Development of Mechanism of Integrity in M-Commerce Using Joint Signature Scheme

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Abstract—This research focuses on providing integrity in mobile transactions. The main contribution for this paper is to develop mechanism which can provide integrity in mobile payment methods by using joint signature scheme, as it uses fewer resources. Different hash functions and time stamping is used for providing integrity of data. The result obtained by this research shows that integrity issue is resolved in mobile commerce domain. Message as well as time stamp is send through trusted third party from sender to receiver. Experimental results shows that different hash functions used for hashing will produce different results, in context of time, memory and throughput and it also depends upon message size.

Index Terms—Integrity, joint signature scheme, mobile-commerce, mobile-payment.

I. INTRODUCTION

As world of technology is making heaps now a day, so need for security measures in such technology is also growing rapidly because without basic measure of information security such technology will become useless. Thus to have an efficient use of information technology today we have to make it secure. The purpose of this research is to ensure integrity in m-commerce, as integrity is the one of the most sensitive issue in m-commerce. Mobile commerce is about buying and selling of goods and services by using mobile phones without any restriction of location. In mobile commerce, consumer sends a payment request via an secure message service (SMS) text message to a short code and a premium charge is applied to their phone bill or their online wallet.

Different security issues are involved during transactions through mobile phones such as confidentiality, integrity, non-repudiation, origin authentication etc. All of the security features should be handled with great care for providing a secure mobile commerce. For security we can use a lot of techniques such as, digital signatures, hash functions, Encryption/decryption, joint signatures etc. Among the entire techniques provided joint signature scheme has great importance for providing secure transactions because it is computationally low, less expensive and uses less resources.

This research is based on providing integrity of messages in mobile commerce and this is done by using joint signature scheme. In real world it may happen that during transaction real message is not received at the receiver end, or any intruder may change the message so the transactions must be secured and confidentiality should be supported in it. The main objective of this research paper is that to truly provide integrity mechanism using joint signature for secure mobile transactions.

Section II includes the related work Section III provides the description of the proposed framework. Section IV provides the proposed technique. Section V presents experimental results and analysis with the help of graphs. Section VI gives conclusion of system and gives the future work.

II. RELATED WORK

Now a day’s mobile commerce is gaining importance and different security services are related with mobile transactions, such as non-repudiation, authentication, for secure transactions. For this purpose He and Zhong [1], introduces joint signature scheme. In which two parties signs the message. This scheme is based on hash functions and digital signature methods. Joint signatures provide security services with low computational resources and communication cost. Singh and Khan [2] presents the security of joint signature. His proposed scheme presents the security of message by hybrid encryption method and digital signatures. His proposed scheme uses International Data Encryption Algorithm-Range Scaling Algorithm (IDEA-RSA) for encrypting message and RSA digital signature is used for getting digital signatures. This scheme uses “encrypt-then-sign” instead of “sign-then-encrypt” policy. Ji-yong and Ryu [3], this paper propose secure key checksum which is a secure mechanism using encryption to provide confidentiality and integrity. Issues of confidentiality and integrity are resolved in network encoding. For providing confidentiality secure key checksum utilizes encryption and for integrity it verifies encoded block. Ayub et al. [4], proposed a technique for origin authentication of digitally signed message by using joint signature scheme in mobile commerce. The issue of origin authentication in m-commerce is resolved by this technique. Proposed technique is efficient in mobile domain because it can be used with limited resources in mobile commerce. An experimental analysis shows that proposed technique overcomes the major drawbacks of traditional digital signed message. Aprville et al. [5], is about providing integrity for archival of organizations. For coping with the problem of providing integrity a time stamped scheme is introduced. This paper proposed triple integrity mechanism that include data integrity, time integrity, copy integrity. This scheme is used in digital signatures.
III. PROPOSED SOLUTION

The proposed framework model shown in fig 1 explains that key distribution center shares key between Message Sender (MS) and Message Receiver (MR). Message Sender (MS) sends Message, along with time stamp (TS), encrypt it then compute hash of it and send it to Message Receiver (MR) through Trusted Third Party (TTP). Symbols used in this paper are shown in table I.

<table>
<thead>
<tr>
<th>TABLE I: SYMBOLS.</th>
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<tbody>
<tr>
<td>MS</td>
</tr>
<tr>
<td>MR</td>
</tr>
<tr>
<td>TTP</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>K1</td>
</tr>
<tr>
<td>H</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>PRTP</td>
</tr>
<tr>
<td>PUTTP</td>
</tr>
<tr>
<td>HOAC</td>
</tr>
<tr>
<td>HMAC</td>
</tr>
<tr>
<td>EP</td>
</tr>
<tr>
<td>DP</td>
</tr>
<tr>
<td>E(HOAC)</td>
</tr>
<tr>
<td>E(M)</td>
</tr>
<tr>
<td>E(HMAC)</td>
</tr>
<tr>
<td>TSA</td>
</tr>
<tr>
<td>TS</td>
</tr>
<tr>
<td>PR_TSA</td>
</tr>
<tr>
<td>HTS</td>
</tr>
</tbody>
</table>

Fig 1 show that in doing mobile transactions three parties are involved i.e. Message Sender (MS), Trusted Third Party (TTP) and Message Receiver (MR). Secrete keys are shared between these three parties through a key distribution center. Message sender will send the message, time stamp and hash of the messages to the trusted third party where it is signed by Trusted Third Party and send to Message receiver.

