A Novel Symmetrical Encryption Algorithm with High Security Based on Key Updating

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***Abstract* - The hacking is the greatest problem in the wireless local area network (WLAN). Many algorithms like DES, 3DES, AES,CAST, UMARAM and RC6 have been used to prevent the outside attacks to eavesdrop or prevent the data to be transferred to the end-user correctly. The authentication protocols have been used for authentication and key-exchange processes. A new symmetrical encryption algorithm is proposed in this paper to prevent the outside attacks to obtain any information from any data-exchange in Wireless Local Area Network(WLAN). The new symmetrical algorithm avoids the key exchange between users and reduces the time taken for the encryption, decryption, and authentication processes. It operates at a data rate higher than DES, 3DES, AES, UMARAM and RC6 algorithms. It is applied on a text file and an image as an application. The encryption becomes more secure and high data rate than DES,3DES,AES,CAST,UMARAM and RC6. A comparison has been conducted for those encryption algorithms at different settings for each algorithm such as different sizes of data blocks, different data types, battery power consumption, different key size and finally encryption/decryption speed. Experimental results are given to demonstrate the effectiveness of each algorithm**

***Keywords* - Plaintext; Encryption; Decryption; S-Box; Key updating; Outside attack; key generation for Proposed Algorithm;**

1. INTRODUCTION

Wireless Local Area Network (WLAN) is one of the fastest growing technologies. Wireless Local Area Network(WLAN) is found in the office buildings, colleges, universities, and in many other public areas [1]. The security in WLAN is based on cryptography, the science and art of transforming messages to make them secure and immune to attacks by authenticating the sender to receiver within the WLAN.

The cryptography algorithms are divided into two groups: symmetric-encryption algorithms and asymmetric-encryption algorithms. The most common classification of encryption techniques can be shown in Figure 1.

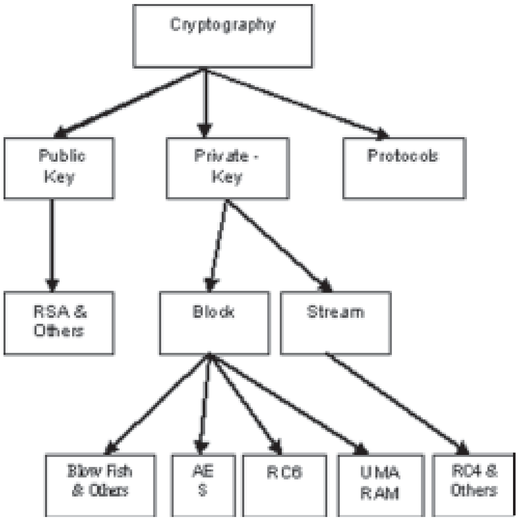


Figure 1: Overview of the field of Cryptography

company sends its title with each message. The outside attacks can use this fixed plaintext, company-title, and encrypted text of that title to obtain the key used in WLAN. The outside attack can also appear as a fox because he/She can lie to use a computer on the WLAN to send an important message to someone because there are some troubles in his device while his device is still open to take a copy from the encrypted message. The plaintext and encrypted text are known. He/She can obtain the key used for encryption and decryption processes easily. The authentication protocols have been used for authentication and key-exchange processes, such as EAP-TLS [9], EAP-TTLS [9], and PEAP [10]. The attacker can be authorized-user and he/she will be accepted to access the network after the success of authentication and key exchange processes. He/She will act as an evil to analysis the data-exchange to eavesdrop or act as man-in-the middle. The proposed algorithm will avoid key-exchange, the time taken for authentication process, and it will avoid the foxes.

This paper examines a method for evaluating performance of selected symmetric encryption of various algorithms. Encryption algorithms consume a significant amount of computing resources such as CPU time, memory, and battery power. Battery power is subjected to the problem of energy consumption due to encryption algorithms. Battery technology is increasing at a slower rate than other technologies. This causes a "battery gap" [17, 18]. We need a way to make decisions about energy consumption and security to reduce the consumption of battery powered devices.

This study evaluates seven different encryption algorithms namely; AES, DES, 3DES, RC6, Blowfish, UMARAM and RC2. The performance measure of encryption schemes will be conducted in terms of energy, changing data types - such as text or document, Audio data and video data power consumption, changing packet size and changing key size for the above and proposed cryptographic algorithms.

This paper is organized as follows. Section 2 gives a short review of the symmetrical-encryption algorithms and authentication protocols. Section 3 presents the proposed algorithm. Section 4 shows the results. Section 5 presents Experimental design of Metrics of our proposed algorithm. Section 6 presents Experimental result. Conclusions are presented in section 7.

2.REVIEW ON THE SYMMETRICAL-ENCRYPTION ALGORITHMS AND AUTHENTICATION PROTOCOLS

There are a lot of the symmetrical-encryption algorithms in WLAN. The Data Encryption Standard [2], known as Data Encryption Algorithm (DEA) by the ANSI [11] and the DEA-1 by the ISO [12] remained a worldwide standard for a long time and was replaced by the new Advanced Encryption Standard (AES). However, it is expected that DES will remain in the public domain for a number of years [12]. It provides a basis for comparison for new algorithms and it is also used in. DES is a block cipher symmetric algorithm; the same data processing and key are used for both encryption and decryption. The basic building block (a substitution followed by a permutation) is called a round and is repeated 16 times [2]. For each DES round, a sub-key is derived from the original key using an algorithm called key schedule. Key schedule for encryption and decryption is the same except for the minor difference in the order (reverse) of the sub-keys for decryption. In the encryption process, DES encrypts the data in 64-bit blocks using a 64-bit key (although its effective key length is in reality only 56-bit).

Triple DES, TDES, is a block cipher formed from the DES cipher by using it three times. When it was found that a 56-bit key of DES is not enough to guard against brute force attacks, TDES was chosen as a simple way to enlarge the key space without a need to switch to a new algorithm. The use of three steps is essential to prevent the man-in-the-middle attacks that are effective against double DES encryption. The simplest variant of TDES encryption operates as follows: DES(k3;DES-1(k2;DES(k1;M))), where M is the message block to be encrypted , k1, k2, and k3 are DES keys, and DES and DES-1 refer to the encryption and decryption modes respectively. While the TDES decryption operates as follows: DES-1(k1; DES(k2;DES-1(k3;C))) , where C is the cipher text block.

The Advanced Encryption Standard (AES) algorithm is a symmetric block. AES algorithm can encrypt and decrypt the plaintext and cipher text of 128-bits respectively by using cryptographic keys of 128-bits (AES-128), 192-bits (AES-192), or 256-bits (AES-256). Number of rounds in the encryption or decryption processes depends on the key size. CAST-256 belongs to the class of encryption algorithms known as Feistel ciphers; overall operation is thus similar to the Data Encryption Standard (DES). The algorithm was created by Carlisle Adams and Stafford Tavares. It is a symmetric block. RC6 is more accurately specified as RC6-w/r/b where the word size is w bits, encryption consists of a nonnegative number of rounds r, and b denotes the length of the encryption key in bytes. Since the AES submission is targeted at w = 32 and r = 20, RC6 shall be used as shorthand to refer to such versions. When any other value of w or r is intended in the text, the parameter values will be specified as RC6-w/r. Of particular relevance to the AES effort will be the versions of RC6 with 16-, 24-, and 32-byte keys.

The UMARAM is a Symmetrical encryption algorithm. The key generation generates 16-keys during 16-rounds.One key of them is used in one round of the encryption or decryption process. The new algorithm uses a key size of 512-bits to encrypt a plaintext of 512-bits during the 16-rounds. In this Algorithm, a series of transformations have been used depending on S-BOX, different shift processes, XOR-Gate, and AND-Gate. The S-Box is used to map the input code to another code at the output. It is a matrix of$16\times16\times16$ .The S-Box consists of 16-slides, and each slide having 2-D of16×16 . The numbers from 0 to 255 are arranged in random positions in each slide.

