

An Approach of Providing Secure and Time Efficient Confidentiality Algorithm

Shriya Pandey, Manish Shrivastava

Abstract: In today's world, the medium used for communication is internet, or a local area network which can transmit data from one end to another very fast. Communication through this medium changes the human life and now it is a part of daily life but there are also some major issues that should be solved for the betterment of this communication medium. One and also the major issue is security. Many algorithms have been proposed to provide security on the transmitted or stored data. Encryption/ Decryption algorithm and Steganography are one of them. Also there are many encryption/ decryption and steganography algorithm but there is always a competition to develop such an algorithm which is not only fast but also secure too. Taking step towards this direction, authors have proposed a new architecture for providing high confidentiality over transmitted data. The proposed architecture first encrypts the secret text with proposed encryption algorithm and then hides it behind another text file through steganography algorithm. Authors have proved that the proposed algorithm are not only time efficient but also secure through its implementation analysis.

Keywords- Computer Security, Network, Encryption, Decryption, Algorithm, Cryptography, Symmetric Key

I. INTRODUCTION

With the rapid growth in the computer technology, need of security also increases. There is always a requirement to keep the information confidential, so that unauthorized person cannot be able to gain the access of secret data. To provide confidentiality encryption/decryption algorithms are used. Encryption algorithm is an algorithm which takes a secret message and a key and shuffles the secret message in such a way such that no other person can guess the original meaning of that secret message without knowing that key. Only the key used at the time of encryption is used reshuffle the data in the original form. There are many encryption/decryption algorithms exist to provide confidentiality, but there is always a competition to develop an algorithm which is faster and more secure than existing algorithms.

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*Shriya Pandey, Information Technology, LNCT, Bhopal
Manish Shrivastava Information Technology, LNCT, Bhopal*

On the other hand steganography algorithms are also used to ensure the confidentiality. Steganography is a way of hiding the secret data behind any cover file such that no one can guess the presence of secret data with the naked eyes or without performing any additional work. Again, there are many steganography algorithms to provide confidentiality, but there are always competitions to develop a steganography algorithm which hide the complete data behind the cover file with minimum changes in the cover file and also keep the cover file less.

In this paper authors have developed a new architecture which is a combination of encryption/decryption algorithms and steganography algorithms.

II. PROPOSED WORK

The proposed architecture is a combination of two algorithms first encryption/ decryption algorithm which shuffles the data in such a way that unauthorized person cannot determine the original meaning of the text and then hide the data behind any other text file.

The proposed algorithm is a block cipher that divides data into blocks of equal length and then encrypts each block using a special logical operation and key. This algorithm uses symmetric key technique for encoding and decoding of data i.e. it uses the same key at both ends. The attractive feature of proposed algorithm is its time complexity. It is simple and converts any plaintext into cipher text very fast. Another plus point of proposed algorithm is that it protects the cipher text from Brute-force attacks as the large variable key length used in the encryption process. This algorithm generates 8 different key to encrypt the plaintext into cipher text. Thus without knowing the exact sequence of key, it will be very hard to gain plaintext from cipher text.

