Rfid Authentication Protocol for security and privacy Maintenance in Cloud Based Employee Management System

ArchanaThange

Post Graduate Student, DKGOI’s COE, Swami Chincholi, Maharashtra, India

archanathange7575@gmail.com,

9620099711

AmritPriyadarshi

Assistant Professor,DKGOI’s COE, Swami Chincholi, Maharashtra, India

Abstract— Cloud based RFID authentication is becoming a large area of interest among researchers and engineers these days. However, there is not much attention given to the RFID authentication concern. Most of the work done on this issue till now has its focus on RFID functionality without considering security and privacy. Classical RFID authentication schemes do not meet the security and privacy requirements of cloud based RFID. Main features available in traditional backend-server-based RFID authentication are secure backend channels and purely trustworthy database, which are not available when moved to cloud based scenarios. Here the concept is implemented on employee management system. Many organizations now days wants have a high-tech employee management system using which a salary, attendance and location of a particular employee within an organization can be easily find out. An organization invests a large amount of money for developing and maintaining its own software and system. As compared to traditional model, newly adapted cloud based IT model is more cost effective but they are having the problems of insecure database and disclosing the privacy of tags and readers. So, there is a RFID authentication protocol is developed and VPN agency is suggested to build secure backend channels. It will secure the database using hashing technique and preserves the privacy of tags and readers by providing backend communication over secure channels. Proposed scheme has the advantages like deployment cost saving, pervasiveness of authentication, database security and mobile reader holders privacy.

Keywords— Cloud computing, RFID, AL, CA, Authentication.

1. INTRODUCTION

The objective of the paper is to discuss the issues of Radio frequency identification (RFID), what are the concepts of employee management system, cloud based employee management system and give proposed cloud based RFID authentication protocol. RFID is a technology, which has gained increased attention of researchers and practitioner’s. This enables acquisition of data about an object without need of direct line of sight from transponders and readers [4]. To make RFID system more secure, authentication is one solution. It also maintains the security and privacy of system. Tag identification without authentication raise a security problem. Attackers sometime may tap, change and resend messages from the tag as if it has the tagged object.

An Employee management system using RFID becomes efficient on cloud system because it has several advantages like (1) Verifier is enabled to authenticate the tagged objects using any reader over internet. (2) Pay on demand resource distribution is effective for small and medium scale organizations. (3) Cloud is more robust due to resource sufficiency. However, this cloud-based RFID is insufficient in two aspects. (1) Most current works focused on functionalities without giving importance to security and privacy. (2) No study shows that classical RFID schemes meet the security and privacy requirements of cloud based systems. This system can be effectively used for calculating the attendance, salary of a particular employee for particular month and for track keeping of him/her. Classical RFID schemes when moved to cloud, they are having the problems of insecure database, privacy of tags and a reader gets revealed which is not acceptable. Because cloud is publically available to any one and the clients cannot fully trust on the cloud service providers. So to recover from these drawbacks, cloud-based RFID authentication protocol should get developed. It also secures the database using hashing technique like SHA1 and maintains the privacy of tags, readers [3]. Successful implementation of this system brings the advantages like deployment cost saving, pervasiveness of authentication. Tag verification complexity reduces to O (1). It preserves the privacy of tag and reader holders. It makes the database more secure.

2. BACKGROUND

2.1 Traditional RFID

There is an extensive work on RFID authentication schemes which are, backend server based and server-less [1] [2]. The backend server based RFID is shown in Figure 1. It is composed of tags, readers and backend server. Readers identify and verify the tags by querying to backend server. However, the drawback is limited mobility of readers.