Fig 2 represents the detailed view of integrity of both message as well as time stamp will be provided in mobile commerce using joint signature scheme.

The proposed model is shown in Fig. 2. The technical description of this model is explained below.

Technical Description of Proposed Model

ALGORITHM:

In this section we explain about the detail technical description of proposed model. Initially before starting the keys are being shared between Message Sender (MS) and Message Receiver (MR) through Trusted Third Party (TTP). The steps for proposed technique are explained below:

Step 1:
Message Sender (MS) sends an encrypted message to Message Receiver (MR) and gives a joint signature with the help of Trusted Third party (TTP).

Step 2:
In addition with message send to Message Receiver (MR) by Message Sender (MS) a Time Stamp (TS) is also send to Message Receiver (MR) for providing integrity for both time as well as message.

Step 3:
Firstly as user start entering the message, timer will get start to calculate the time stamp till encryption. Then one of the hash function is applied on the message i.e. SHA1, SHA512, ShA256, MD5.

Step 4:
Then encrypted message, hashed message as well as time stamp are concatenated and send to Trusted Third Party (TTP). TTP will behave as a linking party between Message Sender (MS) and Message Receiver (MR).

Step 5:
After receiving an encrypted message from TTP, message receiver decrypts that message with the same decryption technique by which it was encrypted as well as it will be compared for providing integrity of message. In the same way time stamp will also be compared after receiving the message for providing integrity of time.

Pseudo code of proposed model is

Algorithm: Hash Functions

SHA1

Algorithm for hash function SHA1 is shown in table II.

<table>
<thead>
<tr>
<th>TABLE II: ALGORITHM FOR HASH FUNCTION SHA1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UnicodeEncoding UE = new UnicodeEncoding();</td>
</tr>
<tr>
<td>byte[] hexValue;</td>
</tr>
<tr>
<td>byte[] message = UE.GetBytes(text);</td>
</tr>
<tr>
<td>SHA1Managed hashString = new SHA1Managed();</td>
</tr>
<tr>
<td>string hex = &quot;&quot;;</td>
</tr>
<tr>
<td>hashValue = hashString.ComputeHash(message);</td>
</tr>
<tr>
<td>foreach (byte x in hashValue) {</td>
</tr>
<tr>
<td>hex += String.Format(&quot;{0:x2}&quot;, x);</td>
</tr>
<tr>
<td>}</td>
</tr>
<tr>
<td>return hex;</td>
</tr>
</tbody>
</table>
Fig. 1. Proposed framework for providing integrity in m-commerce.

**Message Sender (MS)**

**Trusted Third Party (TTP)**

**Message Receiver (MR)**

**Secure Channel**

**Key Distribution center**

**Shared Id key K1**

**Shared Id key K2**

**Message Time Stamp**

**HOAC HMAC**

**Fig. 2. Proposed model for providing integrity of messages and time stamp in m-commerce.**

**SHA256**

Algorithm for producing hash function SHA256 is shown in table III.

TABLE III: ALGORITHM FOR HASH FUNCTION SHA256.

```csharp
UnicodeEncoding UE = new UnicodeEncoding();
byte[] hashValue; byte[] message = UE.GetBytes(text);
SHA256Managed hashString = new SHA256Managed();
string hex = "";
hashValue = hashString.ComputeHash(message);
foreach (byte x in hashValue)
{
    hex += String.Format("{0:x2}", x);
}
return hex;
```

**SHA512**

Algorithm for producing hash function SHA512 is shown in table IV.

