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Preserving Data Integrity in Cloud Storage

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ABSTRACT: Cloud computing has been envisioned as the de-facto solution to the rising storage costs of IT Enterprises. With the high costs of data storage devices as well as the rapid rate at which data is being generated it proves costly for enterprises or individual users to frequently update their hardware. Apart from reduction in storage costs data outsourcing to the cloud also helps in reducing the maintenance. Cloud storage moves the user's data to large data centers, which are remotely located, on which user does not have any control. However, this unique feature of the cloud poses many new security challenges which need to be clearly understood and resolved. One of the important concerns that need to be addressed is to assure the customer of the integrity i.e. correctness of the data in the cloud. This project provides a scheme which gives a proof of data integrity in the cloud which the customer can employ to check the correctness of the data in the cloud. This proof can be agreed upon by both the cloud and the customer and can be incorporated in the service level agreement. The project first identify the difficulties and potential security problems of direct extensions with fully dynamic data updates from prior works and then show how to construct an elegant verification scheme for the seamless integration of these two salient features in the protocol design. To support efficient handling of multiple auditing tasks, and further explore the technique of bilinear aggregate signature to extend that main result into a multi-user setting, where TPA can perform multiple auditing tasks simultaneously. Extensive security and performance analysis show that the proposed schemes are highly efficient and provably secure.

KEYWORDS: Data storage, privacy preserving, public auditability, cloud computing.

I. INTRODUCTION

Cloud computing has been envisioned as the next-generation information technology (IT) architecture for enterprises, due to its long list of unprecedented advantages in the IT history: on-demand self-service, ubiquitous network access, location independent resource pooling, rapid resource elasticity, usage-based pricing and transference of risk. As a disruptive technology with profound implications, cloud computing is transforming the very nature of how businesses use information technology. One fundamental aspect of this paradigm shifting is that data are being centralized or outsourced to the cloud. From users' perspective, including both individuals and IT enterprises, storing data remotely to the cloud in a flexible on-demand manner brings appealing benefits: relief of the burden for storage management, universal data access with location independence, and avoidance of capital expenditure on hardware, software, and personnel maintenances, etc.,

While cloud computing makes these advantages more appealing than ever, it also brings new and challenging security threats toward users' outsourced data. Since cloud service providers (CSP) are separate administrative entities, data outsourcing is actually relinquishing user's ultimate control over the fate of their data. As a result, the correctness of the data in the cloud is being put at risk due to the following reasons. First of all, although the infrastructures under the cloud are much more powerful and reliable than personal computing devices, they are still facing the broad range of both internal and external threats for data integrity. Examples of outages and security breaches of noteworthy cloud services appear from time to time. Second, there do exist various motivations for CSP to behave unfaithfully toward the cloud users regarding their outsourced data status. For examples, CSP might reclaim storage for monetary reasons by discarding data that have not been or are rarely accessed, or even hide data loss incidents to maintain a reputation. In short, although outsourcing data to the cloud is economically attractive for long-term large-scale storage, it does not immediately offer any guarantee on data integrity and availability. This problem, if not properly addressed, may impede the success of cloud architecture.

To fully ensure the data integrity and save the cloud users' computation resources as well as online burden, it is of critical importance to enable public auditing service for cloud data storage, so that users may resort to an independent third-party auditor (TPA) to audit the outsourced data when needed. The TPA, who has expertise and capabilities that users do not, can periodically check the integrity of all the data stored in the cloud on behalf of the users, which provides a much more easier and affordable way for the users to ensure their storage correctness in the cloud. Moreover, in addition to help users to evaluate the risk of their subscribed cloud data services, the audit result from TPA would also be beneficial for the cloud service providers to improve their cloud-based service platform, and even serve for independent arbitration purposes. In a word, enabling public auditing services will play an important role for this nascent cloud economy to become fully established; where users will need ways to assess risk and gain trust in the cloud.

The task of allowing a third party auditor (TPA), on behalf of the cloud client, to verify the integrity of the dynamic data stored in the cloud. With the establishment of privacy-preserving public auditing, the TPA may concurrently handle multiple auditing upon different users' delegation. The individual auditing of these tasks for the TPA can be tedious and very inefficient. Given K auditing delegations on K distinct data files from K different users, it is more advantageous for the TPA to batch these multiple tasks together and audit at one time. Keeping this natural demand in mind, this project slightly modify the protocol in a single user case, and achieve the aggregation of K verification equations (for K auditing tasks) into a single one.

