Implementation of New Method to Generate a Key in Automatic Variable Key for Perfect Security

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Abstract

Automatic variable key is a technique to generate time variant key. In this paper, we have proposed a new key generation technique. The proposed technique provides higher level of security compared to that provided by other key generating schemes. The newly generated keys in the technique are more random.

Keywords: Randomness, Standard Deviation, Alternating and Shifting Automatic Variable Key, Computing and Shifting Automatic Variable Key, Decimal Shifting Automatic Variable Key, Automatic Variable Key

1. Introduction

The fundamental research of Shannon [1-2] on perfect security proposed that if the key is made variable from data to data or session to session in data communication, perfect security can be realized. The first practical approach of perfect security is due to Automatic Variable Key (AVK), proposed by Bhunia [4-7] in the year 2006. There are many researchers like Goswami, Banerjee and Dutta [8-9] who proposed more secure techniques based on Automatic Variable Key (AVK). Basic fundamentals of AVK technique is based on the following procedure:

Let K_0 be the initial key that will be exchanged between sender and receiver in a secret mode like RSA. Subsequent keys for different data D_{i-1} will be automatically generated between sender and receiver as follows:

$$K_i = K_{i-1} \oplus D_{i-1} \quad \forall i > 0 \dots \dots \dots (1)$$

Where K_{i-1} is the previous key and K_i is the generated key.

The key is made variable with exchanged data between sender and receiver. The generated new key is used for exchanging next data.

In Computing and Shifting Automatic Variable Key [14] technique proposed by Goswami in the year 2013, the key is made variable by agreement that creates new key for each data.

Subsequent keys for different data (D_{i-1}) will be generated as per the following equation

$$K_i = K_{i-1} \oplus D'_{i-1} \quad \forall i > 0 \dots \dots \dots (2)$$

Where K'_{i-1} = bit wise right shifted key K_{i-1} / number of shift will be the number of 1's present in K_{i-1} and D'_{i-1} = bit wise left shifted data D_{i-1} / number of shift will be the number of 1's present in D_{i-1} .

In Decimal Shifting Automatic Variable Key [11] technique the key is made by another agreement that creates another new key.

$$K_i = K_{i-1} \oplus D_{i-1} \quad \forall i > 0 \dots \dots \dots (3)$$

Where K'_{i-1} =bit wise right shifted key K_{i-1} /the number of shift will be corresponding decimal value of $K_{i-1} \oplus D_{i-1}$.

The newly generated key is used subsequently for exchange of data.

In Alternating and Shifting Automatic Variable Key [16] technique the key is made variable by an agreement that also creates new key for each data.

Initial key K_0 is exchanged between sender and receiver and subsequent key K_i (i^{th} stage) is generated by both sender and receiver as follows:

$$K_i = K'_{i-1} \oplus D_{i-1} \quad \forall \quad i > 0 \dots \dots \dots (4)$$

$$K_{i+1} = K_i \oplus D'_{i-1} \quad \forall \quad i > 0 \dots \dots \dots (5)$$

Where K'_{i-1} =block wise shift K_{i-1} /the number of shift will be total length of K_{i-1} divided by 2.

and D'_{i-1} =block wise shift D_{i-1} /the number of shift will be total length of D_{i-1} divided by 2.

2. Proposed Scheme

We have proposed a new technique to generate new key in Automatic Variable Key. The main purpose is to generate new key to enhance more security by making more randomness between two successively generated keys.

The proposed technique is as follows:

Step 1: K_0 =initial key and D_0 =first data

Step 2: Count Number of 1's and 0's in the previous key (K_{i-1})

Step 3: Count Number of 1's and 0's in the previous data (D_{i-1})

Step 4: $K'_1 \leftarrow K_0 \oplus D_0$.

Step 5: $K_1 \leftarrow CLS(K'_1)$

Step 6: $K'_2 \leftarrow K_1 \oplus D_1$

Step 7: $K_2 \leftarrow CLS(K'_2)$

Continue this procedure until dataset $\neq \emptyset$

Step 8. Exit

Where CLS (K'_i) is circular left shift of K'_i by n bits.

