Detecting Malicious Third-Party Auditor and Privacy Preserving Protocol for Public Cloud

B.Rajani, V. Purna Chandra Rao

Abstract: ***Cloud computing is an anticipated and an inevitable solution for large storage capacities, the virtual presence of ownership and universal accessibility which extends the boundaries of a user today. These benefits also open up a challenge for being too exposed for welcoming attackers to steal potential information from those cloud environments. Irrespective of types of data, information stored on these cloud environments vary from databases to the coding of software and raw and processed information of various organizations, including governments. To ensure confidentiality and integrity of data input from various users, cloud service providers employ third-party auditors to verify the safety measures are intact and maintained. As the name predicts, an auditor may not possess a responsibility to protect the data after their intended verification is over. Third-Party Auditors have the function of confirming that the saved data has the same integrity as of original data, does not seek any information shortly to disturb the integrity and finally do not introduce any loopholes for new attacking attempts from external sources. This proposal intends to derive a mechanism to limit the resources provided to third party auditors in the architecture. The location of data and users protected in this approach along with locking of data segments to enhance the security of the architecture. The simulation results compare the technique and prove that this method outperforms the previous techniques when addressing the sturdiness, communication complexity, and time consumption concerns.***

Keywords: ***public auditing, privacy-preserving, third party auditor (TPA),***

I. INTRODUCTION

Enhancing the technological services in storage and computation, many resources are now available to the common man for cheaper and faster rates. These services are preferred more than ever before, and technologies are advancing the second we speak. Limitations of handheld devices with minimal storage capacity, processing speed, and computation complexity answered in cloud computing. The concept of master and slave computing has evolved to a great new extent, which never imagined. New features [2] are added to existing cloud computing technologies every day by various cloud service providers (CSP). These resourced technologies have opened a universal access theory with endless benefits. The space offered by public or private data centers is virtually segmented, assigned, and dedicated to users. Space is utilized for storage through request and automatic back up from registered devices.

oud computing demands innovations for several automated processes like allocation of memory spaces, extension and reuse of resources, billing and protection plays a significant role in defining a standard for versatility [3][4].

Internet service is the background and fundamental component of cloud computing. This establishes and completes the connection between the user and remote data centers for data storage, processing and retrieval [1]. Based on the functionality of these cloud servers, the service categorized into an environment which acts either as Software, Platform, or an Infrastructure. Software as a Service is a component designed for simplicity to both sides of users being end-users or administrators. The next category encourages users to implement carefully designed software into the cloud environment. An Infrastructure defines how the components of the cloud, users, and data are supposed to function in a given virtual space [1].

Despite these advantages, the openness of such a cloud is susceptible as the same leniency applies to attackers present in the same domain. The challenge comes when the data owners have the belief that their data is safe and sound in a very open sphere of influence. Protective measures are defined and imposed in spite of growing attacking mechanism, and this proposal intends to give a promising solution for identifying malicious attacks from called third-party auditors. The solutions to these problems should be confined to consume less energy and cost of a cloud service provider. Third-party auditors gained the confidence of data owners and cloud service providers as they charge a lesser cost delivering a trustworthy comment on existing security standards. The rate of increasing users is exponential and thus imposes an additional challenge for a cloud service provider to audit and periodically report to its users.

The challenges in protecting the data in a cloud are categorized based on the following factors. Access to clients with potential information, the partiality of service to different clients, location of data and data owners, uniform service through a standard administration, technical support, retrieval, and overall maintenance are the factors which need to be balanced when security implementations enforced.

II. BACKGROUND STUDY

The Third-Party Auditor is believed to be a common implementer of both cloud service provider and data owners where they test how the mechanism works and if the data are secured. The question is whether the third-party auditor has the intentions to steal potential information as they possess the credibility to access the same. Provided with better benefits than auditing alone, bribed auditors may also lead to loss of information and degrading the integrity of data.

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The following section illustrates how a system is defined to check on such malicious attacks from trusted third party auditors.

This system gives relief to either benefactor of the cloud service and ensures that only trusted auditors are appointed to ensure the protective schemes. Adding to the time and computation complexity of overall processes, this mechanism should utilize minimal resources for defining a strategy for identifying dishonest third-party auditors. A protocol defined for certifying security and conserving the privacy details of data owners when they use cloud storage [7]. The protocol has limited the accessibility of third-party auditors using RSA encryption and preventing the exposure of owners' data but with details required for auditing. This technique enabled users to modify, add, and delete data whenever needed. Participants of this model were the data owners, cloud service provider, and third-party auditors. The data owners compare the services of different cloud service providers and prefer one based on economic norms. The cloud service provider offers the space required and provides mechanisms to protect the data. The data owners decide to use the service as a platform or service, as mentioned in previous sections. A third-party auditor justifies the benefits of one CSP, but the decision depends on how trustworthy they are. The TPA cannot be blindly believed to be reliable and honest as they are no way in connection with either of the other participants. Both the parties cannot confirm that their data is protected when a third-party auditor is involved. This led to the absolute necessity of an algorithm for securing the data, commencing the encryption through RSA.

