A Review on Secure Data Sharing in Cloud Computing Environment

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Abstract -- Data sharing in the cloud is a technique that allows users to conveniently access data over the cloud. The data owner outsources their data in the cloud due to cost reduction and the great conveniences provided by cloud services. Data owner is not able to control over their data, because cloud service provider is a third party provider. The main crisis with data sharing in the cloud is the privacy and security issues. Various techniques are available to support user privacy and secure data sharing. This paper focus on various schemes to deal with secure data sharing such as Data sharing with forward security, secure data sharing for dynamic groups, Attribute based data sharing, encrypted data sharing and Shared Authority Based Privacy-Preserving Authentication Protocol for access control of outsourced data.

Keywords - Cloud, data sharing, access control, security, privacy

I. INTRODUCTION

Cloud systems can be used to enable data sharing capabilities and this can provide several benefits to the user and organization when the data shared in cloud. Since many users from various organisations contribute their data to the Cloud, the time and cost will be less compared to manually exchange of data. Google Docs provides data sharing capabilities as groups of students or teams working on a project can share documents and can team up with each other successfully. This allows higher productivity compared to previous methods of frequently sending updated versions of a document to members of the group via email attachments. People are expecting data sharing capability on their computers, phones and laptop etc. People love to share their information with others such as family, colleagues, friends or the world. Students also get benefit when working on group projects, as they are able to team up with members and get work done efficiently.

The security requirements for data sharing in cloud computing system are as follows:

A. Data security

The provider must ensure that their data outsourced to the cloud is secure and the provider has to take security measures to protect their information in cloud. [13]

B. Privacy

The provider must ensure that all critical data are encrypted and that only authorized users have access to data in its entirety. The credentials and digital identities must be secure as any data that the provider collects about customer activity in the cloud. [13].

C. Data confidentiality

The cloud users want to make sure that their data contents are not made available or disclosed to illegal users. Only authorized users can access the sensitive data while others should not access any information of the data in cloud. [14][15].

D. Fine-grained access control

Data owner can restrict the unauthorized users to access the data outsource to cloud. The data owner grants different access rights to a set of user to access the data, while others not allowed to access without permissions. The access permission should be controlled only by the owner in un-trusted cloud environments.

E. User revocation

When a user gets back the access rights to the data, it will not allow any other user to access the data at the given time. The user revocation must not affect the other authorised users in the group.

F. Scalable and Efficient

The number of Cloud users is extremely large and the users join and leave unpredictably, it is essential that the system maintain efficiency as well as scalability. An effective data sharing in cloud computing system must satisfy all the security requirements.

II. SECURITY SYSTEM FOR DYNAMIC GROUPS IN CLOUD

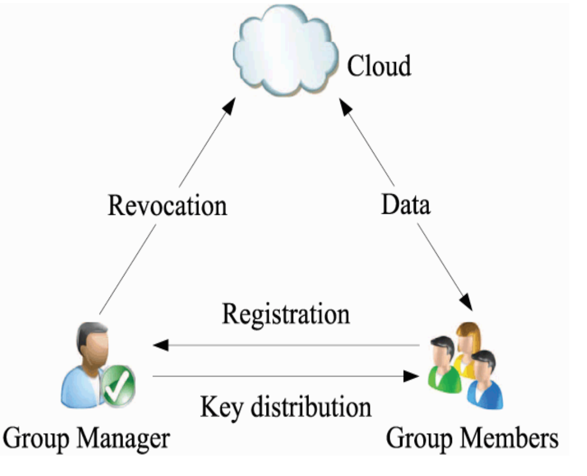

Fig 2.1 Secure Group Sharing in Cloud

To enable data sharing in the Cloud, it is essential that only authorised users are able to get access to data stored in the Cloud. Figure 2.1 demonstrates the Secure Group Sharing in Cloud. When the data owner wants to share their own data to a group, he/she sends the key used for data encryption to each member of the group. Any of the group members can then get the encrypted data from the Cloud and decrypt the data using the key and hence group member does not require the interference of the data owner.

The problem in this technique is that it is inefficient. When the data owner gets back the access rights from a member of the group, that member must not be able to access to the corresponding data. Since the unauthorized member of the group still has the data access key. So the data owner has to re-encrypt the data with a new key. When the data is re-encrypted, data owner must give out the new key to the remaining users in the group and this is computation inefficient. The Constraints to be followed in group sharing are stated as follows:

1. The data owner can specify a group of users that are approved to view his or her data.
2. Any time the member of the group must access the data without the data owner's interference.
3. Only data owner and the members of the group should access the data, no other can access the data including the Cloud Service Provider.
4. The data owner gets back the permission to access data for any member of the group.
5. The data owner can add new user to the group.
6. The member of the group must not be allowed to revoke rights of other members of the group or add new users to the group.
7. The data owner has to specify who has read/write permissions on the data owner's files.