II. PROBLEM STATEMENT

We consider a cloud data storage service involving three different entities, as illustrated in Fig. 1: the cloud user, who has large amount of data files to be stored in the cloud; the cloud server, which is managed by the cloud service provider to provide data storage service and has significant storage space and computation resources (we will not differentiate CS and CSP hereafter); the third-party auditor, who has expertise and capabilities that cloud users do not have and is trusted to assess the cloud storage service reliability on behalf of the user upon request. Users rely on the CS for cloud data storage and maintenance. They may also dynamically interact with the CS to access and update their stored data for various application purposes. As users no longer possess their data locally, it is of critical importance for users to ensure that their data are being correctly stored and maintained. To save the computation resource as well as the online burden potentially brought by the periodic storage correctness verification, cloud users may resort to TPA for ensuring the storage integrity of their outsourced data, while hoping to keep their data private from TPA.

We assume the data integrity threats toward users' data can come from both internal and external attacks at CS. These may include: software bugs, hardware failures, bugs in the network path, economically motivated hackers, malicious or accidental management errors, etc. Besides, CS can be self-interested. For their own benefits, such as to maintain reputation, CS might even decide to hide these data corruption incidents to users. Using third-party auditing service provides a cost-effective method for users to gain trust in cloud. We assume the TPA, who is in the business of auditing, is reliable and independent. However,it may harm the user if the TPA could learn the outsourced data after the audit.

Note that in our model, beyond users' reluctance to leak data to TPA, we also assume that cloud servers has no incentives to reveal their hosted data to external parties. On the one hand, there are regulations, e.g., HIPAA , requesting CS to maintain users' data privacy. On the other hand, as users' data belong to their business asset, there also exist financial incentives for CS to protect it from any external parties. Therefore, we assume that neither CS nor TPA has motivations to collude with each other during the auditing process. In other words, neither entities will deviate from the prescribed protocol execution in the following presentation.

To authorize the CS to respond to the audit delegated to TPA's, the user can issue a certificate on TPA's public key, and all audits from the TPA are authenticated against such a certificate. These authentication handshakes are omitted in the following presentation.

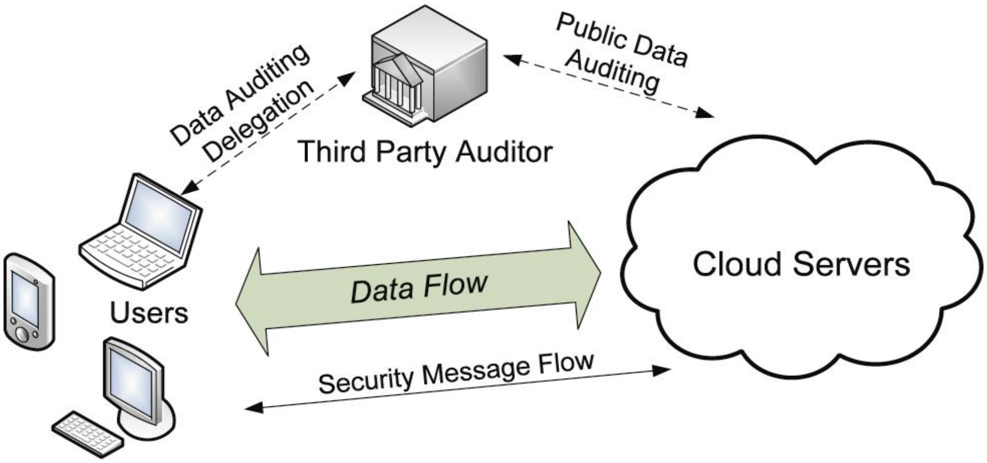


Fig. 1 The architecture of cloud data storage service.

III. THE EXISTING METHOD

It ensures the integrity of data stored in the cloud computing. The introduction of TPA eliminates the involvement of the client through the auditing of whether the users data stored in the cloud is indeed intact, which can be important in achieving economies of scale for Cloud Computing. The problem of providing simultaneous public auditability and data dynamics for remote data integrity check in cloud storage.

To ensure cloud data storage security, it is critical to enable a TPA to evaluate the service quality from an objective and independent perspective. Public audit ability also allows clients to delegate the integrity verification tasks to TPA while they themselves can be unreliable or not be able to commit necessary computation resources performing continuous verifications. Another major concern is on construction of verification protocols that can accommodate dynamic data files.