The data owners generate public and private key for encrypting the data. The public key shared with the CSP for outsourcing for the auditing process to complete. The audit process is initiated from the TPA side and sent to CSP for providing sufficient resources.

The encrypted data is transferred to TPA when this request initiated from Audit.

TPA verifies the encrypted data once the public key received from the data owners through the CSP.

Evaluation of this technique done in two different analyses. One for estimating the time taken for the transfer of encrypted data between the cloud space and third party auditor is communication time. The next is the computation cost, which is consumed by TPA to audit the given data and confirm that information integral.

The next methodology implements the usage of a modern ciphertext [8] for encrypting the data before it sent to TPA. This scheme does not require a copy of the data, which removes redundancy cost and concentrates more on storage of integrated data. Five steps included in the procedure, namely data owners, CSP, TPA, and algorithms for encryption and sharing. A function KeyGen is used by TPA and data owners to generate private and public keys like other encryption schemes. After verifying the data in cloud space, TPA generates metadata about verification done on data in cloud space using the function SigGen. CSP then generates the proof that the data stored is at the right place and time by the function GenProof, which is later used by TPA to verify and authenticate that data is integral by the function VerifyProof.

The public key generated for sharing between the data owners, cloud service providers, and third-party owners once the owned data is shared whereas the private key is used to protect data which not revealed to third party auditors. The cloud service provider establishes a communication medium between TPA and data owners to share the keys and data for verifying the correctness. The data requested by TPA verified, and a Proof generated. This proof forwarded back to data owners through CSP. The verified proof should match with the key generated by the data owners. This confirms that the data is not disturbed by any factors internally and externally [8]. Performance evaluated in terms of communication cost, computation cost, including storage/retrieval cost. This study aims to impose a stronger encryption standard with a lesser computational cost. Requests and responses are made shorter to reduce the communication cost.

The foundation of this privacy preservation commenced with homomorphic linear authenticator scheme [3]. Original content is marked by an arbitrary masking technique which prevents the need of a local copy when third-party auditors do the verification process. The operations are dependent on the exchange of keys without the need of preparing a local copy for verification processes. Privacy preserved with the same set of algorithms used in previously mentioned schemes [10].

The next scheme introduced the scheme of auditing the data in terms of batches without exposing all the available data. This is modified in our previous paper to lock specific modules based on the importance of data. The data owners themselves define the importance. The method implements a bilinear map for encryption process [5]. The background study explains the standard terms used for encryption and transferring of data to and from — Keygen used for producing two sets of keys for public and private usage. The public key transferred to third-party auditors who are authorized by CSPs. Cloud service providers generate a signature before outsourcing the data files for auditing. After auditing process, a proof for integral data and outsourced files compared for ensuring that the verification process is complete [12]. A challenge-based authentication process is also provided in the literature survey [6]. The schemes' complexity is constant even with the different approaches are implemented and investigated [13].

III. PROPOSED ALGORITHM

The technique used in this proposal is dependent on the algorithm and its phases. Key exchange regulated between the cloud service providers, data owners, and third-party auditors.

The algorithm I: Authentication of Keys

The cloud service provider is asked to prepare a list of random numbers along with legitimate secret keys. Data owners are asked to segregate the data based on the importance and save the credential information into the locked modules [1]. The testing process initiated once these keys and random numbers shared with the data owners. Using these secret keys, data is encrypted. Now the request for auditing is initiated from the TPA side. Unless the keys exist in both lists obtained from CSP and TPA, malicious activity is detected. The data owners prevent the transfer of encrypted data to TPAs who exist without the right keys.