III. ENCRYPTION TECHNIQUES

Some of the encryption techniques used in the existing system are discussed and summarized as follows:

A. Attribute Based Encryption (ABE)

Attribute-based encryption is a type of public-key encryption. In this technique, the secret key of a user and the ciphertext are dependent upon attributes. The decryption of a ciphertext is possible only if the set of attributes of the user key matches the ciphertext attributes. It provides a secure way that allows data owner to share outsource data on untrusted server.

B. Identity-Based Encryption (IBE)

Identity-based systems allow any party to create a public key from a known identity value such as an ASCII string (e.g email id). Figure 3.1 shows an Identity based Encryption scenario. A trusted third party called as Private Key Generator, which generates the corresponding private keys. To operate, the Private Key Generator first distributes a master public key, and retains the equivalent master private key. Given the master public key, any party can compute a public key related to the identity by combining the master public key with the identity value. To achieve a corresponding private key, the party authorized to use the identity ID contacts Private Key Generator, which uses the master private key to create the private key for identity ID. As a result, parties may encrypt messages without prior distribution of keys between individual participants.

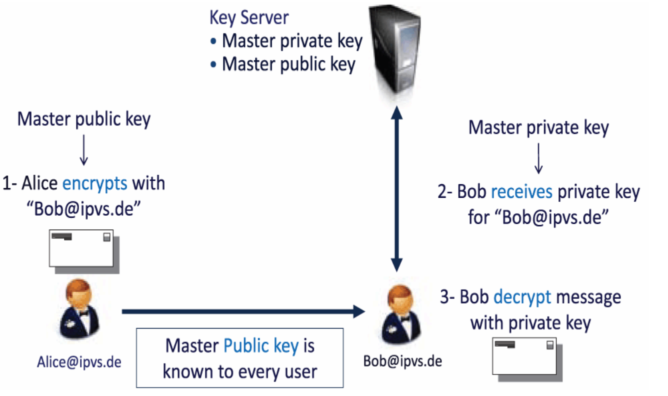

Fig 3.1 Identity-Based Encryption

C. Proxy Re-encryption

Proxy Re-encryption is another technique that enables secure data sharing and confidential data sharing in the Cloud. Proxy Re-encryption allows a semi-trusted proxy with a re-encryption key to convert a cipher-text under the data owner's public key into another cipher-text that can be decrypted by other user's secret key.

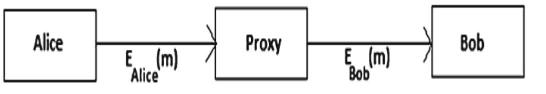

Fig 3.2 A basic proxy Re-encryption scheme

Figure 3.2 shows the basic Proxy Re-encryption scheme. A user, Alice, encrypts her data using her public key. Alice sends the encrypted data to a proxy, when she wants to share her data with another user, say Bob. The proxy then converts the data encrypted under Alice's public key into data that is encrypted under Bob's public key and sends this to Bob. Bob is able to use his private key to decrypt the cipher-text and reveal the data.

D. Ciphertext-Policy Attribute Based Encryption

In cipher text - policy attribute-based encryption (CP-ABE) a user's private-key is related with a set of attributes and a ciphertext define an access policy over a set of defined attributes within the system. A user will be able to decrypt a ciphertext, only if his attributes suit the policy of the respective ciphertext. Policies may be determined over attributes using disjunctions, conjunctions and (k, n)-threshold gates, i.e., k out of n attributes have to be given. For instance, let us assume that the attributes is defined to be {A, B, C, D} and user 1 receives a key to attributes {A, B} and user 2 receives a key to attribute {D}. If a ciphertext is encrypted with respect to the policy $(A \wedge C) \vee D$, then user 1 will not be able to decrypt, while user 2 will be able to decrypt. An advantage of CP-ABE is that the users can get their private keys only after the data has been encrypted with respect to policies. So data can be encrypted without knowledge of the actual set of users that will be able to decrypt only by specifying the actual policy.