A. Encryption:

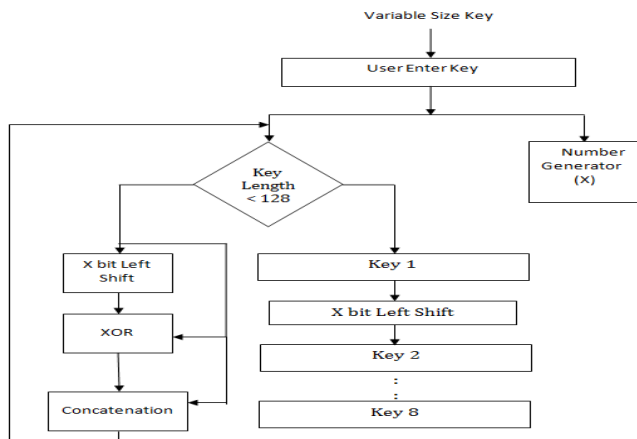


Figure 1 (a): Generation of eight different keys

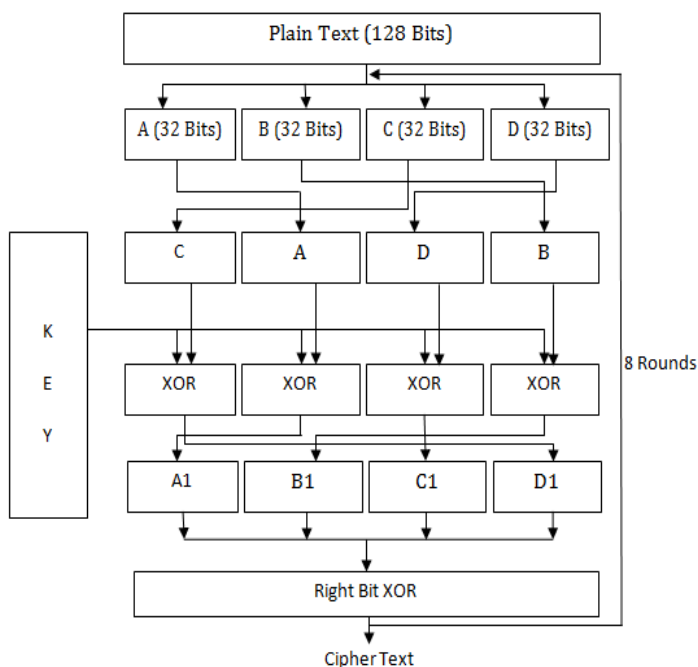


Figure 1 (b): Proposed Encryption Block

B. Proposed Encryption Algorithm:-

Proposed Encryption Algorithm is divided in to two part, first key generation and second encryption block. Steps to convert a plaintext into cipher text are as follows:

1. **Key Generation:** Figure 1 (a) shows the block diagram of key generation. Proposed key generation algorithm takes a variable length key. This key is used to generate a random number X and different 8 keys. Steps of creating 8 different keys are as follows:

- a. Key entered by user is used to generate a random number in between 0 to 7. This number is a sum of all the 1's bit mod 8.

- b. Now, if the length of key in bits is less than 128 then
 - i. Perform left shift of operation on a key by X bits.
 - ii. Now, the result of step i xor with the key
 - iii. Result of step ii is concatenated with the key.
 - iv. Repeat step i to ii, while the key length is less than 128.

c. If key length is greater than equal to 128 than the first 128 bits are used as first key. First key is left shifted by X bits and the result is key 2 repeat the same process to calculate all the eight keys.

2. **Encryption Block:** Encryption block converts the plaintext into cipher text. Steps of converting plaintext into cipher text are as follows:

a. First the complete plaintext is divided in to a block of 128 bits. If last block contains less bits then padding of zero bits make them equal to 128 bits block.

b. Now for each 128 bit plaintext block do the following steps:

- i. Divide the 128 bits block in to four 32 bits block.
- ii. Now, shuffle each block as shown in figure 1 (b).
- iii. Now the result of step ii is xor with key 1. (Keys are also divided in to four blocks of 32 bits.)
- iv. Result of step iii is again shuffled as mentioned in figure 1 (b).
- v. Now, all the block are concatenated and perform right bit xor operation on it. Right bit xor is xor of each bits with is right bits.
- vi. Repeat step i to step v eight times, but each time different keys are used from the key set generated at step 1.

c. After eight round the result comes is the cipher text of first 128 bits. Repeat step b for 128 bit plaintext block.

d. Exit.

C. Proposed Decryption Algorithm:-

Proposed decryption is exactly reverse of encryption process. Decryption process again divided into two parts. First key generation and second is decryption block.

1. **Key Generation:** Key generation of decryption block is exactly same as mentioned in encryption process.

2. **Decryption Block:** Decryption block is a reverse of encryption block. Steps of converting cipher text into plaintext are as follows:

a. First the complete cipher text is divided in to a block of 128 bits.

- b. Now for each 128 bit cipher text block do the following steps:
 - i. Perform reverse right bit xor operation on 128 bit cipher text.
 - ii. Divide the 128 bits block in to four 32 bits block.
 - iii. Now, shuffle each block as shown in figure 2 (a).
 - iv. Now the result of step ii is xor with key 8. (Keys are also divided in to four blocks of 32 bits.)
 - v. Result of step iii is again shuffled as mentioned in figure 2 (a).
 - vi. Repeat step i to step v eight times, but each time with different keys in reverse order are used from the key set generated at step 1.
- c. After eight round the result comes is the plaintext of first 128 bits. Repeat step b for 128 bit cipher text block.
- a. Exit.