Initialization**:** *(kk:known key; sk: Secret key; TPAT: Third Party Auditor Test; TPATR: Third Party Auditor Test Result; CSPR: Cloud Service Provider Result; DO: Data Owner; pn: prime number, rn: random number, and V: validation) Input: Dc*

Input*: (kk; sk;TPAT; rn; p) /* Other than Locked modules*

Output: *(TPATR ; CSPR; V)*

```
Select rn within range 1 < rn < p
Compute Srn  /* Set of random numbers
DO initiates TPAT
Declare TPAT = Srn
DO computes CSPR = Srn.K
SPres to CC: Srn.K
DO computes TPAT = (kk)rn
DO checks if TPAT = Srn.K = CSPR then
DO confirms successful V
else if CC determines the malicious activity of TPA
End if
End else if
```

Algorithm II: Trust Helmet

The trust helmet is a common party which maintains the common keys to shared within all the participants. The trust helmet issue security checks over the keys and participants, making sure that keys confined within the group. When the keys are shared with the TPA by the CSP, TOA also checks for the presence of those keys in Trust Helmet. If the keys are verified to be present, then the process continues. Similarly, the same process also confirmed with Data owners. At any given time, the keys should be commonly present in all participants,

Initialization*: (Srk : Set of Random keys to be shared; Sk: Hk: Hidden key; p: prime number; rk: Random key; TPA: Third-Party Auditor; and TH: Trust Helmet)*

Input: *(Srk; CSP; Sk; TH)*

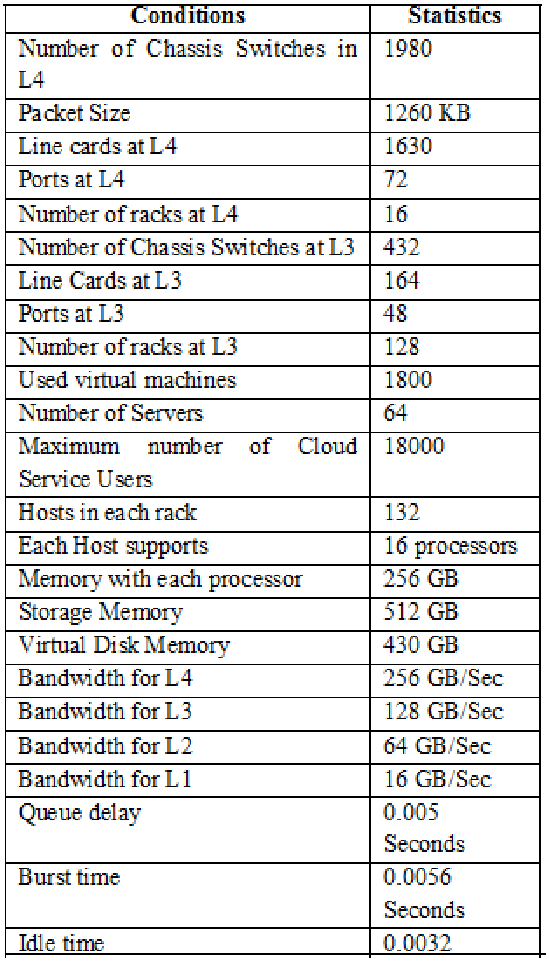
Output: *(TPA; HK)*

```
DO & CSP use rk
Set 1<rk<p && TPA knows Srk && Srk belongs to T
CSP to TPA: HK = Sk + rk mod p
TPA examines SHK if Srk Ssk= Ssk+rk mod p then
Set SHK = Srk+rk
Else if Srk rk not equal to Srk+rk then
Set CSP to SHK
End if
End else-if
TPA to CS belongs to HK
CC computes HK - rk = Srk mod p if DO = HK then
Set TPA = DO
End if
```

The CSP assign a trusted key to the Data owners for encryption following which the auditors request for verifying the integrity. Now if the auditors ensure that data owners possess the same set of keys as given by the cloud service providers or else, the presence of manipulated entries is present either in the auditing or cloud service providers. The following section implements these concepts into a model and examines the possible outcomes. Previous strategies are also compared to provide a detailed report on the advantages of this proposed system.

IV. RESULTS AND DISCUSSIONS

Green Cloud simulator utilized for investigating the performance of privacy-preserving third party auditing using locality parameters. This is an open-source simulation tool which can implement with C++ and results demonstrate the computational cost and energy consumption. Simulated results obtained as the scenarios portray the real-time occurrences. The conditions that initialized portrayed in the next table.



Conditions	Statistics
Number of Chassis Switches in L4	1980
Packet Size	1260 KB
Line cards at L4	1630
Ports at L4	72
Number of racks at L4	16
Number of Chassis Switches at L3	432
Line Cards at L3	164
Ports at L3	48
Number of racks at L3	128
Used virtual machines	1800
Number of Servers	64
Maximum number of Cloud Service Users	18000
Hosts in each rack	132
Each Host supports	16 processors
Memory with each processor	256 GB
Storage Memory	512 GB
Virtual Disk Memory	430 GB
Bandwidth for L4	256 GB/Sec
Bandwidth for L3	128 GB/Sec
Bandwidth for L2	64 GB/Sec
Bandwidth for L1	16 GB/Sec
Queue delay	0.005 Seconds
Burst time	0.0056 Seconds
Idle time	0.0032