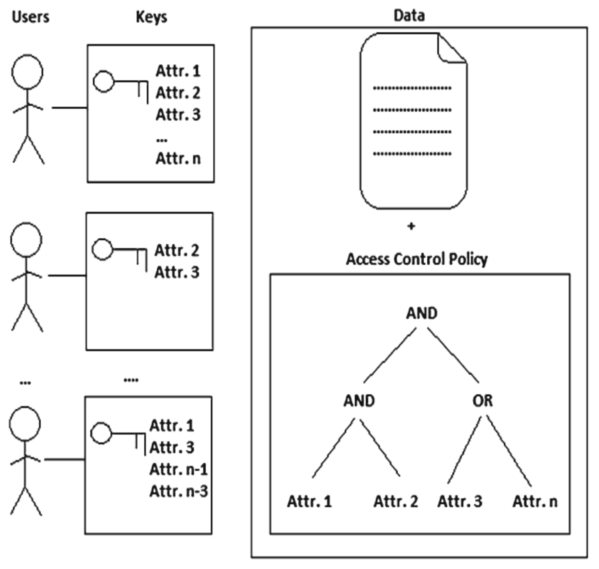

Fig 3.3 Ciphertext-policy attribute-based encryption

IV. LITERATURE SURVEY

In this paper, we review existing literature on methods of achieving data sharing in the Cloud that is both secure and efficient.

Xinyi Huang et.al [10] (2015) introduced a Identity-based (ID-based) ring signature, which eliminates the process of certificate verification. By providing forward secure ID-based ring signature method security level of ring signature is increased. In this method, if the secret key of any user has been compromised, previous generated signatures of all is included and the user still remains valid. If a secret key of single user has been compromised it is impossible to ask all data owners to reauthenticate their data. It is especially important to any large scale data sharing system and it is very efficient and does not require any pairing operations. The user secret key is one integer, while the key update process requires an exponentiation. This scheme is useful; especially to those require authentication and user privacy.

Huang Qinlong et.al [6] (2015) suggested an attribute-based secure data sharing scheme with Efficient revocation (EABDS) in cloud computing. To guarantee the data confidentiality and to achieve fine-grained access control this proposed scheme encrypts data with Data encryption key (DEK) using symmetric encryption method and then encrypts DEK based on Ciphertext policy attribute-based encryption (CP-ABE). The homomorphic encryption technique is used to solve key escrow problem in order to generate attribute secret keys of users by attribute authority in support with key server. This homomorphic encryption technique is used to prevent the attribute authority from accessing the data by generating the attribute secret keys alone. EABDS scheme achieves immediate attribute revocation which guarantees forward and backward security, and less computation cost on users. Advantages of this method are more secure and efficient.

Hong Liu et.al [2] (2015) proposed a shared authority based privacy preserving authentication protocol (SAPA) to address the privacy issues for a cloud storage. Their protocol is attractive for multi-user collaborative cloud applications. The existing security solutions mainly focus on authentication. In SAPA, the shared access authority is achieved by anonymous access request matching mechanism, provides Ciphertext-policy attribute based access control to enable users to reliably access its own data fields and proxy re-encryption is applied to provide data sharing among multiple users. Universal Composability (UC) model is established to prove the SAPA has design correctness. When a user challenges the cloud server to request other users for data sharing, this access request itself may reveal user's privacy. This scheme addresses user's sensitive access related privacy during data sharing in cloud environment and achieves data access control, access authority sharing and privacy preservation. Through the SAPA protocol, authentication and authorization is preserved without compromising user's private information.

Xin dong et.al [3] (2014), proposed an effective, scalable and flexible privacy-preserving data policy with semantic security. They used two techniques Ciphertext policy attribute-based encryption (CP-ABE) and Identity based Encryption (IBE) that provided a dependable and secure cloud data sharing service that allows dynamic data access to users. Their scheme ensures robust data sharing, preserves privacy of cloud users and supports efficient and secure dynamic operations which includes file creation, user revocation and modification of user attributes. This scheme also enforces fine-grained access control, full collusion resistance and backward secrecy. Although cloud computing is economically attractive to customers and enterprises, it does not guarantee users privacy and data security. The proposed scheme provides semantic security for data sharing in cloud computing through the generic bilinear group model and also imposes backward secrecy and access privilege confidentiality. The performance analysis of this scheme incurs a small overhead compared to existing schemes.

Qiang Tang et.al [9] (2014) suggested a searchable encryption namely multi-party searchable encryption (MPSE). It enables users to selectively permit each other to search in their encrypted data. For worst-case and average-case collusion due to the user status dynamics a security model is considered. He proposed a new scheme with provable security. A security model for MPSE provides stronger security guarantee than that from [11]. In the formulation of MPSE, authorization is approved on index level, for each of her indexes example Alice can make a decision whether Bob can search or not i.e. if all keywords try by authorized Bob then Alice supports authorize Bob to look for a subset of keywords in her indexes as well as the cloud server colluded with Bob can recover the keyword in all Alice's search queries. In this MPSE formulation, expected to be that Alice can find out a problem of single trapdoor search for all indexes that have been authorized by her. Disadvantages of this formulation are If Alice have many key pairs in the index and use them with various peers then it leaks some unnecessary information. In contrast, inverted index structure may not face this kinds of problem, as shown in [12].

