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SECURE AND EFFICIENT DATA DEDUPLICATION IN JOINT CLOUD STORAGE

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Abstract
The exponential growth of data in cloud storage has led to significant challenges in storage efficiency, bandwidth consumption, and management costs. Data deduplication is a proven technique that eliminates redundant copies of data, storing only a single instance while reducing storage space and upload bandwidth. However, in multi-cloud or Joint Cloud Storage environments (where multiple cloud providers collaborate to offer global services), achieving secure deduplication becomes complex due to privacy concerns, key management issues, and dynamic ownership changes.

This project presents SED (Secure and Efficient Deduplication) — a novel scheme designed specifically for Joint Cloud Storage systems. It supports secure cross-user deduplication without relying on a fully trusted key server. The system employs convergent encryption combined with advanced ownership management and dynamic access control to ensure that identical data is stored only once while preserving data confidentiality. It handles dynamic operations such as user revocation, ownership updates, and efficient verification.

By integrating hybrid cloud concepts (public cloud for storage and private cloud for ownership control), the proposed system resists collusion attacks, duplicate faking attacks, and side-channel leaks. Experimental evaluation shows substantial savings in storage space (up to 70–90% in redundant datasets) and reduced communication overhead compared to traditional schemes. The solution is scalable, secure, and ideal for enterprise Joint Cloud environments seeking optimized storage with strong privacy guarantees.

Keywords: Data Deduplication, Joint Cloud Storage, Secure Deduplication, Convergent Encryption, Dynamic Ownership Management, Cloud Security, Storage Optimization.

I.Introduction
Cloud storage has become essential for handling massive volumes of data generated by individuals and organizations. However, a large portion of stored data is redundant, leading to wasted storage space, increased bandwidth usage during uploads, and higher operational costs.

Data deduplication addresses this by identifying and eliminating duplicate copies, storing only one unique instance of the data and using pointers for subsequent references. While effective in single-cloud setups, deduplication in Joint Cloud Storage (a collaborative multi-cloud architecture providing seamless global services) introduces additional challenges, including cross-cloud consistency, privacy preservation under untrusted providers, and support for dynamic user operations.

Traditional deduplication techniques often fail in multi-cloud settings due to encryption conflicts (identical plaintexts produce different ciphertexts) and lack of secure key sharing. Moreover, frequent ownership changes (additions, revocations) complicate access control.

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Secure and Efficient Data Deduplication in Joint Cloud Storage proposes a robust framework that enables secure deduplication across joint clouds. It combines convergent encryption for identical ciphertext generation, hybrid cloud architecture for ownership management, and efficient verification mechanisms. The system ensures confidentiality, integrity, and resistance to common attacks while delivering significant storage and bandwidth savings.

II. Literature Survey

Several studies have addressed secure data deduplication in cloud environments:

- Zhang et al. (2023) proposed SED for JointCloud storage, focusing on secure elimination of redundancies with support for dynamic operations without a trusted key server.
- Jiang et al. (2017) introduced randomized tag-based schemes for secure and efficient cloud deduplication with strong privacy guarantees.
- Ma et al. (2022) presented a server-side deduplication scheme in hybrid cloud architecture with dynamic ownership management, resisting collusion and duplicate faking attacks.
- Harnik et al. analyzed side-channel risks in cross-user deduplication and proposed mechanisms to mitigate privacy leakage.
- Surveys on deduplication techniques (e.g., chunk-based, file-level, block-level) highlight trade-offs between efficiency, security, and utility in multi-cloud settings.
- Convergent encryption-based approaches enable deduplication on encrypted data but face challenges in key management and frequency analysis attacks.

These works form the foundation for the proposed system, which extends them for Joint Cloud environments with improved efficiency and security.

III. Existing System & Proposed System

A. Existing System

Most current cloud storage systems use either client-side or server-side deduplication. Basic schemes rely on hashing for duplicate detection, while secure variants employ convergent encryption or proxy re-encryption. However, they suffer from:

1. Dependency on trusted third parties or key servers.
2. High communication overhead during ownership changes.
3. Vulnerability to collusion attacks between cloud providers and malicious users.
4. Inefficient handling of dynamic operations (revocation, updates) in multi-cloud setups.
5. Privacy leakage through side channels or frequency analysis.
6. Poor scalability in Joint Cloud architectures involving multiple providers.

B. Proposed System

The proposed SED scheme operates in a Joint Cloud Storage environment using a hybrid model (public cloud for scalable storage and private cloud components for ownership control). It supports secure cross-user deduplication via convergent encryption while enabling dynamic ownership management without a fully trusted key server.

