subsequent users with the same file shall be provided a pointer from the server while not having to upload the identical file. A person can download the encrypted file with the pointer from the server, which can only be decrypted by way of the corresponding information house owners with their convergent keys. As a result, convergent encryption allows for the cloud to participate in de-duplication on the cipher texts and the proof of possession prevents the unauthorized person to entry the file.

Nonetheless, prior de-duplication methods can not support differential authorization duplicate determine, which is important in lots of purposes. In such a licensed de-duplication process, each and every user is issued a set of privileges throughout approach initialization (in part 3, we intricate the definition of a privilege with examples). Each file uploaded to the cloud is also bounded by way of a collection of privileges to specify which kind of customers is allowed to perform the duplicate assess and access the records. Before submitting his duplicate check request for some file, the user needs to take this file and his own privileges as inputs. The user is able to find a duplicate for this file if and only if there is a copy of this file and a matched privilege stored in cloud. For example, in a company, many different privileges will be assigned to employees. In order to save cost and efficiently management, the data will be moved to the storage server provider (SCSP) in the public cloud with specified privileges and the de-duplication technique will be applied to store only one copy of the same file. Because of privacy consideration, some files will be encrypted and allowed the duplicate check by employees with specified privileges to realize the access control. Traditional de-duplication systems based on convergent encryption, although providing confidentiality to some extent, do not support the duplicate check with differential privileges. In other words, no differential privileges have been considered in the de-duplication based on convergent encryption technique. It seems to be contradicted if we want to realize both de-duplication and differential authorization duplicate check at the same time.

Contributions

In this paper, aiming at efficiently solving the problem of de-duplication with differential privileges in cloud computing, we consider a hybrid cloud architecture consisting of a public cloud and a private cloud. Unlike existing data de-duplication systems, the private cloud is involved as a proxy to allow data owner/users to securely perform duplicate check with differential privileges. Such architecture is practical and has attracted much attention from researchers. The data owners only outsource their data storage by utilizing public cloud while the data operation is managed in private cloud. A new Deduplication system supporting differential duplicate check is proposed under this hybrid cloud architecture where the S-CSP resides in the public cloud. The user is only allowed to perform the duplicate check for files marked with the corresponding privileges.

II. System Model

Hybrid Architecture for Secure Deduplication

At a high level, our setting of interest is an enterprise network, consisting of a group of affiliated clients (for example, employees of a company) who will use the S-CSP and store data with de-duplication technique. In this setting, de-duplication can be frequently used in these settings for data backup and disaster recovery applications while greatly reducing storage space. Such systems are widespread and are often more suitable to user file backup and synchronization applications than richer storage abstractions. There are three entities defined in our system, that is, users, private cloud and S-CSP in public cloud as shown in Fig 1. The S-CSP performs de-duplication by checking if the contents of two files are the same and stores only one of them.

Figure 1 Architecture of Authorized Deduplication

The access right to a file is defined based on a set of privileges. The exact definition of a privilege varies across applications. For example, we may define a role-based privilege [9], [19] according to job positions (e.g., Director, Project Lead, and Engineer), or we may define a time-based privilege that specifies a valid time period (e.g., 2014-01-01 to 2014-01-31) within which a file can

be accessed. A user, say Alice, may be assigned two privileges "Director" and "access right valid on 2014-01-01", so that she can access any file whose access role is "Director" and accessible time period covers 2014-01-01. Each privilege is represented in the form of a short message called token. Each file is associated with some file tokens, which denote the tag with specified privileges (see the definition of a tag in Section 2). A user computes and sends duplicate-check tokens to the public cloud for authorized duplicate check.

Users have access to the private cloud server, a semitrusted third party which will aid in performing de-duplicable encryption by generating file tokens for the requesting users. We will explain further the role of the private cloud server below. Users are also provisioned with per-user encryption keys and credentials (e.g., user certificates). In this paper, we will only consider the file-level de-duplication for simplicity. In another word, we refer a data copy to be a whole file and file-level Deduplication which eliminates the storage of any redundant files. Actually, block-level de-duplication can be easily deduced from file-level de-duplication, which is similar
to [4]. Specifically, to upload a file, a user first performs the file-level duplicate check. If the file is a duplicate, then all its blocks must be duplicates as well; otherwise, the user further performs the block-level duplicate check and identifies the unique blocks to be uploaded. Each data copy (i.e., a file or a block) is associated with a token for the duplicate check.

- S-CSP. This is an entity that provides a data storage service in public cloud. The S-CSP provides the data outsourcing service and stores data on behalf of the users. To reduce the storage cost, the S-CSP eliminates the storage of redundant data via Deduplication and keeps only unique data. In this paper, we assume that S-CSP is always online and has abundant storage capacity and computation power.

- Data Users. A user is an entity that wants to outsource data storage to the S-CSP and access the data later. In a storage system supporting de-duplication, the user only uploads unique data but does not upload any duplicate data to save the upload bandwidth, which may be owned by the same user or different users. In the Approved De duplication process, every user is issued a set of privileges in the setup of the system. Each file is protected with the convergent encryption key and privilege keys to realize the authorized de-duplication with differential privileges.

- Private Cloud. Compared with the traditional Deduplication architecture in cloud computing, this is a new entity introduced for facilitating user's secure usage of cloud service. Specifically, since the computing resources at data user/owner side are restricted and the public cloud is not fully trusted in practice, private cloud is able to provide data user/owner with an execution environment and infrastructure working as an interface between user and the public cloud. The private keys for the privileges are managed by the private cloud, who answers the file token requests from the users. The interface offered by the private cloud allows user to submit files and queries to be securely stored and computed respectively.