TABLE IV: ALGORITHM FOR HASH FUNCTION SHA512.

```csharp
UnicodeEncoding UE = new UnicodeEncoding();
byte[] hashValue; byte[] message = UE.GetBytes(text);
SHA512Managed hashString = new SHA512Managed();
string hex = "";
hashValue = hashString.ComputeHash(message);
foreach (byte x in hashValue)
{
    hex += String.Format("{0:x2}", x);
}
return hex;
```

**MD5**

Algorithm for producing hash function MD5 is shown in table V.

```csharp
UnicodeEncoding UE = new UnicodeEncoding();
byte[] hashValue; byte[] message = UE.GetBytes(text);
SHA1Managed hashString = new SHA1Managed();
string hex = "";
hashValue = hashString.ComputeHash(message);
foreach (byte x in hashValue)
{
    hex += String.Format("{0:x2}", x);
}
return hex;
```
TABLE V: ALGORITHM FOR HASH FUNCTION MD5.

```csharp
UnicodeEncoding UE = new UnicodeEncoding();
byte[] hashValue;
byte[] message = UE.GetBytes(text);
MD5Managed hashString = new MD5Managed();
string hex = "";
hashValue = hashString.ComputeHash(message);
foreach (byte x in hashValue)
{
    hex += String.Format("{0:x2}", x);
}
return hex;
```

**Algorithm: Time Stamp Function:**
Algorithm for time stamping is shown in table VI.

TABLE VI: ALGORITHM FOR TIME STAMPING.

```csharp
TimeSpan span = DateTime.Now.Subtract(da);
span.Milliseconds.ToString();
```

**Algorithm: Encryption Function:**
Algorithm for encryption is shown in table VII.

TABLE VII: ALGORITHM FOR ENCRYPTION USING AES.

```csharp
RijndaelManaged symmetricKey = new
RijndaelManaged();
```

First of all input is given to message sender, and timer got started, after input is entered encryption of entered message will be started and as encryption start, timer will get stop. Then one of the hash functions (SHA1, SHA256, SHA512, and MD5) will be applied on encrypted message. Then after this concatenation of encrypted message, hashed message, and time stamp will be occur. Then message will be send to message receiver through trusted third party. Message receiver after receiving the message does decryption of the message. And then after decryption message as well as time stamp will be compared for integrity.

IV. EXPERIMENTAL RESULTS

A. Graphical comparison of time consumed by Hash Functions:
Time consumed by different hash functions i.e. SHA256, SHA1, SHA512, MD5 are shown in fig 3. In fig 3 time is shown along y axis where as hash functions are plotted against x axis. SHA256 consume more time for hasing for input ‘shahidalaptop’, SHA1 consume more time with input shahidalaptop, SHA512 consume more time with ‘haniahpc’, where as hash function MD5 will consume more time with input ‘shahidalaptop’. So we can conclude that as message size is larger than hash functions SHA256, SHA1, and MD5 will consume more time for hashing. Least time is consumed by hash function SHA1 and MD5 for input ‘sobiacar’

B. Graphical Comparison of Memory Consumed by Hash Functions:
Memory consumed by different hash functions i.e. SHA256, SHA1, SHA512 and MD5 is shown in fig. 4 In fig. 4 memory in bites is taken along y axis where as hash functions are taken along x axis. Memory consumed by input ‘haniahpc’ is largest for hash function SHA256, SHA1, SHA512 and MD5 where least memory consumed by hash functions SHA256, SHA1, SHA512 and MD5 is for input ‘sobiacar’.

C. Graphical Comparison of Throughput Consumed by Hash Functions:
Throughput consumed by hash functions SHA256, SHA1, SHA512 and MD5 is shown in fig. 5. In fig 5 throughput is taken along y axis where as hash functions are taken along x axis. Least through for hash function SHA256 is for input ‘shahidalaptop’ where least throughput for hash functions SHA1, SHA512, MD5 is for input ‘sobiacar’. Maximum throughput for all hash functions is for input ‘haniahpc’.

D. Graphical Comparison of Time Consumed by AES Encryption:
Time consumed for encryption of message using AES is shown in fig 6. In fig 6 time in milliseconds is taken along y axis and inputs are taken along x axis. Time for encryption will change for each input. In our example time consumed by AES encryption method is maximum for input ‘shahidalaptop’ and minimum for input ‘haniahpc’.
E. Graphical Comparison of Time Consumed by AES Decryption:

Time consumed for decryption of message using AES is shown in fig 7. In fig 7 time in milliseconds is taken along y axis and inputs are taken along x axis. In our example time consumed by AES decryption method is maximum for input ‘sobiacar’ and minimum for input ‘shahidalaptop’.

Fig. 7. Time consumed by AES decryption.

V. CONCLUSION AND FUTURE WORK

In this paper, we present a model for providing integrity in mobile commerce. That model uses different hash functions for applying hash on the message as well as uses time stamping for providing integrity of time as well. By encrypting message and applying any one of the hash function on the message we achieve integrity of the message, and when we concatenate time stamp with encrypted message as well as hashed message we will get integrity for time also. That will make our integrity technique stronger. At the receiving end message will be compared to provide integrity, in this way no intruder can intrude that message which is sending along network. By this research we have overcome the issue of integrity in m-commerce with less resources being consumed.

In future this research work can be extended for different encryption and decryption techniques and copy integrity can also be done as future work of this research work.

REFERENCES


Biographies

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