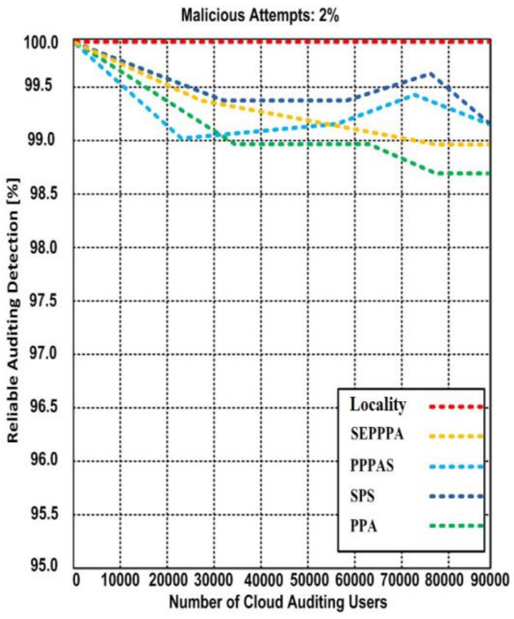


Figure 1: Reliable Auditing Detection

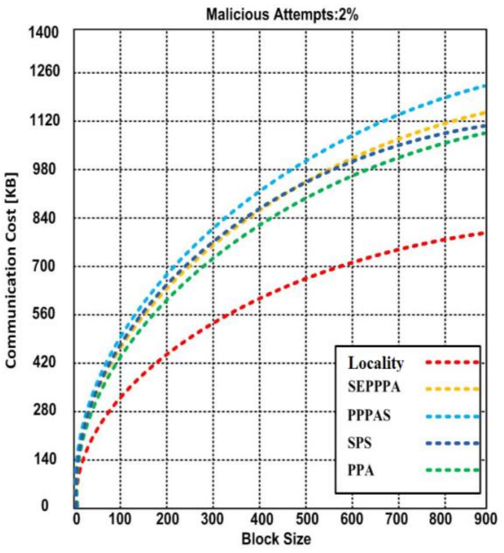


Figure 2: Communication Cost

These investigations tested with dishonesty rates of 0 to 5% of Third-Party Auditors. The proposed algorithms have shown that this method has outperformed the previous strategies, and the results shown in the following graphs for malicious attacks of 2%. The model was tested to express how the trustworthy third party auditors identified in an environment. The next set of results demonstrates the communication cost of this system in spite of a new scheme introduced. The first figure provides sufficient evidence that when the number of cloud users i.e., data owners increase, the durability of the locality-based privacy-preserving scheme remained constant at 100%, where the other models produced results of 99% approximately. This simulates the real-time environment where the actions and users are dynamic. Subsequently, the system tested for the time taken for auditing actions by the third-party auditor. The proposed scheme also demonstrated reduced false positives than the other methods. Communication cost was also estimated with an increasing number of blocks, ranging from 0 to 900. The simulation results show that the proposed model took 830 KB while the previous methods cost around 1100KB. This evidence provides enough justification to prove that this model is outperforming the existing standards.

The approach has been an adept technique to identify the presence of malicious third-party auditors even before the encrypted data shared among the participants in the domain. The Cloud Service Provider, Data Owners, and Third-Party Auditors can rely on this methodology for efficient and secured communication for auditing and privacy-preserving. The proposed method has shown 100% reliability even in the presence of 90000 users at the same time. The rate of false positives addressed, and this approach has been more efficient than existing methods. The third simulation proves that computation cost also turned up lesser for blocks of size 900KB. The processing and communication time considerably reduced after enhancing the security mechanism.

CONCLUSION

Organizations, including governmental operations, are deploying their services through cloud environments. The data owners believe that along with unlimited benefits of accessing a cloud environment, security also is achieved. The system is susceptible in several cases. This proposal introduced a scheme for authenticating the third-party auditor to ensure that data is secured when verification is one. The CSPs, rather than being an economic need to be more secure in this virtual world with no boundaries.

Having these objectives in mind, computational and processing overhead cannot be compromised when security added. This proposal intends to address all these defects in a mechanism to authenticate the third party auditors based on their locations. The method was to signify that auditors are trusted users who participate in verifying the integrity of data stored. Schemes were introduced to regulate the exchange of keys between the typical participants. An external trust helmet was maintained and referred to whenever there is a need to transfer data in an encrypted form. Instead of passing data, the keys were shared and compared before the original data is at stake. Results from simulation have shown promising results at an affordable computation and processing time. In the future, tracing back to the location where the system failed to preserve the privacy of data owners is to be derived with betterments to this scheme.

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