The Authentication Protocols are used for Authentication and key-exchange processes to avoid the outside attacks to access the network. The researchers have researched on the best authentication protocol to authenticate the overall devices in the network and prevent the attacks to effect on the network or eavesdropping on the interchangeable data. The Extensible Authentication Protocol (EAP) [13] is an authentication framework which supports multiple authentication methods. EAP typically runs directly over data link layers such as Point-to-Point Protocol (PPP) [14] or IEEE 802.11 [15], without requiring IP [1]. EAP has been implemented with hosts and routers that connect via switched circuits or dial-up lines using PPP. It has also been implemented with switches and access points using IEEE 802.11. EAP-TLS EAP-TTLS are EAP methods used for WLAN authentication and key derivation. EAP-TTLS provides additional functionality beyond what is available in EAP-TLS. There are a lot of Authentication protocols used for WLAN authentication and key derivation but, the proposed algorithm will avoid the key derivation and reduce the delay time for authentication process, as the following sections.

3. PROPOSED SYMMETRICAL ALGORITHM

A block encryption algorithm is proposed in this approach. In this Algorithm, a series of transformations have been used depending on S-BOX, XOR Gate, and AND Gate. The proposed algorithm encrypts a plaintext of size 64-bits by a key size of 64-bits. It uses eight rounds for encryption or decryption process. It overcomes some drawbacks of the other algorithms. It is more efficient and useable for the Wireless Local Area Network because it avoids the using of the same key with other packets within a message. The algorithm is simple and helpful in avoiding the hackers. S-BOX generation is the backbone of this algorithm. It has eight columns and 256 rows; each element consists of 8-bits, see Appendix A for the contents of S-boxes. It replaces the input by another code to the output. The order of the columns is changed in each round as follows:

Round 1: C1C2C3C4C5C6C7C8

Round 2: C2C3C4C1C8C5C6C7

Round 3: C3C4C1C2C7C8C5C6

Round 4: C4C1C2C3C6C7C8C5

Round 5: C5C8C7C6C3C2C1C4

Round 6: C6C5C8C7C2C1C4C3

Round 7: C7C6C5C8C1C4C3C2

Round 8: C8C7C6C5C4C3C2C1

Figure (2) combines between keys generation and Data encryption. There are two external inputs for keys generation, Rni and Rv, where i is the round number, i=1,…, 8. Rv has two hexadecimal values, (00 00 00 00 00 00 00 00) and (FF FF FF FF FF FF FF FF). Rni has two hexadecimal values, (00 00 00 00 00 00 00 00) and the initial key value, 64-bits, used at the first time. The initial key, 64-bits, can be the same for all rounds or each round can have different initial key as the designer like.

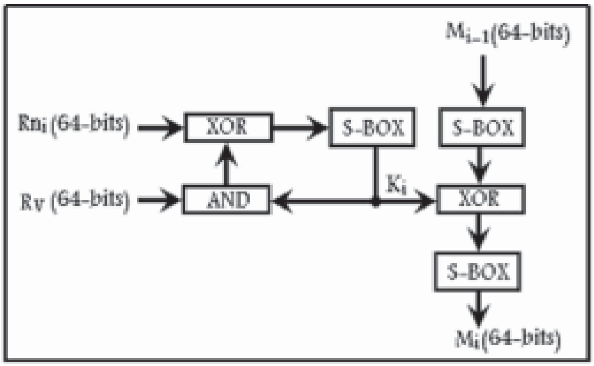


Figure (2): Proposed Algorithm for Encryption or Decryption

Round-Key generation, at the first time, begins by using the first value of Rv, (00 00 00 00 00 00 00 00), to avoid any noise from the feedback of the S-BOX to the initial key. Rni equals, at the first time, to initial value of round-key. Then, the initial value of the key, 64-bits is divided into eight parts, 8-bits each. Each part will travel to a row, under the same column, having a number equals to its number plus one, it will find a code, 8-bits, that will be used instead of this part. For example, part 3=A2 , it will take the code in the column number 3,according to the columns-ordering of the S-BOX in each round, and the row number 162+1=163 and column number 3, where A2 in a hexadecimal format equals to 162 as a decimal value. The eight parts will be replaced by another eight parts, they will be used as a round-key to encrypt the message in each round, and also will feedback to update the round-key to another key by changing Rv to its second value, (FF FF FF FF FF FF FF FF), and also Rni to the other value, (00 00 00 00 00 00 00 00). So the algorithm will update its round-key by itself, and each round will choose its key randomly from 264 = 18,446,744,073,709,551,616 available keys. Thus, in each encryption process, a different key will be used for each round; it gives the impossibility to the hackers to decrypt the cipher text. The Rv initial value, (00 00 00 00 00 00 00 00), is used to make synchronization between the transmitter and receiver when there are troubles appeared in the decryption process, the receiver must send a message to the transmitter to request the reset of Rv value, in this case Rv= (00 00 00 00 00 00 00 00), and the Rni must equal to the initial key value. Otherwise, Rv=(FF FF FF FF FF FF FF FF) and Rni= (00 00 00 00 00 00 00 00).

In the data encryption, as round-key generation, the message block, 64-bits, is divided into eight parts to apply them to the eight columns of the S-BOX. The order of column depends on the round number. The output of the S-BOX will be XORed with round-key. The output of the XOR gate will be divided into to eight parts to apply to the S-BOX. The encrypted block will be the input of the next round, see figure (2), The Key generation of each round does not depend on the other round-key generation. The data decryption process is the same as the data encryption process but, the order of the round-key, Ki, used in the encryption process will be reversed to be used in the decryption process, and cipher text becomes instead of the plaintext to obtain the decrypted block as the same as the plaintext. The key will be updated by itself and the next packet will use different key. Each round will use different key because the order of columns of the S-BOX is interchanged. If there are NAK from the receiver, the sender will encrypt the packet by the initial key, default case, by applying Rni = Initial key, and Rv=, (00 00 00 00 00 00 00 00) to reset the system to the default case. If the outsider attack prevents any packet or message to reach the receiver, the next packet or message can not be decrypted correctly because at this situation the key used for encryption is not the same as that used for decryption and these will be no synchronization between the sender and the receiver. The receiver will know that there is something wrong in the transmitted message because of virus, outside attacks, or environment noise to reach correctly. The receiver will send NAK to the sender. The NAK is a message of all 0-bits and the number of the damaged packet. The NAK length is 64-bits as the normal message. The NAK will be encrypted by the last updated-key, as the normal message will be encrypted, to avoid the traffic analysis from the outsider attacks.

This initial key is used only in three cases, the connection in the first time, NAK, and authentication process. In authentication process, the sender and the receiver will interchange a secret message encrypted by last updated key. If this message encrypted again, the encrypted message will have a different contents than the first one. The outside attack can not find out the key even if He/She knows the title of the company because the encrypted title will take other form and the key- generation of each round does not depend on each others. The designer can use different initial keys for each round to make the system more secure.

4. RESULTS

The proposed algorithm is applied on a text by using:

A. Software

- Microsoft Visual C++ Program.

B. Hardware

- Intel(R) Pentium(R) 4 CPU 2.8GHz
- 1GB of RAM

The plain text, the encrypted text, the decrypted text are shown in figure (3a, b, and c). When the same text is encrypted again, a different encrypted text is obtained, see figure (3d), it means that, the key is updated in each round.