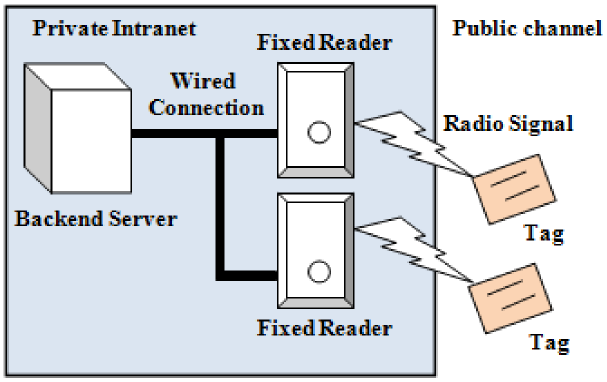


Figure 1: the backend-server-based RFID architecture

The server-less RFID scheme is shown in Figure 2. It is composed of tags, readers and CA (Certification Agency).

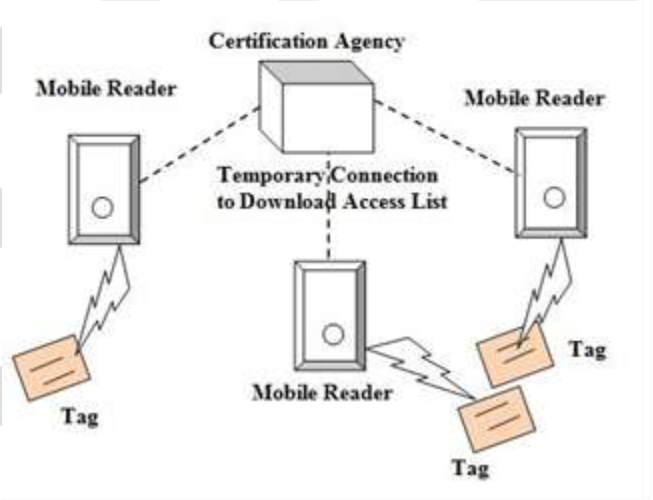


Figure 2: Server-less RFID architecture

There are two phases in server less scheme: initialization and authentication [5]. The mobile reader accesses the CA (Certification Agency) and downloads the AL (Access List) through the secure connection in an initialization phase. The mobile reader is generally a portable device such as notebook computer or smart phones. It might be stolen. Then AL is stored in it. It may wrongly be used to imitate the tags. Credentials of tag authentication are derived with the help of tags key and RID. It makes AL exclusively usable for the reader. But as a result, it is not possible for tag to create a valid request without the RID. In the authentication phase, the reader challenges a tag with RID, waiting for tags response with H (RID, Kt). The reader then searches its AL and finds the matched value to verify the Kt. It then identifies the TID. Sever-less RFID architecture provides readers with the scalability. However, there are drawbacks in server-less authentication protocol. (1) All they transmit RID in plaintext. (2) Searching through AL has complexity of O (N), where N denotes the number of tags. (3) Computational processes of searching and verifying are executed all by single personnel portable device, which reduces the performance significantly**.**

2.2 Requirements of cloud based RFID

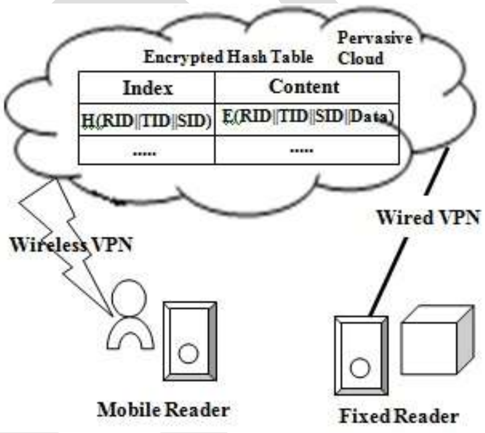
Cloud based RFID has many advantages, but has the challenges of security and privacy. Existing authentication protocols are inapplicable to cloud based employee management system because of lacking two primary capabilities. Firstly, instead of providing protection to front end communication, protection of backend communication is important in Cloud based authentication schemes. Also in cloud based schemes, mobile readers often accesses the public cloud using open wireless connections. There are two solutions for this issue. (1) Establish VPN connections among readers and cloud in a network layer. (2) In application layer design an RFID authentication protocol protecting backend security [1]. Secondly, these schemes are required to prevent the privacy of tags/readers from untrustworthy cloud. Therefore, readers/tags should provide the confidentiality about data storage, which is against the cloud.