The above mentioned technique may be named as LSAVK (Left Shifting Automatic Variable Key)

Example:

Let us assume, Initial key (K_0) = 0110011100111101111000101001000011110001001000 001010011010001100 and initial data (D_0) = 0100011001101111011100100111011101 100001011100100110010000100000

To generate key K'_1 , initial key (K_0) perform the XOR operation with data D_0

$$K'_1 \leftarrow K_0 \oplus D_0$$

$$\begin{array}{l} 0110011100111101111000101001000011110001001000001010011010001100 \oplus 010001 \\ 1001101111011100100111011101100001011100100110010000100000 = 0010000101010 \\ 010100100001110011110010000010100101100001010101100 \end{array}$$

$$K_1 \leftarrow CLS(K'_1) \text{ [1bit circular left shift of } K'_1]$$

$$K_1 = 0100001010100101001000011100111100100000101001011000010101011000$$

$$c) K'_2 \leftarrow K_1 \oplus D_1$$

$$\begin{array}{l} 0100001010100101001000011100111100100000101001011000010101011000 \\ \oplus 0110010101110010011100100110111101110010001000000110001101101111 = 0010 \\ 011111010111010100111010000001010010100001011110011000110111 \end{array}$$

$K_2 \leftarrow CLS(K'_2)$ [2 bit circular left shift of K'_2]
100111110101110101001110 1000000101001010000101111001100011011100
and procedure is continued until dataset $\neq \emptyset$

3. Review of Existing Computing and Shifting Automatic Variable Key, Alternating and Shifting Automatic Variable Key, Decimal Shifting Automatic Variable Key, Automatic Variable Key

3.1. Explanation of Computing and Shifting Automatic Variable Key (CSAVK)

Let us assume that sender sends initial data $D_0=010110110101111001110001010110010101100001010101111011001110011$ in encrypted through initial key $K_0=111011000101011100101110110111001101111011110001001101011000110$. As per Computing and Shifting Automatic Variable Key technique in equation number (2) the new key will be generated as:

$$K_1 = 111000100101110000001010110100001101001111110000011100111100000$$

and data will be generated as:

$D_1 = 1001010110000101010111110110011100110101101101011110011100010101$

Data has been changed by left shifting the previous data (D_0) up to the total no of 1's present and key has been changed by right shifting the previous key (K_0) up to the total no of 1's present in key.

$$K_1' \leftarrow K_1 \oplus D_1$$

$$\begin{array}{l} 111000100101110000001010110100001101001111110000011100111100000 \oplus 1001 \\ 010110000101010111110110011100110101101101011110011100010101 \end{array}$$

$$K'_1 = 001010111101000111110111011011110000100000011111100101000000100010$$

3.2. Explanation of Decimal Shifting Automatic Variable Key (DSAVK)

Let us assume that sender sends initial data $D_0 = 00000000000000000000000000000000$ in encrypted through initial key $K_0 = 00000110000001100000011000000110000001100000011000000110$. By the Decimal Shifting Automatic Variable Key technique in equation number (3) the new key will be generated by right shift operation and key will be as:

$$K_1 = 0000011000000110000001100000011000000110000001100000011000$$

$$K_1 \leftarrow K_0 \oplus D_0$$

[illegible]

$$K_1 = 00000110000001100000011000000110000001100000011000000110$$

3.3. Explanation of Alternating and Shifting Automatic Variable Key (ASAVK)

Let us assume that sender sends initial data $D_0=0000000000000000000000$
 $000001101101011111110000000000001010$ in different form key $K_0=01111100$
 $10010011001111011101111111011110101$ 01010111110001000. By the
 Alternating and Shifting Automatic Variable Key technique in equation number (4-5) the
 next key will be generated as: 100100000010011010101111000000100010111011
 0111100111101110 10110

3.4. Explanation of Automatic Variable Key (AVK)

Let us assume that sender sends initial data $D_0 = 101111001010010011110110011000110011101011011110100111111111011$ in different form

key $K_0=11111000000110110111000111110000110110100100100100011000111011000$
01100100. By the Automatic Variable Key technique in equation number (1) the new key
will be generated as: 0100010010111111100001111001001111100000100101 11100001
1100010111

4. Performance Analysis

For performance analysis of proposed (Left Shifting Automatic Variable Key) we have
taken initial key as $K_0=01100111001111011110001010010000111100010010000010$
10011010001100 with following three datasets:

Dataset 1 = "Forward error correction is the process in which the receiver tries to get
the message by using redundant bits where as in retransmission receiver asks the sender
to resend the message".