This paper has proposed a block encryption algorithm using S-Box and XOR gate. The system becomes more secure because of key-updating with each packet. It is simple and the delay time will be reduced than DES, 3DES, AES, and RC6 algorithms because of no multiple functions used. The outsider attacks can not know the key even if they have the plaintext and the cipher text. The algorithm will help the authentication protocols to reduce the delay taken by them, and gives the channel the data security wanted. The programs ensure the key updated without any problem on the decryption of the text or the image, and show that the algorithm reduce the time used in the encryption or decryption process. It is efficient and useable for the security in the WLAN systems.

Figure (3 a): The Plain Text

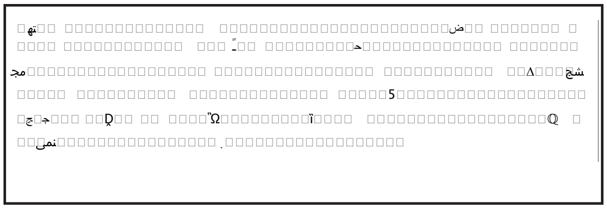


Figure (3 .b): The Cipher Text

This paper has proposed a block encryption algorithm using S-Box and XOR gate. The system becomes more secure because of key-updating with each packet. It is simple and the delay time will be reduced than DES, 3DES, AES, and RC6 algorithms because of no multiple functions used. The outsider attacks can not know the key even if they have the plaintext and the cipher text. The algorithm will help the authentication protocols to reduce the delay taken by them, and gives the channel the data security wanted. The programs ensure the key updated without any problem on the decryption of the text or the image, and show that the algorithm reduce the time used in the encryption or decryption process. It is efficient and useable for the security in the WLAN systems.

Figure (3 .c): The Decrypted Text

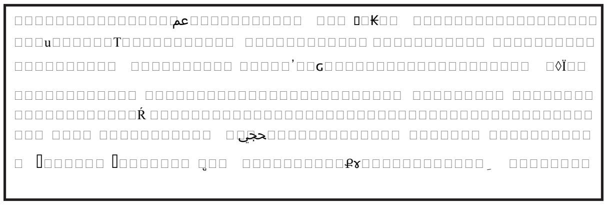


Figure (3 .d): The other Cipher Text for the same Plain Text

The algorithm is also applied on a Black & White image; see Figure (4), and on a color image, see figure (5). The encryption and decryption processes of that image are applied between two wireless computers in WLAN.

The delay time taken for encryption process of DES, RC6, and the proposed algorithms is measured inside their programs for different text messages with different sizes for the comparison purpose, see figure (6). The proposed algorithm takes a time less than DES, 3DES [16], AES [16], UMARAM and RC6 algorithms to encrypt the same text. The average data rate of proposed algorithm to encrypt different messages with different sizes, see figure (6), operates at 909.1526 KB/s, while DES operates at 93.98319 KB/s and RC6 operates at 271.567 KB/s. The data rate of DES algorithm is faster than 3DES and AES Algorithms [16]. The measured results show that, the proposed Algorithm is faster than DES, 3DES, AES, and RC6.

Figure (4) :
Black and white Image

Figure (5) :
The Color Image

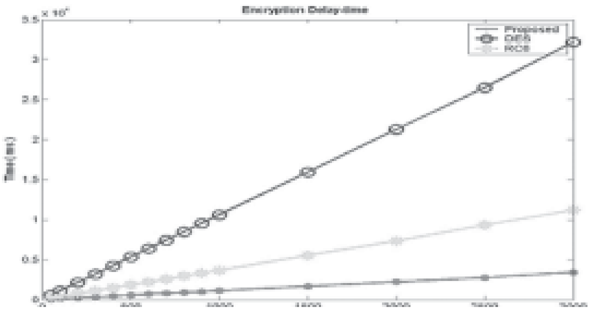


Figure (6): The Encryption delay time for DES, RC6, and the proposed algorithms.

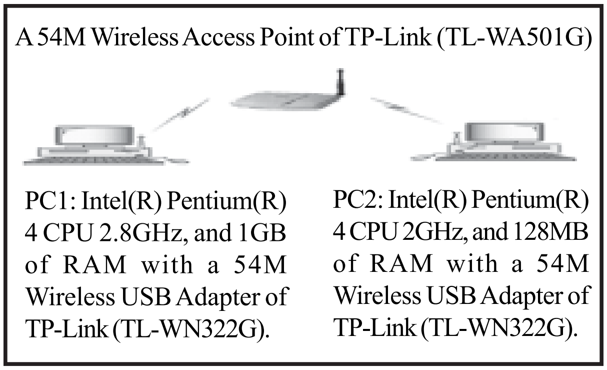
The encryption and decryption processes are applied between two wireless computers in WLAN, their specifications are:

- PC1: Intel(R) Pentium(R) 4 CPU 2.8GHz, and 1GB of RAM.
- PC2: Intel(R) Pentium(R) 4 CPU 2GHz, and 256 MB of RAM.
- A 54M Wireless Access Point of TP-Link (TL-WA501G).
- Two 54M Wireless USB Adapter of TP-Link (TL-WN322G).

The encryption and the decryption of the text, black and white image, and the color image are done successfully, see figure (7).

As an improvement in The proposed algorithm to be extra more secure. . The size of the plain text can be varied and the network administrator generates the S-Box by himself. First, the plain text size must be specified to satisfy the equation (1).

The Plain text size= 8×n ————(1)



A 54M Wireless Access Point of TP-Link (TL-WA501G)

PC1: Intel(R) Pentium(R) 4 CPU 2.8GHz, and 1GB of RAM with a 54M Wireless USB Adapter of TP-Link (TL-WN322G).

PC2: Intel(R) Pentium(R) 4 CPU 2GHz, and 128MB of RAM with a 54M Wireless USB Adapter of TP-Link (TL-WN322G).

Figure (7): Wireless LAN (infrastructure mode)

Where n is the number of rounds used in the encryption or decryption process and is an integer, even, non-zero, and positive number so, n=2,4,6,…, see Figure (8). Second, the Administrator will generate his Network S-Box according to the flowchart of Figure (8), where r and c are the row and column number respectively of the S-Box, and they start from 1 to n. The S-Box Generation starts by generating a random number between 0 and 255 for each element in the S-Box matrix. No number-repetition can be found in each column. .

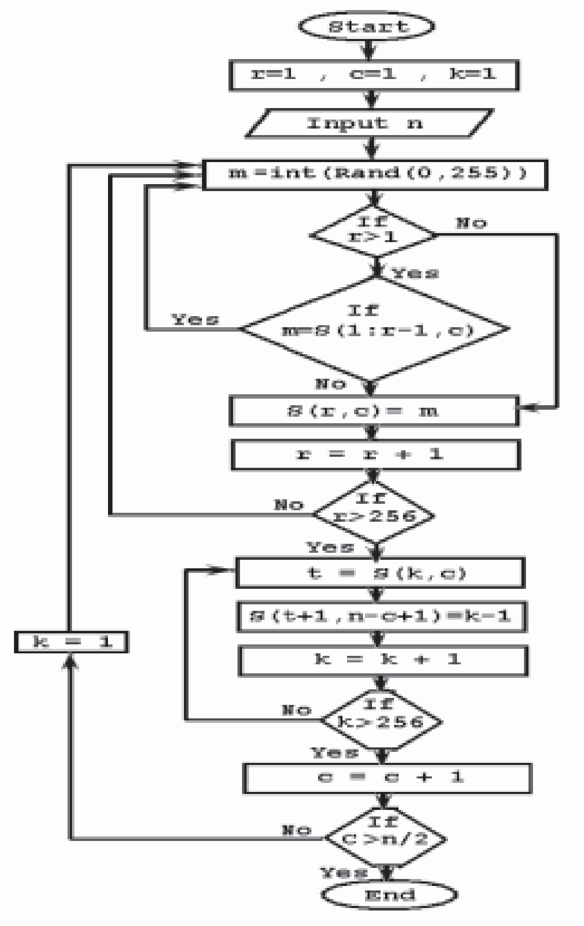


Figure (8): S-Box Generation Flow Chart

The generated S-Box has a size of 256*n. The order of the columns in the S-Box is changed in each round according to the diagram of the figure (9). For example, if n=8, the Columns orders of the round 1 to round 4 are:

