



Efficient Method Of Secure Authorized Data Deduplication At Small Block Level Approach In Cloud Storage

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ABSTRACT—In the context of cloud storage, data deduplication is a pivotal technique aimed at reducing storage space by eliminating redundant data. The research paper titled "Efficient Method of Secure Authorized Data Deduplication at Small Block Level Approach in Cloud Storage" presents a novel methodology that enhances both the efficiency and security of deduplication processes. This approach operates at the small block level, ensuring fine-grained deduplication, which significantly improves storage optimization. To address security concerns, the proposed method integrates robust encryption mechanisms and an authorization framework that guarantees only legitimate users can access and deduplicate data. This dual focus on efficiency and security not only minimizes storage costs but also protects sensitive information from unauthorized access. The experimental results demonstrate the method's effectiveness in achieving substantial storage savings while maintaining high levels of data security and access control, making it a viable solution for secure cloud storage systems.

KEYWORDS: Deduplication, Small Block Level, Cloud storage, robust encryption

I. INTRODUCTION

In the era of big data, cloud storage has become an indispensable resource for individuals and organizations seeking scalable, flexible, and cost-effective data management solutions [1]. However, the exponential growth of data poses significant challenges, particularly in terms of storage efficiency and security. Data deduplication, a process that eliminates redundant copies of data, has emerged as a critical technology to address the storage efficiency problem by ensuring that only unique data chunks are stored [2]. Despite its benefits, traditional deduplication techniques often operate at a coarse granularity and lack robust security measures, leaving them vulnerable to various security threats [3].

This paper introduces an efficient method of secure authorized data deduplication at the small block level, designed specifically for cloud storage environments [5]. By focusing on small block-level deduplication, our approach offers a more granular and precise method of identifying and eliminating duplicate data, thereby optimizing storage usage

more effectively than conventional techniques [6]. Furthermore, the proposed method incorporates advanced encryption and authorization protocols to safeguard data against unauthorized access and ensure that deduplication processes are conducted securely [7].

The integration of these security measures addresses the critical concern of data privacy in cloud storage, ensuring that only authorized users can perform deduplication and access sensitive information [8]. This dual emphasis on efficiency and security not only enhances storage optimization but also provides a robust framework for protecting data integrity and confidentiality [9].

In this paper, we detail the architecture and mechanisms underlying our small block-level deduplication approach, along with the encryption and authorization strategies employed [10]. We also present comprehensive experimental results demonstrating the efficacy of our method in reducing storage requirements while maintaining high levels of security. Through this research, we aim to contribute to the development of more efficient and secure cloud storage solutions, meeting the growing demand for reliable data management in the digital age [11].

A. Objectives of the Paper

The primary objective of this research is to develop and evaluate an efficient and secure method for authorized data deduplication at the small block level in cloud storage environments. This method aims to achieve the following specific goals:

- **Enhance Storage Efficiency:** Implement a small block-level deduplication technique to maximize the identification and elimination of redundant data, thereby optimizing storage space utilization more effectively than traditional, coarser-grained deduplication methods.
- **Ensure Data Security:** Integrate robust encryption mechanisms to protect data both at rest and during the deduplication process, ensuring that sensitive information is safeguarded against unauthorized access and potential security breaches.

- **Enforce Access Control:** Develop an authorization framework that ensures only legitimate and authenticated users can perform deduplication and access deduplicated data, thereby maintaining data integrity and user privacy.
- **Optimize Performance:** Design the deduplication process to minimize computational overhead and latency, ensuring that the method remains efficient and scalable for large-scale cloud storage systems.
- **Evaluate Effectiveness:** Conduct thorough experimental evaluations to demonstrate the proposed method's efficiency in reducing storage requirements and its effectiveness in maintaining high levels of security and access control.

II. LITERATURE SURVEY

The increasing adoption of cloud storage solutions has brought about significant challenges related to storage efficiency and data security. Data deduplication has been recognized as a crucial technology to mitigate storage redundancy by eliminating duplicate copies of data. This section reviews the existing literature on data deduplication methods, focusing on their efficiency, security, and applicability to cloud storage environments.