- 2) Select a cover text file having number of spaces equal or more then number of bits in cipher text.
- 3) Now, to hide the cipher text, find the first space in cover file, if the bit in cipher text is 0 leave the blank space as it is but if the cipher bit is 1 then replace the space with character whose ASCII value is equal to 160.
- 4) Repeat step 3 for all the bits in the cipher bit stream.

At the time of unhiding, reverse process will be performed, means if space encounter whose ASCII value is 32 means 0 and space encounter whose ASCII value is 160 means 1.

III. PERFORMANCE ANALYSIS

This section gives the performance analysis of proposed algorithm. For proving the efficiency of proposed algorithm, authors have implemented the proposed algorithm and compare it with well known AES algorithm. The comparison of proposed algorithm is done different parameters. To compare the internal strength of proposed algorithm, avalanche effect is calculated. To compare its efficiency, time analysis is done and compares it with AES algorithm.

D. Decryption Block Diagram:-

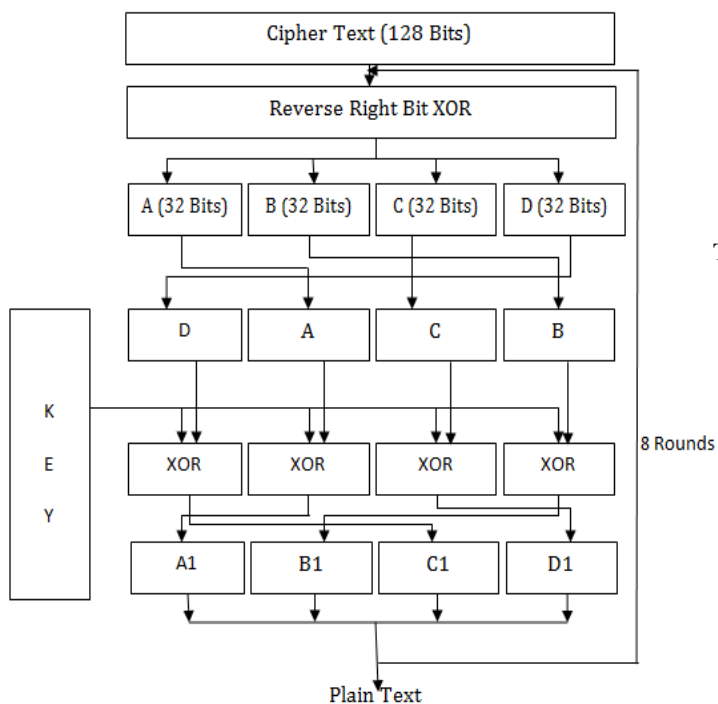


Figure 2 (a): Proposed Decryption Block

E. Steganography:-

After encrypting the entire message, cipher text is hiding behind the text file. For hiding the text behind the text, two characters are used first whose ASCII value is 32 and other whose ASCII value is 160. Both look like a space but there ASCII values are different.

Steps of hiding cipher text are as follows:

- 1) Convert the cipher text again in to binary form.

A. Time Analysis: Time analysis is one of the important features to compare any cryptographic algorithm. Encryption/ Decryption also used to provide confidentiality on real time communication. It is very important for any algorithm to be time efficient when it is used with real time communication. To check time efficiency of proposed algorithm, implementation analysis is done Table 1 and Table 2 shows the analysis result.

Table 1: Comparison of Encryption Time of Proposed Algorithm on Various File Size in seconds

File Size in KB	Algorithm	
	Proposed Algorithm	AES
	Execution Time in Second	
5 KB	0.152	0.741
10 KB	0.507	1.762
20 KB	2.222	3.887

Figure 3 and Figure 4 shows the graphical representation of Table 1 and Table 2. It is very clear from the result that proposed algorithm is time efficient than AES algorithm. Also time taken by proposed algorithm shows that it can be used for any real time communication.