Round 1: C1C2C3C4C5C6C7C8

Round 2: C2C3C4C1C8C5C6C7

Round 3: C3C4C1C2C7C8C5C6

Round 4: C4C1C2C3C6C7C8C5

After the round (n/2), the first part and the second part are interchangeable and are mirrored, and also the shift direction is changed, see figure (9). Thus, the Columns orders of the round 5 to round 8 are:

Round 5: C5C8C7C6C3C2C1C4

Round 6: C6C5C8C7C2C1C4C3

Round 7: C7C6C5C8C1C4C3C2

Round 8: C8C7C6C5C4C3C2C1

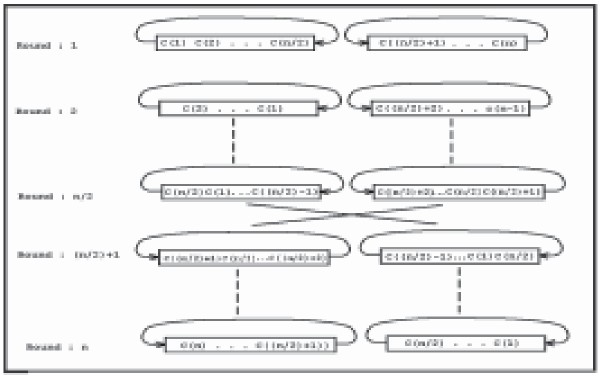


Figure (9): The relationship between Round number and the Column orders of S-Box

Thus, the system will be more secure because of the following reasons.

1. The S-Box generation can be generated from the administrator himself.
2. The delay time taken for the encryption and the decryption processes by the proposed algorithm is less than the time taken **DES, 3DES, AES, UMARAM and RC6** algorithms.
3. Higher data rate than DES, 3DES, AES, UMARAM and RC6 algorithms.
4. The initial key can be chosen from any row in the S-box, and the authentication protocol will interchange the row number of the unknown S-box to be used as a key instead of key interchanging. It will keep the key in the system and prevent it to fly between the network devices.
5. Each round can use special initial key and they are independent.
6. The NAK becomes unknown to the outsider attacks.
7. The outside attacks can not obtain the key or any information about the algorithm even if he/She had the plaintext, the company title, S-Box, and the encrypted message because they will loss the synchronization or the initial key of each round where they are independent.

In addition, the proposed algorithm has the following advantages:

- Simple.
- The updating of the round-key with each packet.
- The encryption and decryption processes are the same.
- Any change in the transmitted message will be known to the sender and the receiver, so it will prevent the attacks such as, man-in-the middle attacks to analysis the traffic or decrypt the encrypted message, and the foxes to have the key.
- Our proposed algorithm can meet the growth of the technology.

We have to add some metrics like

1. CPU Workload
2. Power Consumption
3. Throughput
4. Encryption/Decryption Time
5. Different Data Types
6. Different size of Data Block

5. EXPERIMENTAL DESIGN FOR METRIC OF PROPOSED SYSTEM

For our experiment, we use a laptop IV 2.4 GHz CPU, in which performance data is collected. In the experiments, the laptop encrypts a different file size ranges from 321 K byte to 7.139Mega Byte139MegaBytes for text data, from 33 Kbytes to 8262 Kbytes for audio data, and from 4006 Kbytes to 5073 Kbytes for video files.

Several performance metrics are collected: 1) Encryption time; 2) CPU process time; and 3) CPU clock cycles and battery power,4)Throughput,5)Different data types,6)Different size of data block.

The encryption time is considered the time that an encryption algorithm takes to produce a cipher text from a plaintext. Encryption time is used to calculate the throughput of an encryption scheme. It indicates the speed of encryption. The throughput of the encryption scheme is calculated as the total plaintext in bytes encrypted divided by the encryption time [19].

Throughput=Total plaintext encrypted in bytes / Encryption time

The CPU process time is the time that a CPU is committed only to the particular process of calculations.

It reflects the load of the CPU. The more CPU time is used in the encryption process, the higher is the load of the CPU. The CPU clock cycles are a metric, reflecting the energy consumption of the CPU while operating on encryption operations. Each cycle of CPU will consume a small amount of energy.

The following tasks that will be performed are shown as follows:

- ◆ A comparison is conducted between the results of the selected different encryption and decryption schemes in terms of the encryption time at two different encoding bases namely; hexadecimal base encoding and in base 64 encoding.
- ◆ A study is performed on the effect of changing packet size at power consumption during throughput for each selected cryptography algorithm.
- ◆ A study is performed on the effect of changing data types - such as text or document, audio file, and video file for each cryptography selected algorithm on power consumption.
- ◆ A study is performed on the effect of changing key size for cryptography selected algorithm on power consumption.

6. DIFFERENT METRICS OF PROPOSED ALGORITHM

6.1 Differentiate Output Results of Encryption (Base 64, Hexadecimal)

Experimental results are given in Figures 10 and 11 for the selected seven encryption algorithms at different encoding method. Figure 9 shows the results at base 64 encoding while Figure 10 gives the results of hexadecimal base encoding. We can notice that there is no significant difference at both encoding method. The same files are encrypted by two methods; we can recognize that the two curves almost give the same results.

Time consumption of encryption algorithm (base 64 encoding)

6.2 Effect of Changing Packet Size for Cryptographic Algorithms on Power Consumption

6.2.1 Encryption of Different Packet Size

Encryption time is used to calculate the throughput of an encryption scheme. The throughput of the encryption scheme is calculated by dividing the total plaintext in Megabytes encrypted on the total encryption time for each algorithm in. As the throughput value is increased, the power consumption of this encryption technique is decreased.

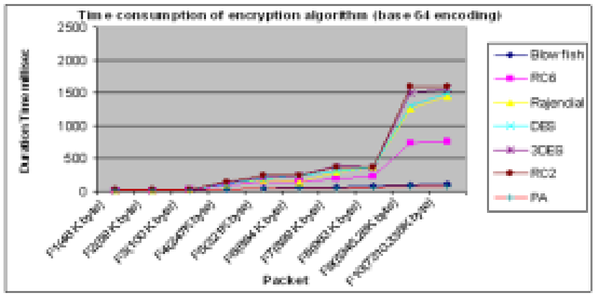


Figure 9: Time consumption of encryption algorithm(base 64 encoding)

Experimental results for this concern point are shown Figure 11 at encryption stage. The results show the advantage of Proposed algorithm over other algorithms in terms of the processing time. Another point can be noticed here; that RC6 requires less time than all algorithms except Proposed Algorithm. A third point can be noticed here; that AES has an advantage over other 3DES, DES and RC2 in terms of time consumption and throughput. A fourth point can be noticed here; that 3DES has low performance in terms of power consumption and throughput when compared with DES. It always requires more time than DES because of its triple phase encryption characteristics. Finally, it is found that RC2 has low performance and low throughput when compared with other six algorithms in spite of the small key size used.