Junbeom Hur et.al [7] (2013) stated that, the most challenging issues in data sharing systems is the implementation of access policies and support of policies updates. Ciphertext policy attribute-based encryption method enables data owners to define their own access policies over user attributes and implement the policies on the data to be distributed. Disadvantages of this method are key escrow problem. Junbeom Hur[7] proposed a attribute based data sharing scheme to implement a fine-grained data access control by the characteristic of the data sharing system. In this scheme, Junbeom Hur[7] proposed a escrow-free key issuing protocol which solves the problem of key escrow problem. The escrow-free key issuing protocol is constructed using the secure two-party computation between the data-storing centre and the key generation centre. This scheme improves confidentiality and data privacy in the data sharing system. In this scheme, user revocation on each attribute set can do an immediate, which takes the advantage of the scalable access control given by the cipher text policy attribute-based encryption. Advantages of this method are more secure, fine-grained data access control in the data sharing system, efficient and scalable to securely manage user data in the data sharing system.

Ming Li et.al [8] (2012) proposed a novel patient-centric framework and a mechanisms for data access control to Personal Health Records (PHRs), which is stored in semi-trusted servers. The attribute based encryption (ABE) techniques is to encrypt each patient's PHR file to achieve fine-grained and scalable data access control for PHRs. In this scheme, it divides the users in the PHR system into multiple security domains which greatly reduces the key management difficulty for owners and users. By using multi-authority attribute based encryption patient privacy is guaranteed. It's also enables dynamic modification of file attributes or access policies, which supports efficient on-demand user or attribute revocation and prove its security. Advantages of this scheme are both scalable and efficient.

V. DYNAMIC SECURE GROUP SHARING

Zhongma Zhu and Rui Jiang [1] (2016), proposed a secure anti collision data sharing scheme for dynamic groups. The group manager takes charge of user registration and user revocation. Group members are a set of registered users. They will store their own data into the cloud and share them with others. They proposed a secure way of key distribution without any secure channels. The users can obtain their private keys from group manager without any Certificate Authorities, due to the verification for the public key of the user. Since there are no secure communication channels between communication entities, the information can be protected from passive eavesdroppers. The proposed scheme achieved fine-grained access control. This allowed any user in the group to use the source in the cloud and the revoked users cannot access the cloud again after they are revoked. This scheme protects from collusion attack and provides a secured user revocation, so the revoked users cannot get the original data file. It supports dynamic groups efficiently. So, previous users need not update their private keys when a new user joins the group or when a user is revoked from the group. The design goals of this scheme include key distribution, data confidentiality, access control and efficiency.

Kaiping Xue [5] (2014) proposed a dynamic secure group sharing framework in public cloud computing environment. This framework combines proxy re-encryption, enhanced Treebased Group Diffie-Hellman (TGDH) and proxy signature together into a protocol. By applying the proxy signature technique, the group leader can give rights to group management to choose one or more groups members, all the session key are protected in the digital envelopes and all the data sharing files are safely stored in Cloud Servers. The improved TGDH scheme is to dynamically modify a group key pair when they are in group ,leaving the group or joining the group as well as its does not require all of the group members been online all the time. Based on proxy re-encryption, most data processing operations can be assigned to Cloud Servers without reveal any private information. Advantages of this proposed scheme is highly efficient and satisfies the security requirements for public cloud based secure group sharing.

Xuefeng Liu [4] (2013) proposed a secure data sharing design for dynamic groups in an untrusted cloud. In this design, a user can share data with others in the group without revealing identity privacy to the cloud. Its supports efficient user revocation, which can be achieved through a public revocation list without modifying the private keys of the remaining users, and new users join can directly decrypt files stored in the cloud before their participation. This scheme guarantees efficiency as well as encryption computation costs are constant.

VI. CONCLUSION

Data sharing in the Cloud is available in the future as demands for data sharing continue to grow rapidly. In this paper, we presented a review on secure data sharing in cloud computing environment. To reduce the cost data owner outsource the data. Data owner is unable to control over their data, because cloud service provider is a third party provider. The problem with data sharing in the cloud is the privacy and security issues. Various techniques are discussed in this paper to support privacy and secure data sharing such as Data sharing with forward security, secure data sharing for dynamic groups, Attribute based data sharing, encrypted data sharing, Shared Authority Based Privacy-Preserving Authentication Protocol for access control of outsourced data. The study concludes that secure anti collision data sharing scheme for dynamic groups provides more efficiency, supports access control mechanism and data confidentiality to implement privacy and security in dynamic group sharing. There is more scope for future research in the field of secure data sharing for dynamic groups.

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