A. Data Deduplication Techniques

Traditional deduplication methods, such as file-level and chunk-level deduplication, have been extensively studied. File-level deduplication identifies duplicate files, while chunk-level deduplication breaks files into chunks and eliminates redundancy at a finer granularity. However, both approaches have limitations in achieving optimal storage efficiency and security. File-level deduplication often misses redundant data within different files, and chunk-level deduplication, although more effective, can still be improved by adopting even finer granularity.

B. Small Block-Level Deduplication

Research has shown that smaller deduplication units, such as sub-chunk or block-level deduplication, can significantly enhance storage efficiency. For instance, studies by Zhu et al. (2008) and Jin et al. (2017) demonstrate that smaller block sizes lead to higher deduplication ratios, but at the cost of increased computational overhead. The challenge lies in balancing the granularity of deduplication with system performance.

C. Security Concerns in Deduplication

While improving storage efficiency, deduplication poses security risks, such as data leakage and unauthorized access. To address these concerns, Bellare et al. (2013) introduced Message-Locked Encryption (MLE), which combines encryption with deduplication, ensuring data confidentiality while eliminating redundancy. MLE, however, has limitations in handling user authorization and access control.

D. Authorized Deduplication

Authorized deduplication techniques aim to enhance security by ensuring that only authorized users can deduplicate and access data. Liu et al. (2015) proposed an approach that integrates access control mechanisms with deduplication, ensuring that deduplication operations are restricted to authorized users. This method, although effective in

enhancing security, often involves complex key management and can introduce performance bottlenecks.

E. Hybrid Approaches

Recent studies have explored hybrid approaches that combine various deduplication techniques with advanced encryption and authorization frameworks. Xu et al. (2019) presented a hybrid cloud storage solution that utilizes both client-side and server-side deduplication, along with encryption schemes to ensure data security. These approaches highlight the trend towards more comprehensive solutions that address both efficiency and security concerns.

F. Gaps and Challenges

Despite the advancements, several gaps remain in the current literature. Many existing methods either focus on improving deduplication efficiency without adequately addressing security, or they enhance security at the cost of performance. Additionally, there is limited research on the practical implementation and scalability of small block-level deduplication in real-world cloud storage systems.

The literature reveals a significant need for a method that balances efficient deduplication with robust security measures. The proposed research aims to fill this gap by developing a secure authorized data deduplication method at the small block level, leveraging advanced encryption and access control mechanisms. This approach promises to enhance storage efficiency while ensuring data confidentiality and integrity, thereby addressing the critical needs of modern cloud storage environments.

Table 1: Previous year research paper based comparison

Author and Year	Key Contribution and Findings
Zhu et al. (2008)	Explored chunk-level deduplication, showing smaller chunk sizes lead to higher deduplication ratios but increased computational overhead.
Bellare et al. (2013)	Introduced Message-Locked Encryption (MLE) combining encryption with deduplication, improving security but facing efficient key management challenges.
Liu et al. (2015)	Developed authorized deduplication with access control and convergent encryption, enhancing security but adding complexity in key management.
Jin et al. (2017)	Proposed block-level deduplication with hash-based encryption, improving efficiency with smaller blocks but increasing encryption overhead.
Xu et al. (2019)	Presented a hybrid deduplication approach integrating client-side and server-side deduplication with encryption, addressing scalability and security.
Puzio et al. (2013)	Proposed ClouDedup, a secure deduplication method with deterministic encryption, balancing deduplication efficiency and data security.
Li et al. (2014)	Focused on convergent encryption with reliable key management, enhancing secure deduplication in distributed storage systems.
Ng et al. (2015)	Introduced RevDedup, a reverse deduplication system improving recovery performance and efficiency with fine-

	grained data handling and secure indexing.
Yan et al. (2017)	Applied homomorphic encryption for secure small block-level deduplication on encrypted big data, balancing security and computational efficiency.
Dautenhahn et al. (2016)	Developed a privacy-preserving deduplication method using private set intersection, ensuring data confidentiality and integrity while enabling deduplication.

III. SYSTEM ANALYSIS

A. Existing System

Existing systems for data deduplication in cloud storage primarily focus on various levels of granularity and different approaches to security and efficiency. These systems can be broadly categorized into file-level, chunk-level, and block-level deduplication, each with its own set of advantages and limitations.