6.2.2 Decryption of Different Packet Size

Experimental results for this compassion point are shown Figure 12 decryption stage. We can find in decryption that Proposed Algorithm is the better than other algorithms in throughput and power consumption. The second point should be noticed here that RC6 requires less time than all algorithms except Proposed Algorithm. A third point that can be noticed that AES has an advantage over other 3DES, DES, RC2.The fourth point that can be considered is that RC2 still has low performance of these algorithm. Finally, Triple DES (3DES) still requires more time than DES.

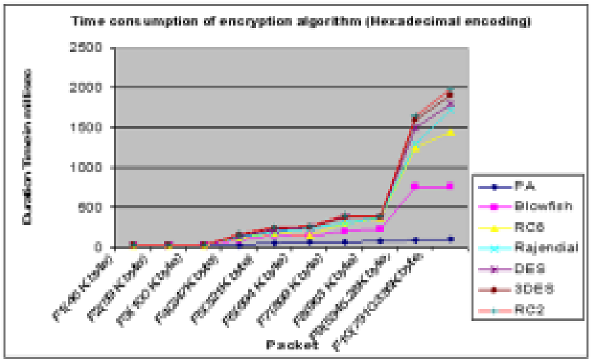


Figure 10: Time consumption of encryption algorithm (Hexadecimal encoding)

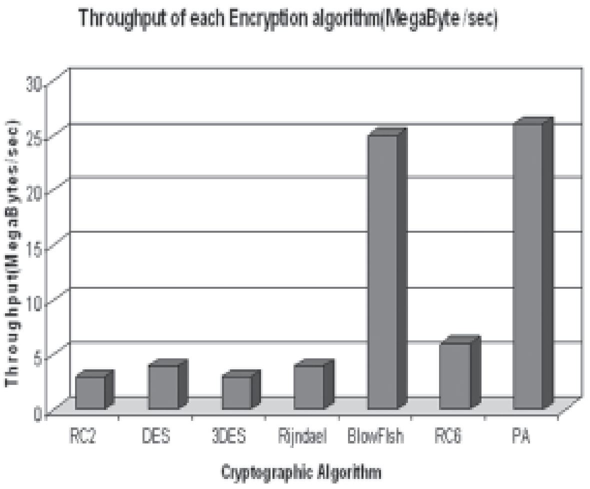


Figure 11: Throughput of each encryption algorithm(Megabyte/Sec)

6.3 The Effect of Changing File Type (Audio Files) for Cryptography Algorithm on Power Consumption

6.3.1 Encryption of Different Audio Files (Different Sizes) Encryption Throughput

In the previous section, the comparison between encryption algorithms has been conducted at text and document data files. Now we will make a comparison between other types of data (Audio file) to check which one can perform better in this case. Experimental results for audio data type are shown Figure 13 at encryption. that

CPU Work Load

In Figure 14, we show the performance of cryptographic algorithms in terms of sharing the CPU load. With a different audio block size Results show the superiority of Proposed algorithm over other algorithms in terms of the processing time (CPU work load) and throughput. Another point can be noticed here; RC6 requires less time than all algorithms except Proposed Algorithm. A third point can be noticed here; that AES has an advantage over other 3DES, DES and RC2 in terms of time consumption and throughput especially in small size file.

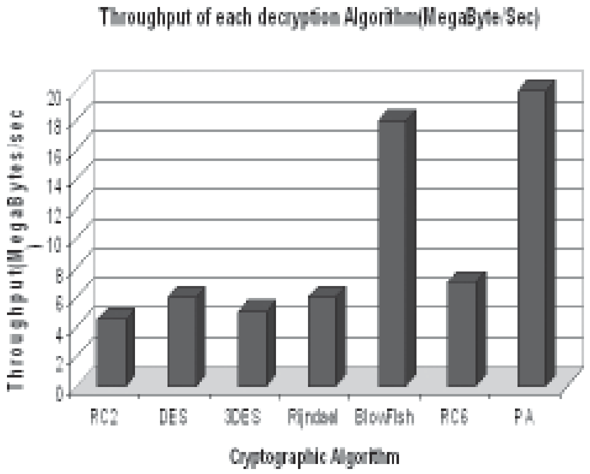


Figure12: Throughput of each decryption algorithm (Megabyte/Sec)

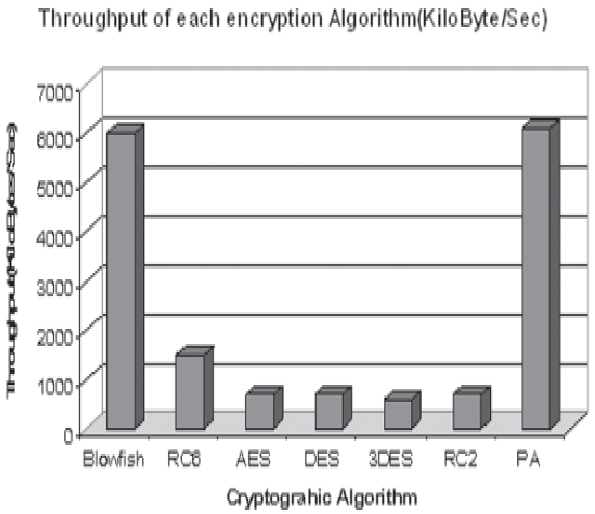


Figure 13: Throughput of each encryption algorithm (Kilo-bytes/Second)

A fourth point can be noticed here; that 3DES has low performance in terms of power consumption and throughput when compared with DES. It always requires more time than DES. Finally, it is found that RC2 has low performance and low throughput when compared with other six algorithms in spite of the small key size used.

Decryption of Different Audio files (Different Sizes)

Decryption Throughput Experimental results for this compassion point are shown Figure 15.

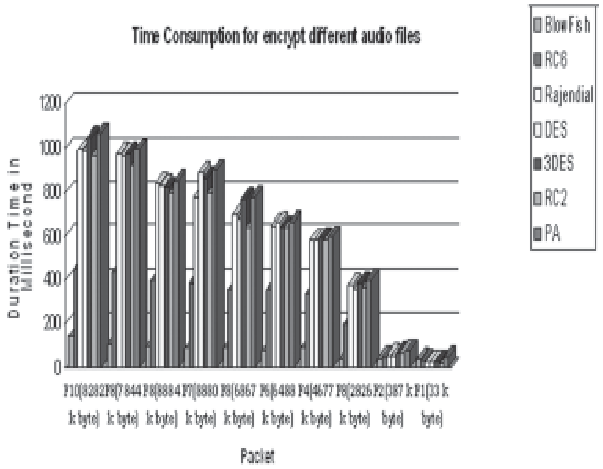


Figure 14: Time consumption for encrypt different audio files

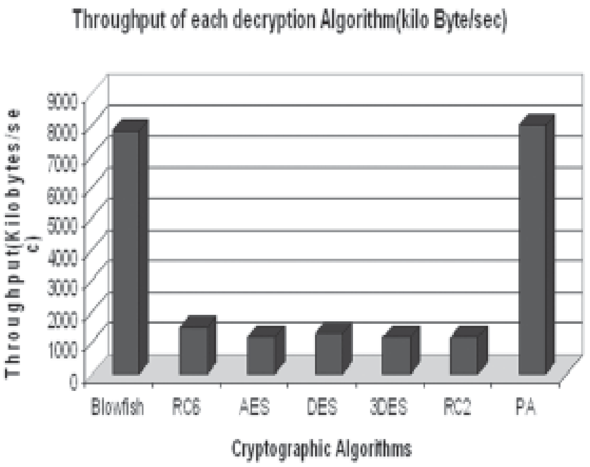


Figure 15: Throughput of each Decryption algorithm (Kilobytes / Second)

CPU Work Load

Experimental results for this compassion point are shown Figure 16.From the results we found the result as the same as in encryption process for audio files.