Notice that this is a novel architecture for data Deduplication in cloud computing, which consists of a twin clouds (i.e., the public cloud and the private cloud). Actually, this hybrid cloud setting has attracted more and more attention recently. For example, an enterprise might use a public cloud service, such as Amazon S3, for archived data, but continue to maintain in-house storage for operational customer data. Alternatively, the trusted private cloud could be a cluster of virtualized cryptographic co-processors, which are offered as a service by a third party and provide the necessary hardware based security features to implement a remote execution environment trusted by the users.

Adversary Model

Typically, we assume that the public cloud and private cloud are both "honest-but-curious". Specifically they will follow our proposed protocol, but try to find out as much secret information as possible based on their possessions. Users would try to access data either within or out of the scopes of their privileges. In this paper, we suppose that all the files are sensitive and needed to be fully protected against both public cloud and private cloud. Under the assumption, two kinds of adversaries are considered, that is, 1) external adversaries which aim to extract secret information as much as possible from both public cloud and private cloud; 2) internal adversaries who aim to obtain more information on the file from the public cloud and duplicate-check token information from the private cloud outside of their scopes. Such adversaries may include S-CSP, private cloud server and authorized users.

Design Goals

In this paper, we address the problem of privacy preserving de-duplication in cloud computing and propose a new de-duplication system supporting for

- Differential Authorization. Each authorized user is able to get his/her individual token of his file to perform duplicate check based on his privileges. Under this assumption, any user cannot generate a token for duplicate check out of his privileges or without the aid from the private cloud server.

- Authorized Duplicate Check. Authorized user is able to use his/her individual private keys to generate query for certain file and the privileges he/she owned with the help of private cloud, while the public cloud performs duplicate check directly and tells the user if there is any duplicate.

III. Proposed System Description

To solve the problems of the construction. We propose another advanced de-duplication system supporting authorized duplicate check. In this new Deduplication system, a hybrid cloud architecture is introduced to solve the problem. The private keys for privileges will not be issued to users directly, which will be kept and managed by the private cloud server instead. In this way, the users cannot share these private keys of privileges in this proposed construction, which means that it can prevent the privilege key sharing among users in the above straightforward construction. To get a file token, the user needs to send a request to the private cloud server. The intuition of this construction can be described as follows. To perform the duplicate check for some file, the user needs to get the file token from the private cloud server. The private cloud server will also check the user's identity before issuing the corresponding file token to the user. The authorized duplicate check for this file can be performed by the user with the public cloud before uploading this file. Based on the results of duplicate check, the user either uploads this file or runs PoW.

Before giving our construction of the Deduplication system, we define a binary relation R = f((p, p′)g as follows. Given two privileges p and p′, we say that p matches p′ if and only if R(p, p′) = 1. This kind of a generic binary relation definition could be instantiated based on the background of applications, such as the common hierarchical relation. More precisely, in a hierarchical relation, p matches p′ if p is a higher-level privilege. For example, in an enterprise management system, three hierarchical privilege levels are defined as Director, Project lead, and Engineer, where Director is at the top level and Engineer is at the bottom level. Obviously, in this simple example, the privilege of Director matches the privileges of Project lead and Engineer.

IV. Related Work

Secure Deduplication. With the advent of cloud computing, secure data de-duplication has attracted much attention recently from research community. Yuan et al. [5] proposed a de-duplication system in the cloud storage to reduce the storage size of the tags for integrity check. To enhance the security of de-duplication and protect the data confidentiality,
Bellare et al. [6] showed how to protect the data confidentiality by transforming the predictable message into un-predictable message. In their system, another third party called key server is introduced to generate the file tag for duplicate check. Stanek et al. [7] presented a novel encryption scheme that provides differential security for popular data and unpopular data. For popular data that are not particularly sensitive, the traditional conventional encryption is performed. Another two-layered encryption scheme with stronger security while supporting de-duplication is proposed for unpopular data. In this way, they achieved better tradeoff between the efficiency and security of the outsourced data. Li et al. [8] addressed the key management issue in block-level de-duplication by distributing these keys across multiple servers after encrypting the files.

Convergent Encryption. Convergent encryption [8] ensures data privacy in de-duplication. Bellare et al. [9] formalized this primitive as message-locked encryption, and explored its application in space-efficient secure outsourced storage. Xu et al. [3] also addressed the problem and showed a secure convergent encryption for efficient encryption, without considering issues of the key-management and block-level de-duplication. There are also several implementations of convergent implementations of different convergent encryption variants for secure de-duplication (e.g., [2], [10], [11]). It is known that some commercial cloud storage providers, such as Bitcasa, also deploy convergent encryption.

V. Conclusion

In this paper, the notion of authorized data Deduplication was proposed to protect the data security by including differential privileges of users in the duplicate check. We also presented a number of new De duplication constructions aiding authorized reproduction determine in hybrid cloud architecture, in which the duplicate-check tokens of files are generated by the private cloud server with private keys. Security analysis demonstrates that our schemes are secure in terms of insider and outsider attacks Specific in the proposed safety mannequin. As a proof of suggestion, we carried out a

prototype of our proposed licensed duplicate assess scheme and habits scan-bed experiments on our prototype. We confirmed that our licensed replica determine scheme incurs minimal overhead compared to convergent encryption and network switch.

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