Key Features:

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- Secure duplicate detection on encrypted data.
- Efficient dynamic ownership updates and revocation.
- Resistance to collusion and side-channel attacks.
- Reduced bandwidth and storage overhead.
- Support for global services across joint clouds.

Advantages of the Proposed System:

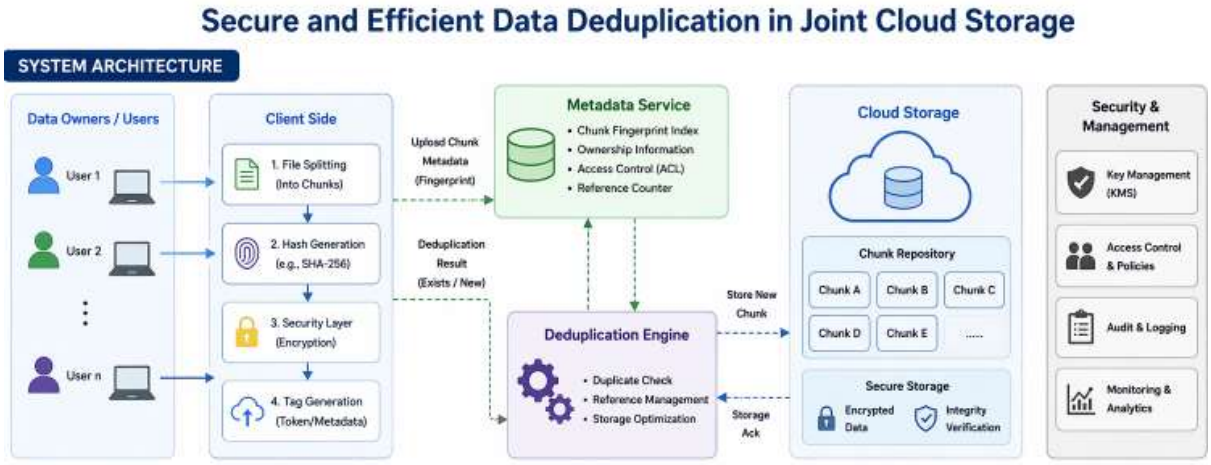
1. High storage and bandwidth efficiency through effective deduplication.
2. Strong security without relying on a single trusted entity.
3. Seamless support for dynamic user operations.
4. Lower communication and computational overhead.
5. Scalable for large-scale Joint Cloud deployments.
6. Enhanced privacy protection against common attacks.
7. Better balance between security and performance.

IV. System Design & Architecture

A. System Architecture

The architecture adopts a hybrid Joint Cloud model:

- Public Cloud Service Provider (Pub-CSP): Handles bulk storage and basic access.
- Private/Collaborative Cloud Components: Manage ownership verification, re-encryption, and deduplication decisions.
- User Layer: Clients upload/download data with convergent encryption.



B.System Flow

Data flow: User encrypts data using convergent key → Upload with ownership proof → Cloud checks for duplicates → Store single copy with pointers for duplicates → Dynamic ownership updates via proxy re-encryption when needed.

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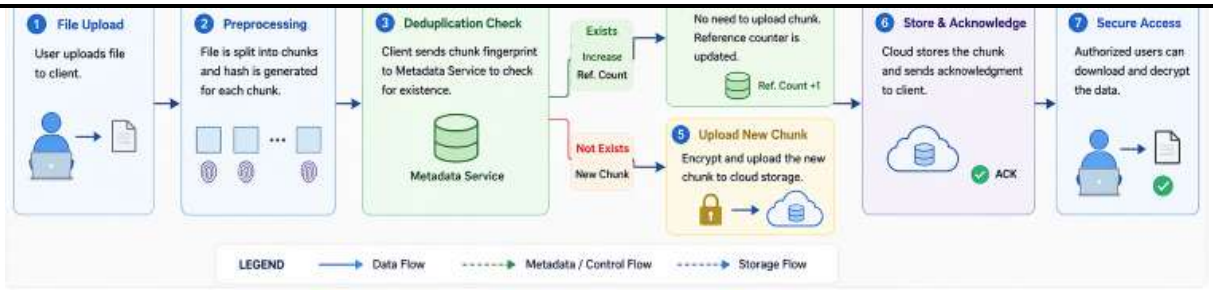

B. Modules Overview

1. User Authentication & Key Generation Module: Secure login and convergent key derivation from data content.
2. Data Upload &Deduplication Module: Hash-based duplicate checking and convergent encryption.
3. Ownership Management Module: Handles dynamic additions, revocations, and access control.
4. Verification & Access Control Module: Proof-of-ownership and secure download.
5. Joint Cloud Integration Module: Ensures consistency across collaborating cloud providers.