6.4 The Effect of Changing File Type (Video Files) for Cryptography Algorithm on Power Consumption

6.4.1 Encryption of different video files (different sizes)

Encryption Throughput

Now we will make a comparison between other types of data (video files) to check which one can perform better in this case. Experimental results for video data type are shown Figure 17 at encryption.

CPU Work Load

In Figure 18, we show the performance of cryptography algorithms in terms of sharing the CPU load. With a different audio block size.

The results show the superiority of Proposed algorithm over other algorithms in terms of the processing time and throughput as the same as in Audio files. Another point can be noticed here; that RC6 still requires less time has throughput greater than all algorithms except Proposed Algorithm. A third point can be noticed here; that 3DES has low performance in terms of power consumption and throughput when compared with DES. It always requires more time than DES. Finally, it is found that RC2 has low performance and low throughput when compared with other six algorithms.

6.4.2 Decryption of Different Video Files (Different Sizes)

Decryption Throughput

Experimental results for this compassion point are shown Figure 19.

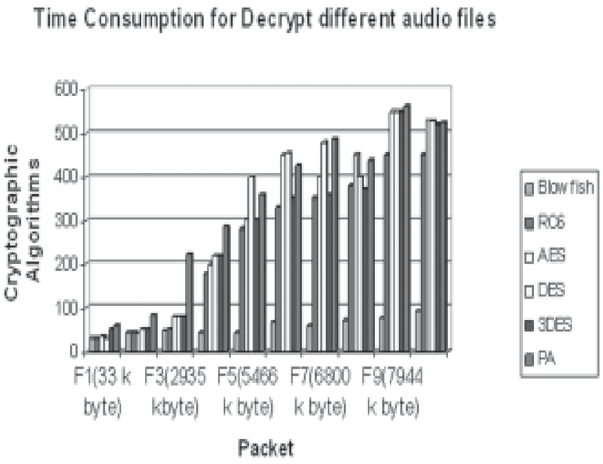


Figure 16: Time consumption for decrypt different audio files

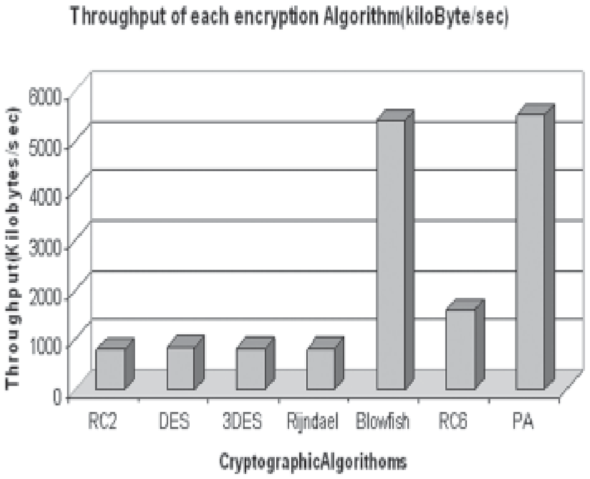


Figure 17: Throughput of each encryption algorithm (Kilobytes/sec)

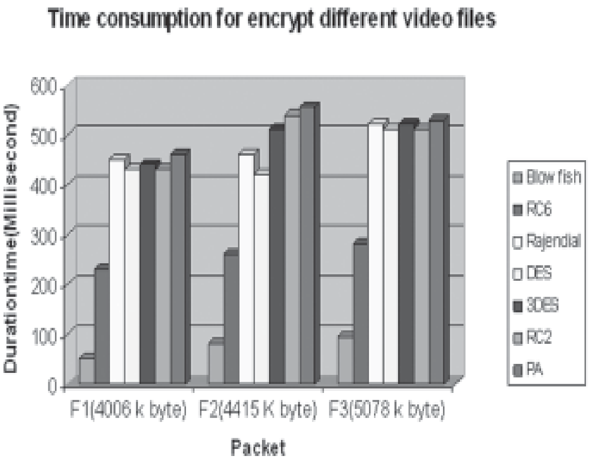


Figure 18: Time consumption for encrypt different video files

CPU Work Load

Experimental results for this compassion point are shown Figure 20.From the results we found the result as the same as in encryption process for video and audio files.

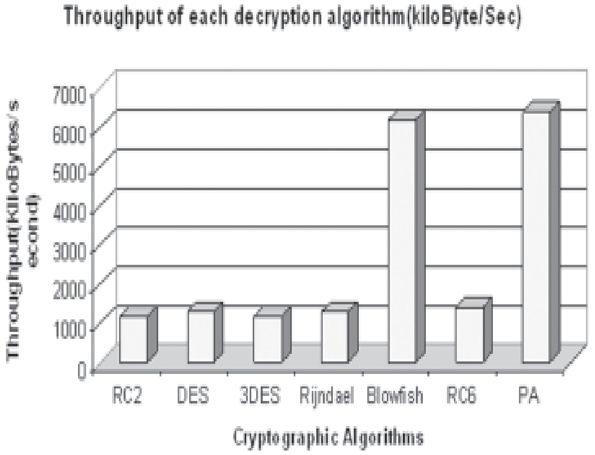


Figure 19: Throughput of each decryption algorithm (Kilobytes/Second)

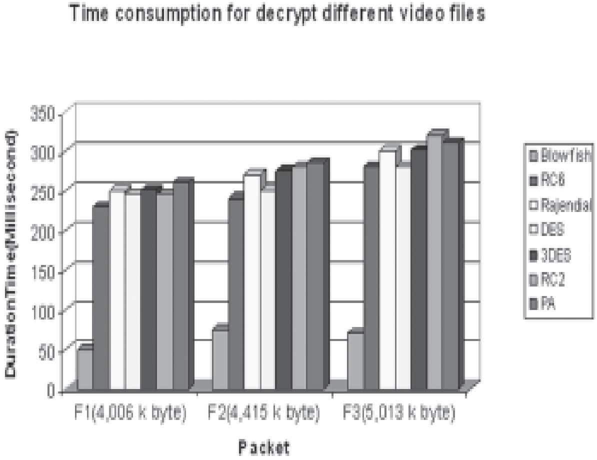


Figure 20: Time consumption for decrypt different video files

6.5 The Effect of Changing Key Size of AES, And RC6 on Power Consumption

The last performance comparison point is changing different key sizes for AES and RC6 algorithm. In case of AES, we consider the three different key sizes possible i.e., 128-bit, 192-bit and 256-bit keys. The Experimental result are shown in Figures 21 and 22.