B. Avalanche Effect: Avalanche effect is another parameter used to show the strength of proposed algorithm. An

algorithm that is time efficient but not enough secure is waste. Therefore to show the internal strength of proposed algorithm avalanche effect is calculated. According to avalanche effect, little change in the key will makes 50% of bits change in the result. This is an ideal state. An algorithm closed to this condition considered more secure than other. Table 3 shows the avalanche effect of proposed algorithm. Analysis result is taken after experimenting it on 50 different sample files and average of all comes out to be a result. It is clear from the result that avalanche effect of proposed algorithm is high and much closed to the ideal state.

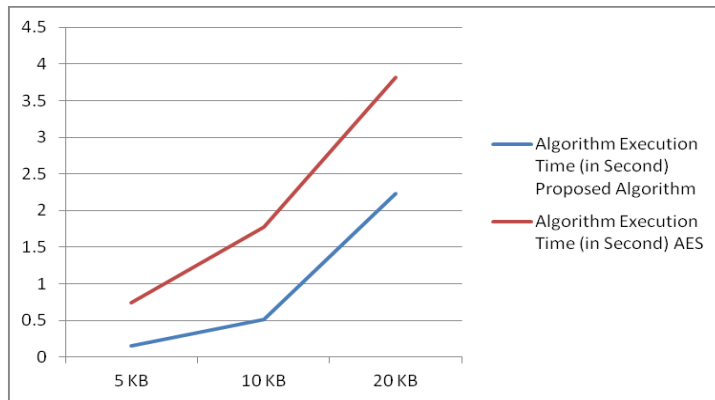


Figure 4: Decryption time of the proposed algorithm

Table 2: Comparison of Decryption Time of Proposed Algorithm on Various File Size

File Size in KB	Algorithm	
	Execution Time (in Second)	
	Proposed Algorithm	AES
5 KB	0.155	0.740
10 KB	0.510	1.777
20 KB	2.231	3.814

Table 3 Avalanche Effect of Proposed Algorithm

File Size in KB	Proposed Algorithm
	Avalanche Effect
Key-1 (ABCD)	49.4475%
Key-2 (ABCE)	

C. Memory Requirements: Table 4 shows the memory requirement of proposed algorithm and memory requirement of AES algorithm. It is clearly understood from Table 4 that memory requirement of AES and proposed is same.

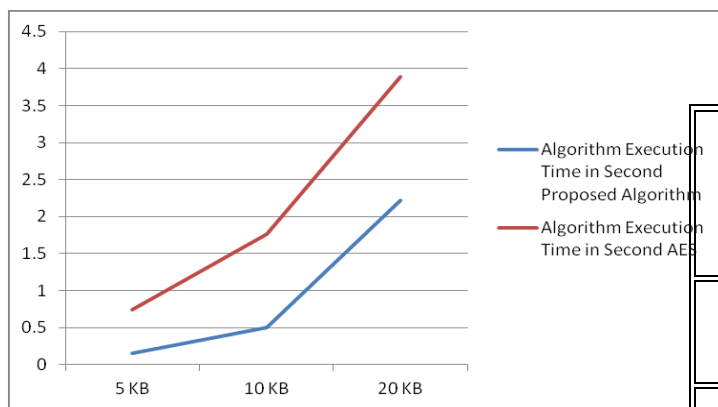


Figure 3: Encryption time of the proposed algorithm

Table 4: Memory comparison between Proposed Algorithm and AES

Algorithms Name	Key Length in Bits	Plain Text Length in Bits (Input Block)	Cipher Text Length in Bits (Output Block)
Proposed Algorithm	1-128	128	128
AES	128	128	128

D. Key Analysis: Security of any encryption algorithm is on key, if intruder get the access on this key, no matter how strong the algorithm is, they can easily get the secret text. Proposed algorithm uses variable length key which is used to generate eight 128 bits key. Hence the complexity to break the proposed key is 2128 which is near to impossible to solve even with a super computer.

IV. CONCLUSION

The proposed architecture is an efficient approach of providing security and confidentiality over the transmitted data or stored data. This architecture proposed a new encryption/decryption algorithm which not only secure but also time efficient. Further in order to improve the security, the resultant cipher text is hiding behind the text file which improves the confidentiality of proposed architecture. Efficiency of algorithm makes it suitable for AD-HOC network and also makes it suitable for real time communication.

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