3. PROPOSED SOLUTION

3.1 VPN AGENCY

Existing cloud based RFID system has four participants. They are tag owner, verifier, VPN agency and cloud provider [1] [6]. The VPN agency has VPN routing between readers and the cloud. Cloud service of RFID authentication is given by cloud provider to the verifier and tag owner. VPN routing makes communication between the reader and cloud as secure as in privet intranet. Attackers are able to intercept, block and resend the TCP/IP packets in the network layer. On the other hand, network-layer-anonymity of readers accessing the cloud is achieved.

3.2 Encrypted Hash Table



Index	Content
H(RID||TID||SID)	E(RID||TID||SID||Data)
.....	.....

Figure 3: Proposed Cloud-based RFID authentication scheme

An EHT is proposed to prevent client's data confidentiality and access anonymity from revealing to the cloud provider. It is illustrated in Figure 4. The index which is a hash digest H (RID||TID||SID) uniquely denotes the session with SID from the reader with RID to tag with TID. The record indexed by H (RID||TID||SID) is E (RID||TID||SID||Data). It is a cipher text according to the reader defined encryption algorithm with a reader managed key. The RID field is used to check the integrity of the cipher text after decryption by reader. Mutual authentication is done using TID between reader and the tag. The SID field is the identifier which is a term in a reader defined sequence. The data field stores any application data such as location of tag and access time.

3.3 Proposed Cloud-based RFID authentication Protocol

The proposed cloud based RFID authentication protocol is illustrated in Figure 4 [1]. For simplicity, replace RID by R, replace TID by T and SID by S. Encrypted function E (RID||TID||SID||Data) in EHT is now simplified to E (R||T||S). Other notations listed in this section are as shown in Table 1. S+1 is the next incremental term after S^{th} term in the sequence defined by reader.

1st step is for the reader to obtain T and S. The tag generates H (T||R||S) as an authentication request and sends generated authentication request to the reader. H (R||T||S) acts as an index to the cipher text E (R||T||S).

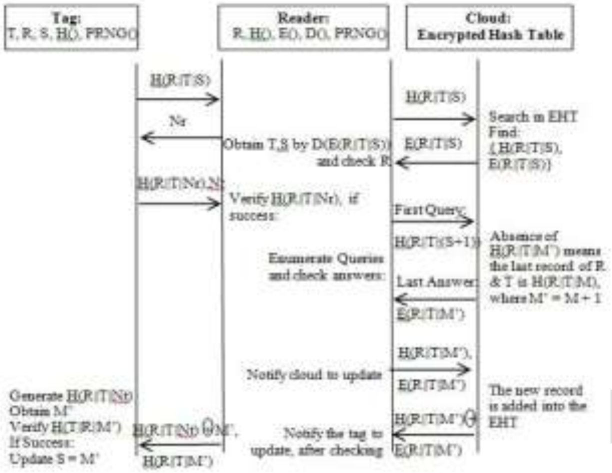


Figure 4: Proposed cloud based RFID authentication Protocol

The reader does the following operation. (1) It reads the cipher text from the cloud EHT and decrypts it in the useful form (2) It then verifies R for integrity and obtains T and S. Authentication of the tag take place in 2nd step. The reader challenges the tag by generating a random number Nr. The tag calculates hash based on challenge Nr received from reader. The tag uses H (R||T||Nr) to generate random nonce Nt and sends Nt as its challenge to the reader. Synchronization of S between the encrypted hash table (EHT) and the tag take place in 3rd step. The reader checks the integrity after reading the next record indexed by H (R||T||(S+1)) from the EHT. Tag has been desynchronized if the valid record is present in EHT. The reader continues the same action until it finds the last valid record, assuming its SID is M. In 4th step the cloud EHT gets updated. In EHT, cipher text E (R||T||M') having index H (R||T||M') is added by reader, where M'=M+1. A message of H (R||T||M') + H (E (R||T||M')) is send back to the reader from the cloud to confirm that the updating is successful. 5th step is to send a comprehensive response to be verified by the tag. In response to tag's random challenge Nt, reader calculates H (R||T||Nt). For simple encryption, response is XORed with M'. Encrypted M' is sent to tag with index H (R||T||M') and get verified by a tag. 6th step does authentication of the reader and also it repairs the desynchronization. To obtain M', tag calculates H (R||T||Nt). Calculated value gets XORed with the received value H(R||T||Nt) M'. It then calculates and verifies H(R||T||M'). If success, it means the M' is not modified. By updating S=M' on the tag, synchronization is achieved.

