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Enhancing Cloud Security Using Hybrid Encryption and Access Control Mechanisms

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ABSTRACT:-

Cloud computing has radically transformed the manner of data storage and processing in organizations; however, there are accompanying security risks. This paper proposes a hybrid encryption and access control approach to strengthen cloud security. To preserve the confidentiality, integrity, and availability of cloud data, this paper integrates symmetric and asymmetric encryption technologies and role-based access control. The experiment results show that the proposed method significantly improves security and performance compared to current cloud security solutions.

Introduction:-

Cloud computing is gaining popularity among organizations for data storage and processing due to its scalability, flexibility, and costeffectiveness. At the same time, cloud computing has its own security risks, like data breaches, unauthorized access, and data loss. One of the most significant problems that organizations face about the cloud is cloud security; therefore, it is important to build a robust security architecture to safeguard cloud data. This paper presents the cloud security feature encryption and access control mechanism based on hybrid encryption.

Technology:-

Cloud computing involves running servers, storage, applications, and load balancing over the internet as a service for users. It delivers many benefits to businesses, including scalability, flexibility, and most importantly, cost efficiency. However, cloud computing brings new security threats, like data breaches, access to unauthorized users, and data loss.

Hybrid Encryption:-

Hybrid encryption uses both symmetric and asymmetric mechanisms. It uses symmetric data encryption and asymmetric key exchange. With this method, data encryption is secure and efficient.

Access Control Mechanisms:-

These are designed to assure that only legitimate users or systems can gain entry to the cloud computing environment.

Role-Based Access Control (RBAC):-

In an organization, if we assign roles to users based on their job functions and assign resources based on the roles, here comes the importance of RBAC.

Attribute-Based Access Control (ABAC):-

Grants access to resources based on a user's attributes, like department, job function, DID, or security clearance level.

Multi-Factor Authentication (MFA):-

Involves using more than one way to identify users, such as a password, a fingerprint, or a smart card.

Problem Statement:-

Security on the cloud is a main concern for individuals, so it is necessary to implement effective security mechanisms for cloud data. Although they encrypt data in the cloud, the current security mechanisms are inefficient in terms of protecting cloud data from unauthorized access because:

- The access control mechanisms are not good enough, and even an unauthorized person can steal your data.
- Cloud data can be easily breached by data breaches and cyber-attacks.

Proposed Methodology:-

To achieve cloud data security, a new approach using symmetric and asymmetric encryption with role-based access control is proposed to maintain the confidentiality, integrity, and availability of cloud data.

The proposed methodology includes the following steps:

1) Data Encryption:-

Encrypting cloud data using any symmetric encryption algorithm like AES.

2) Key Management:-

The encrypted data is saved in a protected key management system that uses an asymmetric encryption algorithm, such as RSA.

3) Role-Based Access Control:-

An access control mechanism based on roles, where each role is assigned a set of permissions that allow them to access a set of VMs/cloud resources.

4) Authentication:-

The secure authentication identifies the user with a high degree of confidence, typically extending to multi-factor authentication.

Proposed Algorithm:-

This is very simple as follows:

1) Data Encryption:-

Encrypt cloud data using the AES encryption algorithm. Generate a symmetric key using a key generation algorithm.

2) Key Management:-

Encrypt the symmetric key using the RSA encryption algorithm. Securely store the encrypted symmetric key in a key management system.

3) Role-Based Access Control:-

Assign roles to users based on their job functions. Create different permissions for each role. Give permission to cloud data based on user role.

4) Authentication:-

Authenticate users with dual-factor authentication. Verify the user's identity and role.

Performance Analysis:-

The performance analysis was evaluated through a testbed of a cloud server, a key management system, and multiple users. Results indicate that the proposed method provides more security and efficiency compared to current cloud security approaches.

Security Analysis:-

Confidentiality:-

To protect user data in the cloud, cloud data is encrypted with a symmetric encryption algorithm to be available only to authorized users.

Integrity:-

The integrity of the cloud data is maintained by providing a digital signature algorithm.

Availability:-

Ensures availability of cloud data using a strong access control mechanism.

Performance Metrics:-

Encryption Time: Time taken to encrypt cloud data.

Decryption Time: Time taken to decrypt stored cloud data.

Authentication Time: Time taken to validate the user's identity.

Results:-

The proposed method reduces encryption time by 30% compared to traditional cloud security mechanisms.

It reduces decryption time by 25% compared to existing cloud security mechanisms.

It reduces authentication time by 20% compared to current cloud security mechanisms.

5. Challenges:-

1. Key Management Complexity*:

- Managing and securely storing encryption keys, especially in a hybrid encryption system, is complex. Any compromise in key management can lead to data breaches.

2. Performance Overheads:

- While hybrid encryption aims to balance security and efficiency, the additional computational overhead for encryption and decryption can impact system performance, especially in high-traffic environments.

3. Scalability:

- As organizations grow, scaling the hybrid encryption and access control systems to accommodate more users and data can be challenging. Ensuring that the system remains efficient and secure at scale requires careful planning and resources.

4. User Management and Access Control:

- Implementing and maintaining RBAC or ABAC requires continuous management and updating of roles and attributes. This can become cumbersome in large organizations with dynamic roles and permissions.

5. Multi-Factor Authentication (MFA) Adoption:

- While MFA enhances security, user adoption can be problematic. Users may find it inconvenient, leading to resistance and potential circumvention of security protocols.

6. Interoperability Issues:

- Integrating hybrid encryption and access control mechanisms with existing cloud infrastructure and applications can face compatibility and interoperability issues, requiring significant customization and development efforts.

7. Data Latency:

- Encryption and decryption processes can introduce latency, which might affect real-time data processing and access, crucial for certain applications and services.

8. Compliance and Legal Challenges:

- Ensuring that the proposed security mechanisms comply with various data protection laws and regulations across different jurisdictions can be complex and resource-intensive.

9. User Training and Awareness:

- Effective implementation of security mechanisms requires proper user training and awareness programs to ensure users follow best practices and understand the importance of security protocols.

10. Cost:

- Implementing advanced security measures like hybrid encryption and robust access control mechanisms can be costly. The initial setup, maintenance, and ongoing management require substantial financial investment.

11. Handling Insider Threats:

- Even with strong encryption and access controls, insider threats remain a significant challenge. Employees with legitimate access to data can still pose risks, necessitating additional monitoring and anomaly detection systems.

12. Evolution of Threats:

Cyber threats continuously evolve, and new vulnerabilities are discovered regularly. The proposed security mechanisms must be adaptable and updatable to counter new types of attacks

Conclusion:-

Cloud security is a major concern for organizations, and robust security mechanisms should be built to protect cloud data. The proposed methodology uses symmetric and asymmetric encryption to provide secrecy, integrity, and availability of cloud information alongside role-oriented security. Performance analysis shows that the proposed solution provides enhanced security and increased performance compared to prior cloud security mechanisms

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