Dataset 2 = "Objective of security under a key would be achieved when any one
authorized to exchange data gets a key".

Dataset 3 = "Frequency analysis is based on the fact that, in any given stretch of written
language, certain letters and combinations of letters occur with varying frequencies".

Using the same initial key and data set pairs we have found the randomness and
standard deviation curves portrayed from Figure 1-6. For analysis, we have assumed
randomness is a parameter which is a measure of amount of variation made between
successive keys. For example if $K_i=10101011$ and $K_{i+1}=00111010$. So the randomness is
3. These results are found more productive and superior among other techniques as per
literature survey.

Figure 1. Randomness of Successive Keys of Different Techniques for Dataset1

Figure 2. Randomness of Successive Keys of Different Techniques for Dataset2

Figure 3. Randomness of Successive Keys of Different Techniques for Dataset3

5. Comparison

We have proposed a technique call Left Shifting Automatic Variable Key and we compared the average randomness and standard deviation of Left Shifting Automatic Variable Key technique with other key generation techniques invented by various other researchers such as Alternating and Shifting Automatic Variable Key, Computing and Shifting Automatic Variable Key, Decimal Shifting Automatic Variable Key, and Automatic Variable Key. The randomness and standard deviation were calculated by running programs and results so obtained are portrayed in figures.

Figure 4. Comparison of Average Randomness for Different Techniques for Dataset1

Figure 5. Comparison of Average Randomness for Different Techniques for Dataset 2

Figure 6. Comparison of Average Randomness for Different Techniques for Dataset 3

Figure 7. Comparison of Standard Deviation for Different Techniques for Dataset 1

Figure 8. Comparison of Standard Deviation for Different Techniques for Dataset 2

Figure 9. Comparison of standard Deviation for Different Techniques for Dataset 3

To find the superiority of the proposed technique compared to various other techniques of Automatic variable Key such as Alternating and Shifting Automatic Variable Key, Computing and Shifting Automatic Variable Key, Decimal Shifting Automatic Variable Key and Left Shifting Automatic Variable Key, we have computed the average randomness and standard deviation of generated keys.

The comparison of average randomness and standard deviation portrayed in Figure 4-9.

From the graph of average randomness & standard deviation the following observations may be inferred:

- For similar dataset (dataset1, dataset2 and dataset3) and initial key, average randomness is varying in different session of secure data transmission for different techniques of Automatic Variable key.
- In some cases, it is found that the superiority of Left Shifting Automatic variable Key technique is higher than other techniques. In case of dataset1 this technique is higher than other techniques but in case of dataset2 and dataset3 it is vice versa.
- Standard deviation of Left Shifting Automatic Variable Key for dataset1 is higher than other techniques. In case of dataset2 and dataset3 the standard deviation of other techniques are higher than the proposed technique.

6. Conclusion

The generated key of Left Shifting Automatic Variable Key, Computing & Shifting Automatic Variable Key, Alternating & Shifting Automatic Variable Key, Automatic Variable Key and Decimal Shifting Automatic Variable Key are well established. After analyzing the experiments, it is found that the security ensured by Left Shifting Automatic Variable Key for dataset1 is much higher than other techniques. However, in case of dataset2, Decimal Shifting Automatic Variable Key is found to be superior to other techniques and similarly, in case of dataset3, Alternating and Shifting Automatic Variable Key technique is superior to. Therefore, from the experiments we can infer that the average randomness depends upon the dataset which we are used during data transmission. The superiority of Left Shifting Automatic Variable Key implies that the new technique can be applied with standard algorithms like RSA, AES and DES for encryption and decryption there by increasing the level of security to the next level in real applications.

