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Cloud Data Security using Authentication and Encryption Technique

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Abstract - Cloud Computing has been envisioned as the next generation architecture of IT Enterprise. In cloud computing application software and databases are moving to the centralized large data centers. This mechanism brings about many new challenges, which have not been well understood. Security and privacy concerns, however, are among the top concerns standing in the way of wider adoption of cloud. In cloud computing the main concern is to provide the security to end user to protect files or data from unauthorized user. Security is the main intention of any technology through which unauthorized intruder can't access your file or data in cloud. We have designed one proposed design and architecture that can help to encrypt and decrypt the file at the user side that provide security to data at rest as well as while moving. In this research paper, we have used the Rijndael Encryption Algorithm along with EAP-CHAP.

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Cloud Data Security using Authentication and Encryption Technique

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I. Introduction

Cloud computing is the next stage in the Internet's evolution, providing the means through which everything- from computing power to computing infrastructure, applications, business processes to personal collaboration -can be delivered to you as a service wherever and whenever you need[1].

a) Cloud Computing Deployment Models

The various cloud deployment models are shown in figure 1 given below:

i. *Public Clouds*

In public cloud vendors dynamically allocate resources on a per-user basis through web applications. For example: Drop Box, SkyDrive and Google drive.

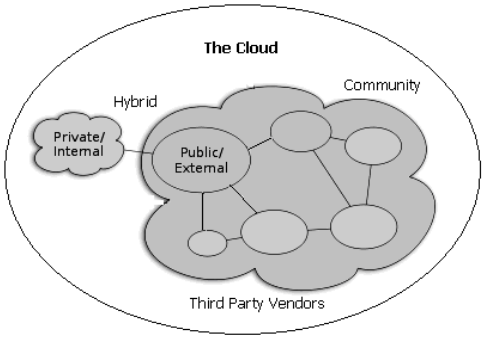

Figure 1 : Cloud Computing Deployment Models

ii. *Private Clouds*

Due to security and availability issues more and more companies are choosing Private Clouds. It provides more secure platform to the employees and customers of an organization. For example Banks, In banks all the employees and customers can access the bank data which is assigned to them particularly.

iii. *Hybrid Cloud*

Hybrid cloud is the combination of the Public cloud and private cloud. In this type of cloud services the internal resources, stays under the control of the customer, and external resources delivered by a cloud service provider.

iv. *Community Cloud*

The community cloud shares the infrastructure around several organizations which can be managed and hosted internally or by third party providers.[7]

b) Cloud Models or Layers

The various layers of cloud are shown in figure 2 given below:

1. SAAS (Software as a service) – In this companies host applications in the cloud that many users access through internet connections. E.g. Gmail, facebook.
2. PAAS (Platform as a service) – Developers can design, build and test applications that run on the cloud provider's infrastructure. E.g. Google app Engine.[2]
3. IAAS (infrastructure as a service) – This part is basically belong to the admin part or we can say the service provider. In this part the service provider provides the user with the basic infrastructure. Like

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platform and the end applications which become the interface between users and the cloud.[7]

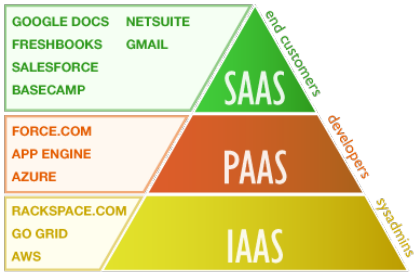

Figure 2 : Cloud Models or Layers

c) Data Security Issues in the Cloud

Securing data is always of vital importance as shown in figure 3 and because of the critical nature of cloud computing and large amounts of complex data it carries, the need is even important. Therefore, data privacy and security are issues that need to be resolved as they are acting as a major obstacle in the adoption of cloud computing services.

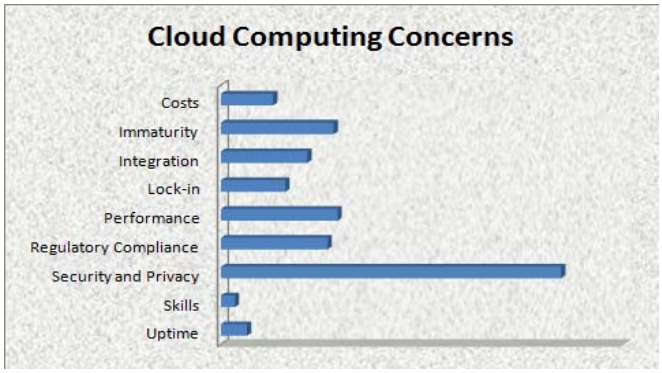

Figure 3 : Cloud Computing Concerns

The major security issues with cloud are:

1. Privacy and Confidentiality

Once the clients outsource data to the cloud there must be some assurance that data is accessible to only authorized users. The cloud user should be assured that data stored on the cloud will be confidential.