3.1 Drawbacks

1. The management of the data and services may not be fully trustworthy.
2. Concept of cloud computing is new and even if hosting companies say that the data is secured it can't be a 100% truth.
3. The biggest concerns about cloud computing are security and privacy. Users might not be comfortable handling over their data to a third party.

IV. THE PROPOSED SCHEMES

Providing simultaneous public auditability and data dynamics for remote data integrity check in Cloud Computing. The project construction is deliberately designed to meet these two important goals while efficiency being kept closely in mind. To achieve efficient data dynamics, this work improve the existing proof of storage models by manipulating the classic Merkle Hash Tree construction for block tag authentication.

To support efficient handling of multiple auditing tasks, this work further explore the technique of bilinear aggregate signature to extend the main result into a multiuser setting, where TPA can perform multiple auditing tasks simultaneously. Extensive security and performance analysis show that the proposed scheme is highly efficient and provably secure.

1. It motivate the public auditing system of data storage security in Cloud Computing, and propose a protocol supporting for fully dynamic data operations, especially to support block insertion, which is missing in most existing schemes.

2. Extend the scheme to support scalable and efficient public auditing in Cloud Computing. In particular, the scheme achieves batch auditing where multiple delegated auditing tasks from different users can be performed simultaneously by the TPA.
3. It proves the security of the proposed construction and justify the performance of the scheme through concrete implementation and comparisons with the state-of-the-art.

4.1 Cloud Storage

Cloud Storage is a model of networked computer data storage where data is stored on multiple virtual servers, generally hosted by third parties, rather than being hosted on dedicated servers. Hosting companies operate large data centers; and people who require their data to be hosted buy or lease storage capacity from them and use it for their storage needs. The data center operators, in the background, virtualized the resources according to the requirements of the customer and expose them as virtual servers, which the customers can themselves manage. Physically, the resource may span across multiple servers.

4.2 Digital Signature

A digital signature or digital signature scheme is a mathematical scheme for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the message was created by a known sender, and that it was not altered in transit. Digital signatures are commonly used for software distribution, financial transactions, and in other cases where it is important to detect forgery or tampering.

Digital signatures employ a type of asymmetric cryptography. For messages sent through a non secure channel, a properly implemented digital signature gives the receiver reason to believe the message was sent by the claimed sender. Digital signatures are equivalent to traditional handwritten signatures in many respects; properly implemented digital signatures are more difficult to forge than the handwritten type. Digital signature schemes in the sense used here are cryptographically based, and must be implemented properly to be effective. Digital signatures can also provide non-repudiation, meaning that the signer cannot successfully claim they did not sign a message, while also claiming their private key remains secret; further, some non-repudiation schemes offer a time stamp for the digital signature, so that even if the private key is exposed, the signature is valid nonetheless.

4.3 Dynamic Data Integrity

The basic idea of the project applies only to static storage of data. It cannot handle to case when the data need to be dynamically changed. This dynamic data integrity is used to support for data dynamics via the most general forms of data operation, such as block modification, insertion, and deletion, is also a significant step toward practicality. While prior work on ensuring remote data integrity often lacks the support of either public auditability or dynamic data operations. The project first identify the difficulties and potential security problems of direct extensions with fully dynamic data updates from prior works and then show how to construct an elegant verification scheme for the seamless integration. to achieve efficient data dynamics, we improve the existing proof of storage models by manipulating the classic Merkle Hash Tree construction for block tag authentication.