References

- [1] C E Shannon, "Communication Theory of Secrecy System", the Bell System Tech J, **1949**.
- [2] C E Shannon, "A mathematical Theory of Communication", Bell System Tech J, 27, 379-423,623-656, **1948**.
- [3] M. Diffie, E. Hellman, "Exhaustive Cryptanalysis of the no of bits Data Encryption Standard", Computer, pp.74-84, **1977**.
- [4] C. T. Bhunia, "New approach for selective AES towards tackling error propagation effect of AE", ASIAN Journal of Information Technology, volume 5990, pp.1017-1022, **2006**.
- [5] P.Chakraborty, C.T.Bhunias, "A novel approach towards realizing optimum data transfer and AVK in Cryptography", International journal Computer Science & Network security, Korea, volume 8, No 5, pp.241-250, **2008**.
- [6] C.T.Bhunias, "Information Technology, Network and Internet", New age publication.
- [7] C.T.Bhunias, "Implementation of AVK with chaos theory and studied thereof", J IUP Computer Science volume V, No 4, pp.22-32, **2011**.
- [8] B. K. Singh, S.Banerjee, M.P.Dutta, C.T.Bhunias, "Generation of Automatic Variable key to make secure communication", International conference on recent cognizance in wireless communication& image processing-ICRCWIP, **2014**.
- [9] M.P.Dutta, S.Banerjee, C.T.Bhunias, "Two new schemes to generate automatic variable key to achieve the perfect security in insecure communication channel", In preceding of the International Conference on Advanced Research in Computer Science Engineering &Technology (ICARCSET, Eluru, India), **2015**.
- [10] R Subhra Goswami, S Chakraborty, C. T. Bhunia "Various new methods of Implementing Automatic Variable Key", Preceding of the 2nd international Conference Advanced Computer science and Engineering, pp.149-152, **2013**.
- [11] R Subhra Goswami, S Chakraborty, C. T. Bhunia, Abhinandan Bhunia, "New approach towards generation of Automatic Variable Key to achieve perfect security", ITNG, IEEE Computer Society, CPS,USA, Las Vegas, pp.489-491, **2013**.
- [12] R Subhra Goswami, S Chakraborty, C Tilak Bhunia, "Approach towards Optimum data transfer with various Automatic variable Key techniques to achieve perfect security with analysis and comparison", International Journal of Computer Application, Volume 82, Issue 1, **2013**.
- [13] R Subhra Goswami, S Chakraborty, C. T. Bhunia, Abhinandan Bhunia, "Generation of Automatic variable key under various approaches in cryptography system", J. Institute Engineering, India Ser. B, 94, 4,215-220.
- [14] C.T.Bhunias, Rajat Subhra Goswami, Swarnendu Kumar Chakraborty, "A new technique of AVK in achieving perfect security", 100th Indian Science Congress Association 3rd-7th, **2013**.
- [15] C.T.Bhunias, G. Mondal, S. Samaddar, "Theory and application of time variant key in RSA and that with selective encryption in AES", in preceding of EAIT (Elsevier Publications, Calcutta CSI), pp.219-221.
- [16] R Subhra Goswami, S Chakraborty, A Bhunia, C. T. Bhunia, "New techniques for generating of Automatic variable Key in achieving perfect security", J. Institute Engineering, India Ser. B, 95, 3, pp. 197-201, **2014**.
- [17] Rajat Subhra Goswami, S. Banerjee, M.P.Dutta, C.T.Bhunias, "Absolute key variation technique of AVK in Cryptography", In preceding SIN'15 of the 8th International Conference on security of Information and Networks(Sochi, Russia),8th-10th September, **2015**.

- [18] Rajat Subhra Goswami, Swarnendu Chakraborty, Chandan Tilak Bhunia, "A study to examine the Superiority of CSAVK, AVK over conventional encryption with a single key", International Journal of Security and Its Applications, Volume 10, No 2 , pp.279-286, **2016**.

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