2. Security and Data Integrity

Data security can be provided using various encryption and decryption techniques. With providing the security of the data, cloud service provider should also implement mechanism to monitor integrity of the data at the cloud.[3]

II. Problem Formulation

Users who put their large data files in the cloud storage servers can relieve the burden of storage and computation. At the same time, it is critically important for users to ensure that their data are being stored correctly and safely. So, users should be equipped with certain security means so that they can make sure that their data is safe. The major concern is the security of data at rest and while moving. So to handle this problem it is required that data at both user and server end must be in encrypted form.

III. Proposed Work Plan

The two different approaches used for ensuring security in cloud are as follows:

1. *Extensible Authentication Protocol-CHAP*

EAP (Extensible Authentication Protocol) will implement on Cloud environment for authentication purpose. It is used for the transport and usage of keying material and parameters generated by EAP methods. In our purposed model we use Challenge-Handshake Authentication Protocol (CHAP) for authentication. [10]

2. *Rijndael Encryption Algorithm*

Rijndael as the standard symmetric key encryption algorithm to be used to encrypt sensitive information. Rijndael is an iterated block cipher, the encryption or decryption of a block of data is accomplished by the iteration (a round) of a specific transformation (a round function). As input, Rijndael accepts one-dimensional 8-bit byte arrays that create data blocks. The plaintext is input and then mapped onto state bytes. The cipher key is also a one-dimensional 8-bit byte array. With an iterated block cipher, the different transformations operate in sequence on intermediate cipher results (states). [6]

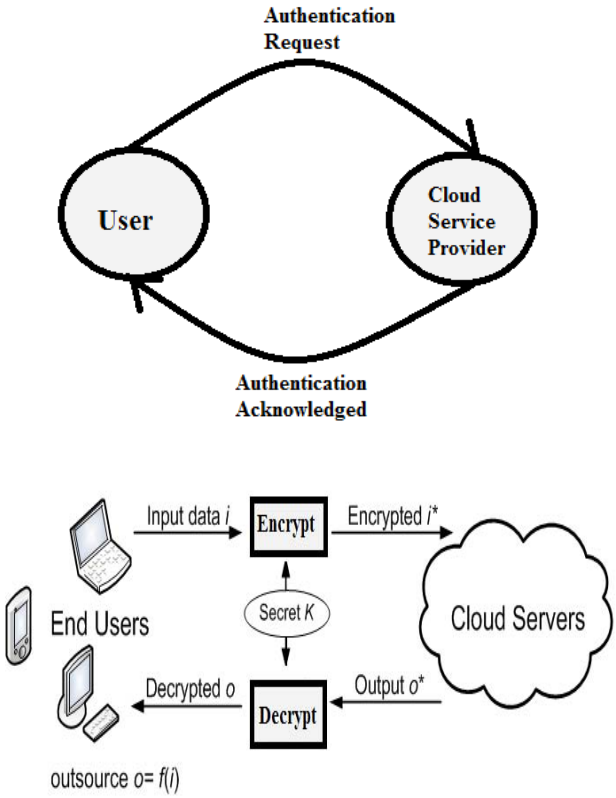

Figure 4 : Methodology

The steps of the methodology shown in figure 4 are given below:-

1. User sends the authentication request to the Cloud Service Provider (CSP).
2. CSP checks the authorization using EAP-CHAP and sends the acknowledgement back to the user.
3. User first encrypts his data and then outsources it to the server.
4. When the user downloads his data from CSP, it is received in the encrypted form.
5. To use the data user can decrypt it using same key used for encryption.

a) Authentication Protocol

EAP will implement on Cloud environment for authentication purpose. However different categories EAP are classified by authentication method. In our purposed model we use Challenge-Handshake Authentication Protocol (CHAP) for authentication. When client demands data or any service of cloud computing. Service Provider Authenticator (SPA) first requests for client identity. The whole process between client and Cloud provide explain in a figure 5 given below.

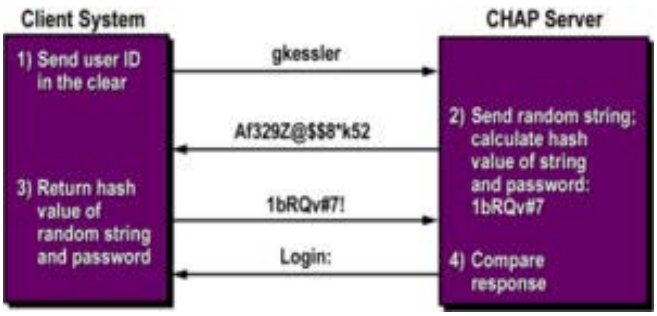

Figure 5 : Implementation of CHAP in Cloud Computing

Authentication of CHAP performs in three steps :-

1. When client demands a service, Service Provider Authentication sends a "challenge" message to client.
2. Client responds with a value that is calculated by using one way hash function on the challenge.
3. Authenticator verifies the response value against its own calculated hash value. If the values match, the Cloud provider will give service, otherwise it should terminate the connection.