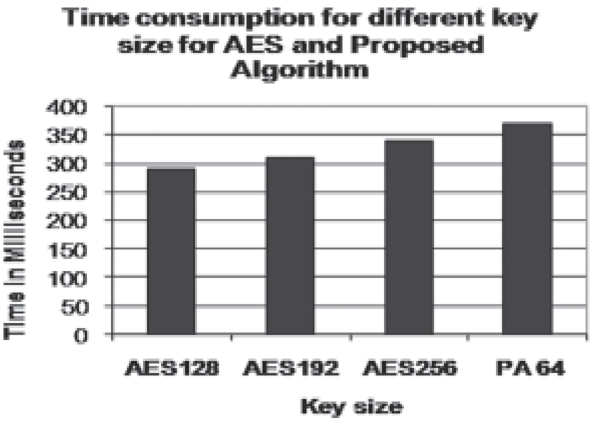


Figure 21: Time consumption for different key size for AES and PA

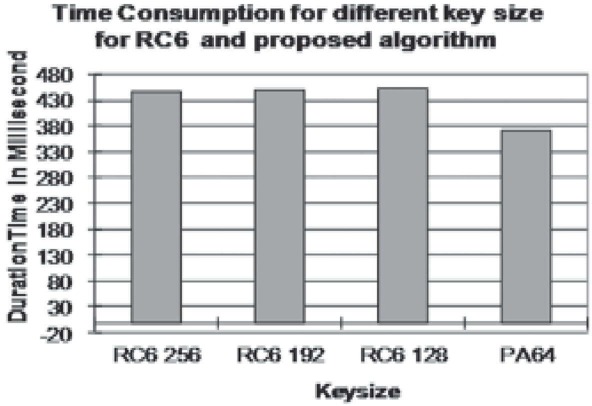


Figure 22: Time consumption for different key size for RC6 and PA

In case of AES it can be seen that higher key size leads to clear change in the battery and time consumption. It can be seen that going from 128-bit key to 192-bit causes increase in power and time consumption about 8% and to 256-bit key causes an increase of 16% [12]. Also in case of RC6, we consider the three different key sizes possible i.e., 128-bit, 192-bit and 256-bit keys. The result is close to the one shown in the following figure: In case of RC6 it can be seen that higher key size leads to clear change in the battery and time consumption.

7. CONCLUSION

This paper has proposed a block encryption algorithm using S-Box and XOR gate. The system becomes more secure because of key-updating with each packet. It is simple and the delay time will be reduced than DES, 3DES, AES, and RC6 algorithms because of no multiple functions used. The outsider attacks can not know the key even if they have the plaintext and the cipher text. The algorithm will help the authentication protocols to reduce the delay taken by them, and gives the channel the data security wanted. The programs ensure the key updated without any problem on the decryption of the text or the image, and show that the algorithm reduce the time used in the encryption or decryption process. It is efficient and useable for the security in the WLAN systems.

The selected algorithms are AES, DES, 3DES, RC6, Blowfish, RC2 and Proposed Algorithm were tested .Several points can be concluded from the Experimental results. Firstly; there is no significant difference when the results are displayed either in hexadecimal base encoding or in base 64 encoding. Secondly; in the case of changing packet size, it was concluded that proposed Algorithm has better performance than other common encryption algorithms used, followed by RC6. Thirdly; we find that 3DES still has low performance compared to algorithm DES. Fourthly; wend RC2, has disadvantage over all other algorithms in terms of time consumption. Fifthly; we find AES has better performance than RC2, DES, and 3DES. In the case of audio and video files we found the result as the same as in text and document. Finally in the case of changing key size - it can be seen that higher key size leads to clear change in the battery and time consumption.

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Appendix A

(S-BOX of Proposed Algorithm)