4.4 Third Party Auditor

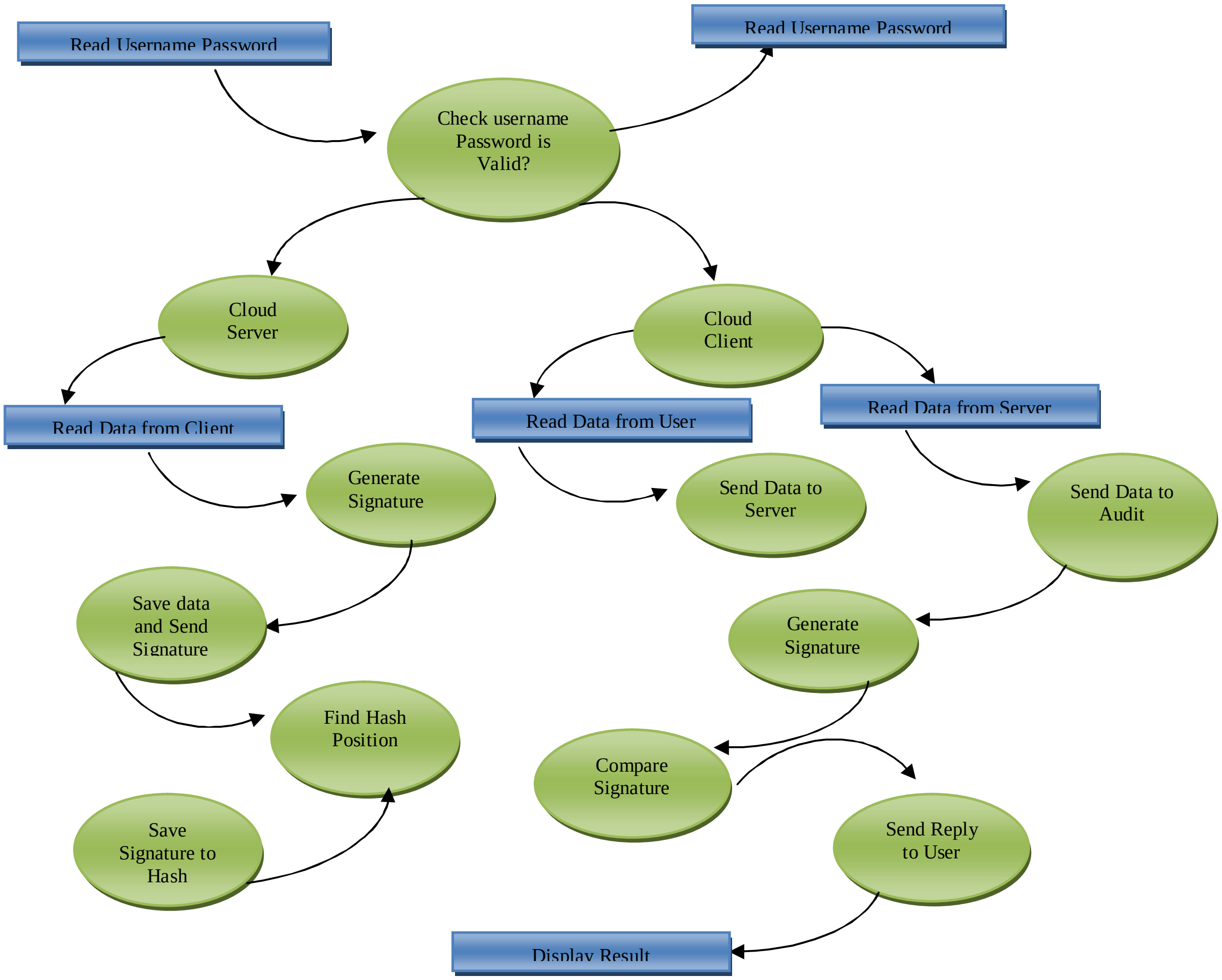
TPA in possession of the public key can act as a verifier. It assume that TPA is unbiased while the server is untrusted. For application purposes, the clients may interact with the cloud servers via CSP to access or retrieve their pre-stored data. More importantly, in practical scenarios, the client may frequently perform block-level operations on the data files. The most general forms of these operations are modification, insertion, and deletion.

Public auditability for storage correctness assurance: To allow anyone, not just the clients who originally stored the file on cloud servers, to have the capability to verify the correctness of the stored data on demand.

Dynamic data operation support: To allow the clients to perform block-level operations on the data files while maintaining the same level of data correctness assurance. The design should be as efficient as possible so as to ensure the seamless integration of public auditability and dynamic data operation support.

Blockless verification: No challenged file blocks should be retrieved by the verifier (e.g., TPA) during verification process for efficiency concern.

V. DATA FLOW DIAGRAM



VI. CONCLUSION

In this project, privacy-preserving public auditing system is proposed for data storage security in cloud computing. It utilizes the homomorphism linear authenticator and random masking to guarantee that the TPA would not learn any knowledge about the data content stored on the cloud server during the efficient auditing process, which not only eliminates the burden of cloud user from the tedious and possibly expensive auditing task, but also alleviates the users' fear of their outsourced data leakage.

Extensive analysis shows that this schemes are provably secure and highly efficient. The preliminary experiment conducted on Amazon EC2 instance further demonstrates the fast performance of the design on both the cloud and the auditor side. It leaves the full-fledged implementation of the mechanism on commercial public cloud as an important future extension, which is expected to robustly cope with very large scale data and thus encourage users to adopt cloud storage services more confidently.

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