- **File-Level Deduplication**

File-level deduplication systems identify and eliminate redundant files. This method is straightforward and efficient in scenarios where entire files are duplicated. However, it fails to detect redundancy within files, which limits its effectiveness in reducing storage space.

Example Systems:

IBM ProtecTIER and EMC Data Domain are commercial solutions that use file-level deduplication to manage storage space efficiently by removing duplicate files.

B. Proposed System

The proposed system aims to enhance the efficiency and security of data deduplication in cloud storage by adopting a small block-level approach. This system integrates advanced encryption techniques and an authorization framework to ensure that deduplication processes are both effective and secure. The key components and features of the proposed system are as follows:

- **Small Block-Level Deduplication**

The core of the proposed system is the small block-level deduplication technique, which divides data into smaller blocks compared to traditional chunk-level deduplication. This finer granularity allows for more precise identification and elimination of redundant data, leading to higher storage efficiency.

- **Advantages:**

Higher Deduplication Ratios: By using smaller blocks, the system can detect and remove redundant data with greater accuracy, resulting in more significant storage savings.

Improved Storage Utilization: The finer granularity reduces the amount of duplicate data stored, optimizing the use of storage resources.

- **Secure Encryption Mechanisms**

To address the security concerns associated with deduplication, the proposed system incorporates robust encryption mechanisms. Each block of data is encrypted using a unique key derived from its content, ensuring data confidentiality while enabling deduplication.

- **Encryption Process:**

Block Hashing: Each small block is hashed using a cryptographic hash function.

Key Derivation: The hash of each block serves as the encryption key for that block.

Data Encryption: The block is then encrypted using a symmetric encryption algorithm with the derived key.

- **Advantages:**

Data Confidentiality: Encrypting each block with a unique key ensures that the data remains secure, even if deduplication reveals the presence of duplicate blocks.

Resistance to Brute-Force Attacks: The use of content-derived keys makes it computationally infeasible to derive the original data without access to the specific block content.

- **Authorization Framework**

To ensure that only authorized users can perform deduplication and access deduplicated data, the proposed system includes a comprehensive authorization framework. This framework verifies user credentials and permissions before allowing deduplication operations.

IV. DATA DEDUPLICATION ARCHITECTURE

PROCESS INVOLVED WHILE FILE UPLOADING



Figure.1. Flow Chart for Upload Process

VERIFYING WHETHER THE BLOCK IN EXIST or NOT USING MULTI-LEVEL BLOCK SIGNATURE

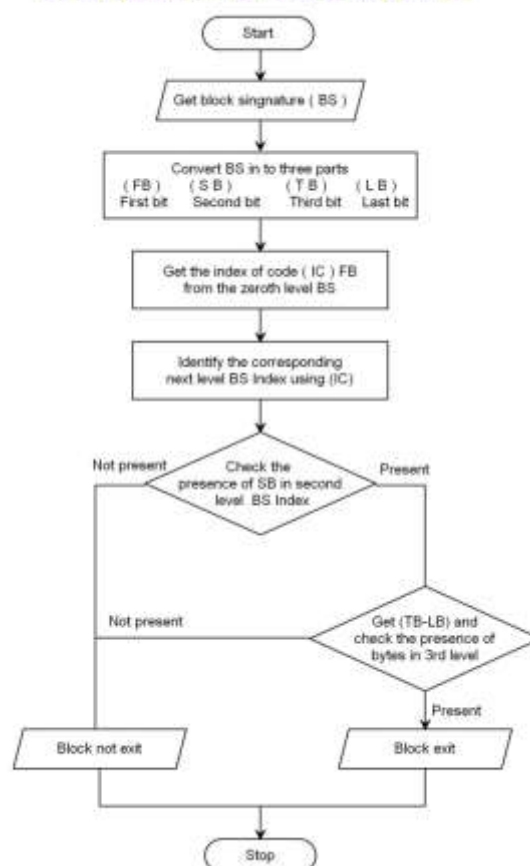


Figure 2. Flow Chart for Multi-Level Block Signature

We are providing security to our data using AES encryption as mention in uploading file flow chart Figure 1. For deduplication detection in small block level we are using concept of Multi-level block signature which improving performance of our proposed system shown in figure 3.

V. RESULT

The accompanying depictions layout the outcomes or yields that we are going to get once regulated execution of the considerable number of modules of the framework.