4. IMPLEMENTATION

4.1 Mathematical Model

In the proposed cloud based RFID authentication scheme readers anonymously access the cloud through wireless or wired connections. An encrypted hash table stores the client's secrets in encrypted form so that secrets should not be easily revealed to the cloud [3]. The first RFID authentication protocol is proposed which preserves the privacy of readers and tags.

Defining System:

Consider an organization with N employees S = {}

Identifying input:

Let, S = {Db, U, T, A, R, Cp} Where,

Db = System database with two tables:

- Employee
- RFID track

U is set of users such that,$u_1, u_2, u_3 \dots u_n \in U$

T is set of users track such that, $t_1, t_2, t_3 \dots . t_n \in T$

A is set of user's attendance such that, $a_1, a_2, a_3 \dots a_n \in A$

R is set of user's RFID tag such that, $r_1, r_2 \dots r_n \in R$

Venn diagram of the System:

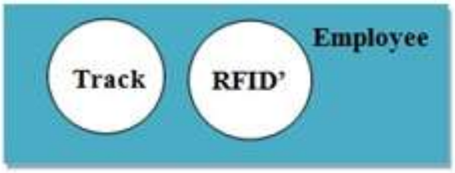


Figure5: Set diagram of employee management system

Functionalities:

The functions of the system are as follows:

(1) U = newEmployee (u_id, u_name, u_add, RFID')
Where,
RFID' = SHA1 (RFID tag)

SHA1 algorithm:

Input: Max 264-1 bit uses 512 bit block size
Output: 160 bit digests
Steps:

- Padding message with single one followed by zeros until the final block has 448 bits and appends the size of original message as an unsigned integer of 64 bit.
- Initialize the 5 hash blocks (h_0, h_1, h_2, h_3, h_4) to the specific constants defined in SHA1 standard
- Hash (for each 512 bit block)
  - ➢ Allocate an 80 words array for the message schedule
    - ✓ First 16 words are obtained by splitting message into 32 bit block.
    - ✓ Rests of the words are generated by following algorithm:

    Word $_{[i-3]}$ XOR Word $_{[i-14]}$ XOR Word $_{[i-16]}$ then left rotate it by 1 bit.

  - ➢ Loop 80 times doing the following:
    - ✓ Calculate SHAfunction() and constant K(these are based on current round number).
    - ✓ e = d
    - ✓ d = c
    - ✓ c = b(rotated left 30)
    - ✓ b = a
    - ✓ a = a(rotated left 5) + SHAfunction() + e + k + Word$_{[i]}$
  - ➢ Add a, b, c, d and e to the hash output.
- Output the concatenation (h_0, h_1, h_2, h_3, h_4) which is the message digest.

---

(2) t = newTrackInfo (RFID', location, date, time)
Keep track of particular employee at different time.

(3) a = getAttendenceInfo (RFID', Date)
Calculate employee attendance for particular period.

4.2 Block Diagram of the System

Block diagram of employee management system using cloud based RFID authentication is illustrated in Figure 6. System contains the following parts**:**

i. RFID Reader:
It is used to read the tags using radio channels and passes to the verifier for the authentication.

ii. Webcam:
Webcam is used to take the snapshot when reader tries to read the tag.