Implementation of EAP-CHAP in Cloud Computing will solve the authentication and authorization problems.[5]

b) Rijndael Encryption Algorithm Implementation

i. *Encryption*

The code for encryption process is given in table 1.

```
Rijndael(State, CipherKey)
{
KeyExpansion(CipherKey,ExpandedKey);
AddRoundKey(State,ExpandedKey);
For( i=1; iFinalRound(State,ExpandedKey +
Nb*Nr);
 }
And the round function is defined as:
Round(State, RoundKey)
{ ByteSub(State);
ShiftRow(State);
MixColumn(State);
AddRoundKey(State,RoundKey);
}
```

Table 1 : Rijndael Encryption Code

The User data is encrypted by using Rijndeal Encryption. Symmetric key is used for encryption. The Rijndeal can be implemented easily and it is one of the most secure algorithms in the world. Rijndeal implementation has 128,192or 256 bit key lengths. Size of data blocks to be encrypted with Rijndeal is always 128 bits. Initial round of Rijndeal is AddRoundKey, this is followed by four iterative round including subBytes, shiftRows, mixColumns and add round key. Rijndeal with 128 bit key length has 10 rounds,192-bit has 12 rounds and 256 bit has 14 rounds. Each round consists of the following steps.

1. Initial AddRoundKey
2. SubBytes () Transformation
3. Substitutional Box Created For Subbytes
4. MixColumns () Transformation
5. AddRoundKey () transformation

The inverse process of encryption gives decryption text.[4]

Rijndael Algorithm : Encryption/Decryption Process for Rijndael Algorithm is shown in Figure 6.

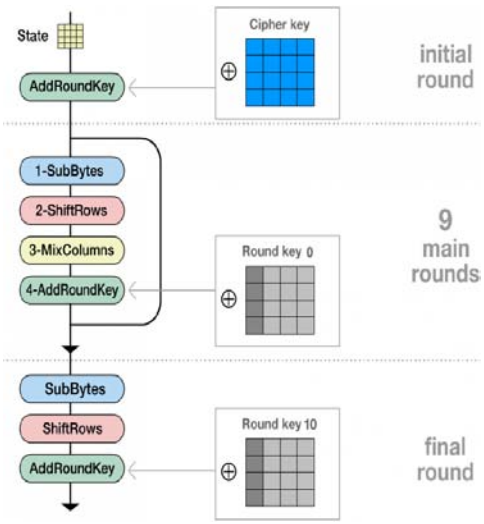

Figure 6 : Rijndael Algorithm

a. *The SubBytes Step*

The SubByte step is a non-linear byte substitution that operates on each of the 'state' bytes independently, where a state is an intermediate cipher result. Here each byte in the state matrix is replaced with a SubByte using an 8-bit substitution box, the Rijndael S-box.

b. *The ShiftRow Step*

The ShiftRows step operates on the rows of the state; it cyclically shifts the bytes in each row by a certain offset. For AES, the first row is left unchanged. Each byte of the second row is shifted one to the left. Similarly, the third and fourth rows are shifted by offsets of two and three respectively. For blocks of sizes 128 bits and 192 bits, the shifting pattern is the same. Row n is shifted left circular by n-1 bytes.

c. *The MixColumns step*

During this operation, each column is multiplied by the known matrix that for the 128-bit key is:

$$\begin{bmatrix} 2 & 3 & 1 & 1 \\ 1 & 2 & 3 & 1 \\ 1 & 1 & 2 & 3 \\ 3 & 1 & 1 & 2 \end{bmatrix}.$$

The multiplication operation is defined as: multiplication by 1 means no change, multiplication by 2 means shifting to the left, and multiplication by 3 means shifting to the left and then performing xor with the initial unshifted value. After shifting, a conditional xor with 0x11B should be performed if the shifted value is larger than 0xFF. In more general sense, each column is treated as a polynomial over $GF(2^8)$ and is then multiplied modulo x^4+1 with a fixed polynomial $c(x) = 0x03 \cdot x^3 + x^2 + x + 0x02$.

d. *The AddRoundKey step*

In the AddRoundKey step, the subkey is combined with the state. For each round, a subkey is derived from the main key using Rijndael's key schedule; each subkey is the same size as the state. The subkey is added by combining each byte of the state with the corresponding byte of the subkey using bitwise XOR.[3]

IV. Conclusion

Data security has become the vital issue of cloud computing security. From the consumers' perspective, cloud computing security concerns, especially data security and privacy protection issues, remain the primary inhibitor for adoption of cloud computing services. So in this we focused on client side security In our proposed system, only the authorized user can access the data. Even if some intruder (Unauthorized user) gets access of the data accidentally or intentionally, he will not be able to decrypt it. Also it is proposed that encryption must be done by the user to provide better security. Henceforth, security is provided using Rijndael Algorithm.

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