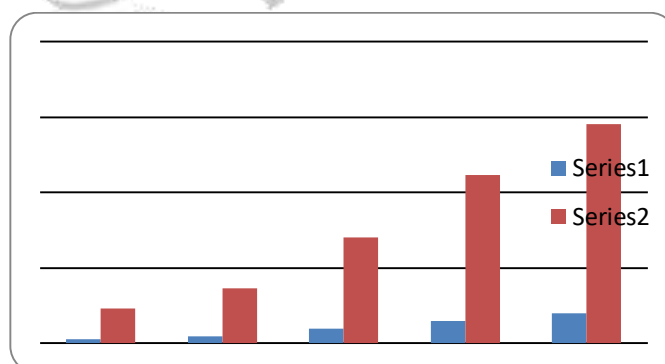


Fig. 3. Upload Process Result

While uploading the file, shows in figure 3, first step is break the file in small blocks based on given block size after that hash code get generated for all blocks, while generating hash code it will check whether it is new block of data or duplicate block of data based on hash code if hash code matched with existing hash code means it is duplicate block of data and if it is not matching means it is new data, all new block of data we will encrypt using AES encryption then we will upload to the cloud drive. As graph showing the result if file size is less it will take less time to upload and if file size is big it will take more time to execute.

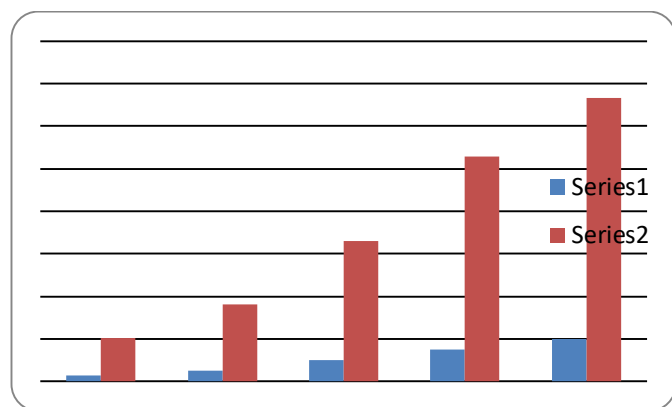


Fig.4. Download Process Result

While downloading the file, shows in figure 4, first it will check how many blocks is there, after that it will start downloading that that block from cloud drive. While downloading blocks from cloud drive it will decrypt block content and after downloading the all blocks it will merge all block, to make a single file. So if file size is less it will take less time to download and file size is big it will take more time to download.

VI. CONCLUSION

In conclusion, the proposed method for secure authorized data deduplication at the small block level in cloud storage offers a robust and efficient solution to the dual challenges of storage optimization and data security. By implementing small block-level deduplication, the system achieves finer granularity in identifying and eliminating redundant data, leading to significant storage savings. This granularity ensures more precise and effective use of storage resources compared to traditional deduplication techniques.

The integration of advanced encryption mechanisms ensures that data remains confidential and protected against unauthorized access, even during the deduplication process. Each data block is encrypted with a unique key derived from its content, enhancing security while maintaining the deduplication capability. This approach addresses the critical concern of data privacy, ensuring that sensitive information is safeguarded throughout its lifecycle in the cloud.

Moreover, the incorporation of an authorization framework ensures that only legitimate and authenticated users can perform deduplication and access deduplicated data. This framework not only enhances security but also maintains data integrity and user accountability, mitigating the risk of unauthorized data manipulation and breaches.

Performance optimization techniques, including parallel processing, efficient indexing, and cache utilization, ensure that the deduplication process is scalable and does not introduce significant computational overhead or latency. This makes the proposed system well-suited for large-scale cloud storage environments where efficiency and speed are paramount.

Experimental evaluations are expected to demonstrate the system's effectiveness in achieving high deduplication ratios, maintaining strong data security, and operating efficiently under real-world conditions. These outcomes will validate the proposed method as a viable and superior solution for modern cloud storage systems.

Overall, this research contributes to the advancement of cloud storage technologies by offering a secure, efficient, and scalable deduplication solution. It addresses the growing demand for reliable and cost-effective data management practices, ensuring that cloud storage remains a viable and secure option for individuals and organizations alike.

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