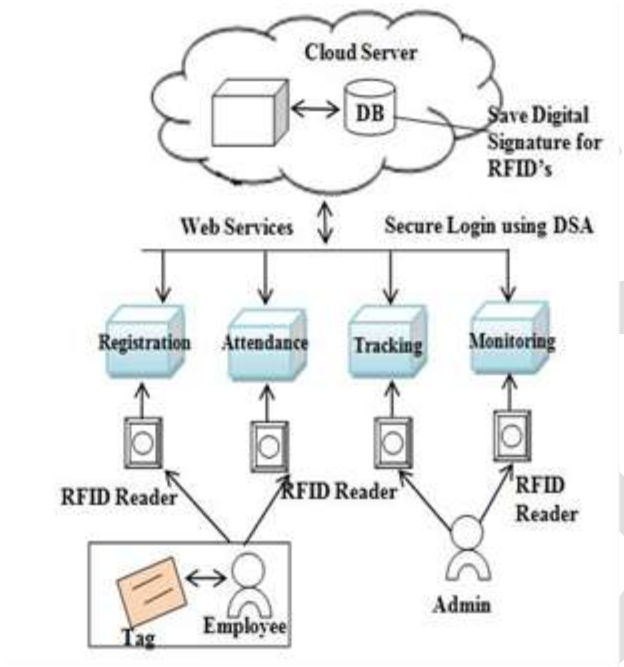


Figure 6: Employee management system using Cloud based RFID authentication

iii. Cloud Service provider:
Cloud service providers are those who provide private/public cloud. Different terminals can be connected to the cloud through the internet network. Deploying employee database, tracking database, admin web service module on the public cloud enable users to access database and web service from anywhere/anytime using Internet.

iv. Admin:
Admin may be the individual machine which has administrative functionality. Admin is connected to cloud service provider via internet connectivity. Admin's web service is deployed on the public cloud which client can access.

v. Client:
Client may be the individual machine or a thin client. Client is connected to cloud service provider using internet connectivity.

4.3 Hardware and Software used:

Hardware Configuration

i. Processor- Pentium-IV
ii. Speed-1.1 GHZ
iii. RAM-256 MB (Min)
iv. Hard Disk-20 GB
v. Key Board- Standard Windows Keyboard
vi. Monitor-SVGA

Software Configuration

i. Operating System - Windows XP/7/8
ii. Programming Language - Java
iii. Database - MySQL

iv. Tools, Net beans
v. Cloud Provider: Jelastic

5. EVALUTION RESULT

In this system of employee management, a new cloud based RFID authentication protocol is developed which provides security and confidentiality. It helps for calculating attendance, salary of an employee and also keeps a track of him/her. It provides other advantages like deployment cost savings, pervasiveness of service and scalability.

Also, Comparison of the tag verification complexity in traditional sever based model, server-less model and cloud-based RFID model is shown in Figure 7. Both server-based and server less RFID authentication protocols depends on search through the database or AL to find matching TID. It makes computational complexity to verify tags as O (n), where n is number of tags. It means these two protocols are not well scalable. In proposed protocol index H(R|T|S) is generated by tag, it is then send to reader. Reader then read the matched record from EHT instead of searching through all TID's. Hence, complexity of proposed scheme is only O (1). That means, it is better scalable than most of the other protocols.