Row 1:86	Row 87:171	Row 172:256
E 88 54 92 12 35 C9 D7	8D 15 28 66 A8 F3 55 B1	1C 06 D7 79 8A 83 73 D4
C7 58 26 E5 4B 96 C1 FF	0A 19 6A A8 11 9D A8 DF	5F E7 EE 75 0D B1 4B B5
0B 7D 0E 1F 6B FB 41 F1	17 70 BC F0 4D C3 01 16	A3 90 BE 0E A9 77 B2 E1
F8 E2 C9 59 81 EE 1C BA	7C E3 36 07 03 09 CB 90	A0 F4 C6 78 6D 64 8F 1A
FF F0 6E 0D E5 EA BB 33	6C 6E 06 27 A6 CE 7B 27	15 B4 A1 BA FD 0D 6D B7
75 D1 5D EA A7 7A 0E 8D	1D 41 8F 37 95 DD 78 11	C9 13 81 61 7F B7 31 21
C8 91 DE D0 D2 5A AB E0	4A C9 18 AA 9D BA D0 0A	56 78 AC DD A2 63 5D 6F
B9 89 FC 3C 59 D6 C0 08	21 B1 4B 88 66 05 29 24	92 AD 7A 2A 1C 0A C4 37

```
07 F8 66 9B 98 65 89 DA
49 BF 59 31 45 22 EB CB
5C 1A B2 34 E7 34 35 57
72 54 8B 55 3E 1D F4 02
67 CC D8 4C 78 E3 E2 C8
FC 2C AF AC 04 A0 1A 7A
0F 05 FA 67 AD 02 30 B4
C3 51 E7 65 36 A3 3B 0E
DF 39 6C C0 D1 1E 23 A8
5B CF 48 57 2D 95 1B F2
2D D7 1B 00 DB E5 37 FE
45 45 52 45 A4 41 B0 22
E3 EA 51 32 9B 3C 79 67
FD 8E FB 4F 33 2B 56 AF
58 25 7D 25 ED F8 18 E3
D2 B3 84 B6 75 9A A9 58
CC 16 99 8C 6C 5C 4F 36
FE DC 68 19 19 3E 57 A9
AE 0D 22 7E 87 D0 0A D8
6F 11 B7 E7 82 12 8C 7F
A8 03 70 B2 3D 6A 92 AB
B4 D5 0B BB 4E E7 36 5B
70 BD 10 D8 AA 8E 33 9C
80 93 2C D1 02 8B EE 9E
34 82 33 35 C7 73 CC F9
B0 A0 EA 95 FB 4C D7 5D
13 F5 09 28 39 1A 26 74
BC 10 7F E3 F9 50 71 55
5D 8D B6 39 D0 78 2B D6
7B 96 A3 BC 16 C6 16 CD
F6 22 D0 A2 9A 01 E0 79
5A 30 5F 3F 5A C1 BC F0
65 85 46 70 22 56 83 A4
2F 5D 35 EB CE A7 62 7C
F2 EE 63 8A B2 94 47 FA
44 24 15 2D E1 2F 75 32
73 34 D3 A0 34 1F 0D 61
EB 76 A9 11 2B B8 A0 12
D6 C1 E4 EF 5F A2 5F B8
CF BA 2B F4 53 67 3F 29
D0 0E 79 A7 72 3B 27 92
3F B0 7B 96 09 4D 43 CF
2B BC F5 F6 14 6C 50 6E
04 1E 34 15 E8 20 8E 45
A7 E1 0A 2C 0A 33 2C 20
E6 C3 8C 9E B7 86 53 B9
E8 2E 55 2E C9 27 FB AC
B6 CA 42 FC 37 E2 E8 BF
2C C0 78 A3 B0 A1 D2 ED
88 29 DC 6D F8 CB FC 63
62 D2 B1 74 CA 2A C6 6D
E5 A3 AE FB E4 DC F2 99
9E 52 08 52 0F 66 C8 28
81 46 65 5D 56 08 A5 DB
14 FA 2F 8D 0E E6 E6 0C
79 EF A7 99 F0 19 4A 87
ED 69 DA DA 76 7C 69 76
7E 49 1C C4 C0 57 94 F5
A6 E8 BD 02 CC E0 EA 93
EF A4 32 18 96 10 C7 5A
63 AF E9 AE 62 87 7A EE
32 4F F9 7F 54 04 5A 00
B1 FE F1 D7 7A 54 D8 1B
E7 77 38 76 28 1C 58 1E
8A 23 9F 53 7E 98 85 CE
36 92 B5 30 EF EB 49 0B
C4 AB 20 83 CB 7D CD 2C
22 80 49 7B 63 4F 86 83
A5 2B D2 17 AC CC CA 05
69 3C 93 69 70 E1 2D 3A
87 C5 AD BD 49 82 70 C3
E1 5B 24 0C AE 61 B1 96
26 14 E2 C5 AB 30 D6 68
0D 6D 05 6F 50 B2 4C E5
55 5A C3 8F 74 31 9C 25
29 E4 69 4A B6 C2 E9 59
A9 A2 73 3B 48 16 02 8E
89 C2 EF 71 1A E4 B6 6A
1B A7 E6 B0 6E 23 A6 C0
97 8C 9E D3 A5 B6 74 1F
38 9F CE 03 C8 B0 F6 66
F3 F2 77 1B BB D5 20 97
74 28 AB E0 73 49 D1 A2
C6 42 DD B7 47 17 3D BE
EE 71 F8 F2 D9 DA 28 4F
D5 74 5E 98 F6 3D EC FC
68 C4 6D 1A 99 C7 CF 77
4F 94 C4 9D 5D 97 00 62
40 08 9C D6 3C F2 07 7E
CE ED B8 AB 2A 8D E3 71
C1 DE 8E A9 51 CD 17 98
0E C6 3C 91 C1 D2 AF 1D
AC 4E 4D C9 F2 72 BE 52
96 7E 80 7C 17 24 4E 60
AF A1 B0 5E 84 1B F1 F7
2E 44 2D D2 F1 8A A2 8F
5E 4C 53 8E 52 F6 C2 07
03 FB 5C CD AF F4 2F FD
F0 04 9B 82 1D EF 48 E9
91 27 AA 93 25 58 32 23
A2 95 3F 97 77 6B 1E F8
84 B5 9D EC C4 AD CE F3
60 4D CB 44 FA 9F 09 8C
7F 07 FE 6A 10 A6 61 EA
CD 01 27 B4 C3 53 2E B3
A1 B9 7C EE 8E 36 7E 47
77 D3 58 C1 97 7B 5E 0F
CA B2 40 BE 6A 88 87 73
94 A9 94 38 79 A8 77 E2
53 63 25 46 94 AE B4 84
3D 6C 87 20 4C F5 52 01
0C 65 D6 81 E9 DB DD 06
3C 00 A8 5F B5 03 5C B0
8F 75 4C 63 43 FC 60 C4
09 59 62 73 EB BF FF E7
93 20 75 6B DF 48 0C 18
25 73 B3 FA BA 43 9E C1
71 BE 5A 29 9E 81 E1 8A
31 87 92 CF CF 4E 11 2F
50 5C 1A 24 06 26 90 30
E2 83 97 10 1F 93 05 42
DB 61 B4 06 B8 75 63 17
41 4A A4 40 80 2C C3 40
AB 97 E8 8B D5 FD E5 54
AA F7 82 D4 41 39 1D 86
24 79 07 41 89 C8 A7 2E
00 21 A6 DF 6F AB 12 EB
1A 6F F0 47 1E 0C ED 3E
54 DB 45 85 EE 45 38 A3
08 3F 85 42 69 69 9D 3D
66 36 C8 12 DD E8 D9 D2
E0 EC 64 9F 4F 62 19 48
99 C8 5B DB B1 84 A1 9F
9B 43 9A E1 EA 06 B3 4D
57 F1 91 CC D7 9E 95 10
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EC 0A 00 FF 20 29 40 50
18 1D C2 0F 3B 59 DB 72
B2 12 E0 60 5B E9 51 95
39 D9 8D 3D C5 70 39 81
8B 38 D5 22 24 FF 10 38
76 8F 43 43 4A 47 9A 46
EA 0F 30 36 7D 92 96 41
90 3D 14 89 07 B4 76 C9
DA 84 86 1C 38 4B 3C C7
D8 50 19 0B E3 46 8B E6
F9 2F F2 F9 27 BD DA 31
D3 35 EC A6 D3 C4 93 89
3B 02 13 D5 D6 A4 5B D3
D1 8B 96 F8 DA 60 84 51
F4 31 CD CA 3A 3A DE 94
8E 47 EB 4E BF AA B8 2B
33 E5 D9 09 13 D9 13 13
3A 53 3E A4 C6 28 66 A0
C2 2A 3A 84 D8 A5 44 FB
DC BB CC 7D FC 11 F0 A6
9A 72 83 77 A1 74 6A 09
4D 68 E1 3A 7C 90 D3 5C
9D AC 3D 01 FF 5D AA 4C
4B 7A 21 C7 0C CA B9 A1
DE 9D 31 58 93 B5 BF 4A
9C B6 CF 1D 44 8C B5 EF
85 18 74 DC 15 99 6E 88
35 32 23 7A 8D 91 3E D0
42 37 A2 B3 EC 14 0F F6
B5 C7 F6 B9 65 13 65 A5
F1 5E C1 2F 71 B9 46 C6
D4 F9 6F 6E F3 00 0B D9
23 56 98 E6 0B 5F 97 7B
98 3E 1F E2 D4 0B 42 39
BF 1B 4E FE 18 5E 80 EC
05 FF 8A 50 67 38 24 56
7D 33 1E C2 B9 B3 15 44
B8 AE F3 9C 7B 5B 3A CA
59 D0 4A A5 E2 F1 AD 3C
95 F3 50 F5 B4 DF 06 BC
30 1C 3B 94 00 CF 72 B2
6B 40 D1 4D BC 76 1F CC
43 6A 2A C6 92 C5 88 C5
37 DF 11 5B 21 ED BD 91
78 3B 01 6C 31 42 25 B6
82 55 88 C3 BD D1 D4 80
B3 F6 71 08 86 55 EF 8B
64 A5 4F 87 68 18 9B DD
E4 3A 17 26 9C DE F3 49
F7 99 ED 14 08 BB F7 DE
1E 7B F4 9A 8F 89 F5 4E
E9 DA 57 5C 88 BE 4D 4B
1F CD DF CE 5E 80 FE 65
DD E6 BF E4 DC 71 81 F4
46 2D 0D FD 2C EC 21 AE
4C DD 61 49 FE AF B7 C2
83 B8 2E B1 26 51 7D BD
D9 FC 0F F7 61 25 64 AD
28 A6 41 13 46 D3 6C AA
52 66 47 80 90 F0 99 75
48 7F C0 5A 40 D7 A4 6B
F5 D6 29 05 30 68 7F 34
10 57 C5 56 57 C9 FA 1C
19 17 E3 AD B3 2D C5 7D
A4 4B 44 1E 5C BC F8 D5
06 26 6B E9 83 37 FD DC
AD CE 76 2B DE 4A 34 78
C5 0C 60 90 8B 79 03 D1
16 8A 0C 3E 23 A9 59 14
FA FD 7E 64 9F 2E 7C 9A
7A D4 12 04 01 F7 45 64
3E 67 67 F3 55 7F 9F 5E
CB E9 1D 0A 1B 0F AC 70
FB 60 DB 33 F4 D4 6B 5F
BB 7C 37 C8 E0 6D E7 9D
C0 6B 04 DE 05 21 14 3B
D7 09 72 CB 29 44 F9 2D
8C 86 A0 51 BE 40 DC 35
61 D8 95 16 F5 9B 8A 69
6D 1F 03 D9 C2 AC 2A 85
4E 98 BB 72 2E 7E 68 6C
27 48 A5 68 58 D8 04 BB
02 B7 90 B8 F7 6F DF 53
11 64 89 B5 85 3F 82 2A
BE 9A 56 54 E6 8F 91 82
9F 0B BA E8 2F 9C AE 43
6A 9C C7 ED 91 32 22 A7
51 81 B9 86 32 52 98 26
B7 9B E5 F1 A3 F9 D5 9B
BD AA 16 62 42 85 08 03
20 EB F7 23 3F 6E 54 3F
2A A8 FF BF CD 0E 67 E4
47 5F 02 21 64 15 BA E8
86 62 CA 48 60 07 A3 0D
BA E0 D4 AF A0 FE E4 15
12 9E FD A1 8C C0 6F 19
01 CB 39 4B 35 FA 8D 04
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