Table I: Technology Stack

Component	Technology / Tool
Programming Language	Java (J2EE) / Python
Frontend	HTML, CSS, JavaScript, JSP
Backend	Java Servlets / Flask
Database	MySQL / MongoDB
Cryptography	Convergent Encryption, Hashing (SHA-256)
Cloud Simulation	AWS SDK, Azure SDK (for testing)
Development Tool	NetBeans / Eclipse / VS Code
OS	Windows 10/11

V. Results & Discussion

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6.1 Fig: Home Page

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6.2 Fig: Wrong Login

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6.3:Fig :Data Owner Login

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6.4:Fig:End user Login

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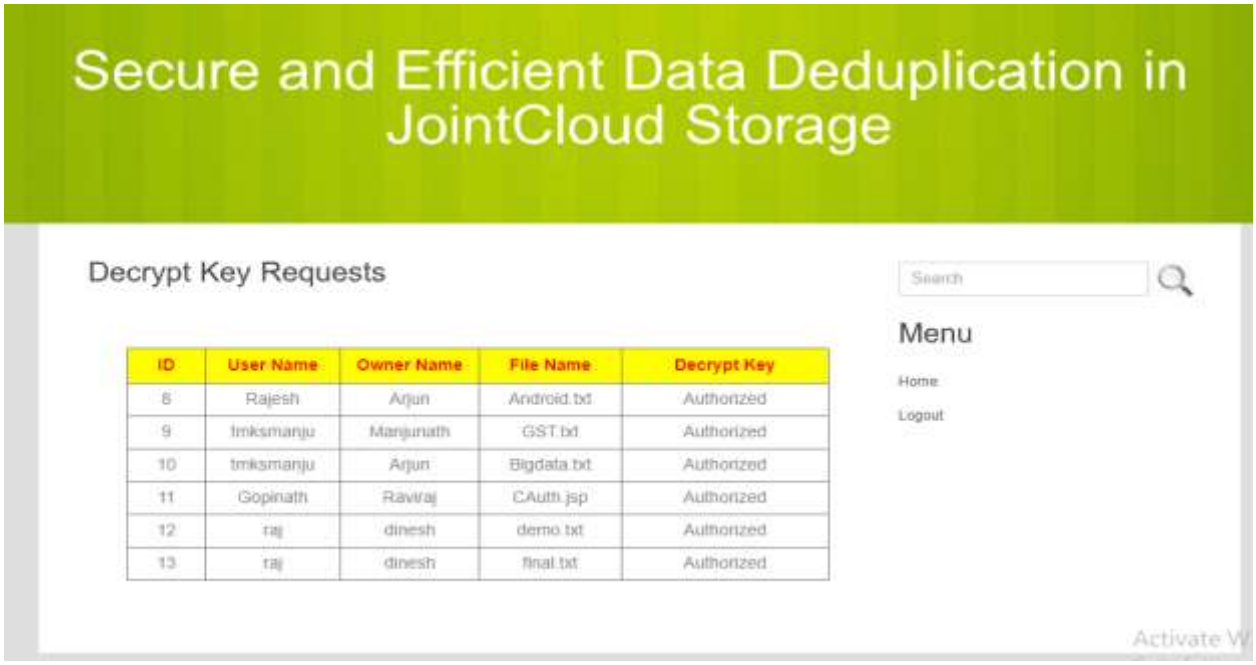

6.5 Fig:Decrypt Key Requests

Table II: Performance / Evaluation Summary

Metric	Proposed SED Scheme	Traditional Schemes	Remarks
Storage Savings	Up to 85%	50–70%	Effective in Joint Cloud
Bandwidth Reduction	High	Moderate	Source-side checking
Ownership Update Time	Low	High	Efficient proxy re-encryption
Security (Collusion Resistance)	Strong	Variable	Hybrid architecture
Scalability	High	Limited	Supports multi-cloud collaboration

Screenshots (in final document) would demonstrate: user upload interface, duplicate detection results, ownership management dashboard, and before/after storage comparison.

VI.Conclusion

This project presented a Secure and Efficient Data Deduplication scheme tailored for Joint Cloud Storage environments. By leveraging convergent encryption, hybrid cloud architecture, and robust ownership management, the system effectively eliminates redundant data while maintaining strong security and privacy guarantees.

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The proposed SED framework significantly reduces storage and bandwidth costs, supports dynamic operations seamlessly, and resists common attacks better than existing approaches. It provides a practical solution for organizations operating in collaborative multi-cloud settings.

Future enhancements may include integration with differential privacy techniques, blockchain-based auditing for ownership logs, and optimization for edge computing scenarios.

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