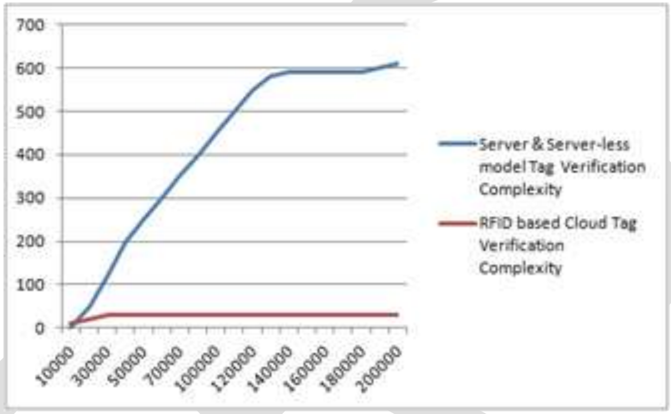


Figure 7: Comparison in the complexity of protocols

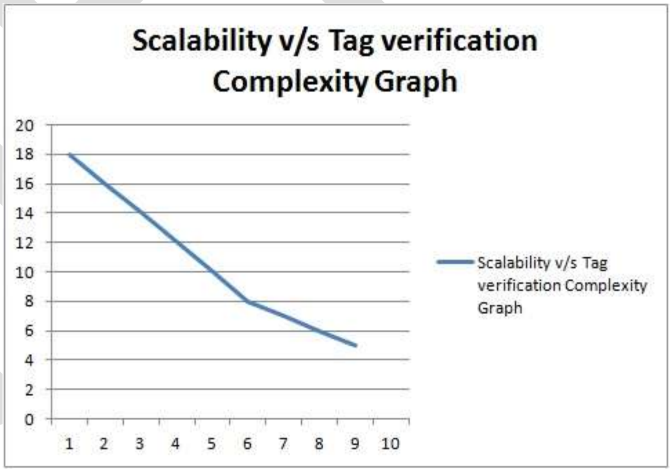


Figure 8: Scalability v/s tag verification complexity graph

Other points of comparison are listed in the following table.

Table 1: Comparisons

RFID authentication schemes	**Backend-server Based**	**Server-less**	**Proposed cloud-based**
Tag operations	PRNG/CRC	PRNG/HASH	PRNG/HASH
Pay on demand deployment	No	No	Yes
Offline Authentication	No	Yes	No
Pervasive Authentication	No	No	Yes
Mutual Authentication	Yes	No	Yes
Verification Complexity	O (n)	O(n)	O (1)
Tag owners Privacy	Reveled	Preserved	Preserved
Reader holders privacy	Undefined	Revealed	Preserved
Database Encryption	Not at all	Partial	Entire

6. CONCLUSION

The employee database is structured as an EHT. It prevents private user data from leaking to malicious cloud provider. It gives the first RFID authentication protocol which preserves tags and readers privacy against the database keeper. According to comparisons with two classical schemes the proposed scheme has advantages as like (1) the resource deployment is pay-on-demand. (2) The cloud-based service is pervasive and customized. (3) This scheme is more scalable and having complexity O (1) to verify a tag. (4) The proposed scheme preserves mobile reader holder’s privacy.

REFERENCES:

[1] WieXie, et al., “cloud-based RFID Authentication,” in IEEE International Conference on RFID 2013, pp.168-175.

[2] I. Syamsuddin, et al., “A survey of RFID authentication protocols based on Hash-chain method,” in 3rd International Conference on Convergence and Hybrid Information Technology, ICCIT 2008, November 11, 2008-November 13, 2008, Busan, Korea, Republic of ,2008,pp.559-564.

[3] J. Guo, et al., “The PHOTON family of lightweight hash functions,” in 31st Annual International Cryptology Conference, CRYPTO 2011, August 14,2011-August 18,2011, Santa Barbara, CA, United States, 2011, pp.222-239.

[4] A.Chattopadhyay ,et al., “Web based RFID asset management solution established on cloud services,” in 2011 2nd IEEE RFID technologies and Applications Conference, collocated with the 2011 IEEE IMWS on Millimetre Wave Integration Technologies, ,September 15,2011-September 16, 2011, Sitges, Spain,2011,pp.292-299.

[5] T.-C. Yeh, et al., "Securing RFID systems conforming to EPC class 1generation 2 standard," Expert Systems with Applications, vol. 37, pp.7678-7683, 2010.

[6] B.AndalSupriya, et al., “RFID based cloud supply chain management,” in International Journal of Scientific & Engineering Research, vol.4, issue 5, May 2013, pp.2157-2159