

## SECURE AND COST EFFICIENT IMPLEMENTATION OF THE MOBILE COMPUTING USING OFFLOADING TECHNIQUE

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**Abstract:** The offloading techniques have become more prominent among the mobile computing due to the increased number of users and enormous amount of information flowing through the internet. The offloading techniques enhance the competence of the mobile computing by reducing the congestion in the network caused by increased number of users and the enormous data traffic experienced. However in many cases the authentication becomes very essential for the connection establishment. So the paper proposes a secure and cost efficient data offloading technique for the mobile computing to make it safe, secure with an effective management of network traffic. The performance analysis of the security measures proffered in the paper for authentication of the offloading techniques in terms of the security, cost and the delay in the offloading ensures that the proposed method is superior to the existing methods.

**Keywords:** Mobile Computing, Off-Loading Technique, Secure, Cost Efficient, Effective Network Management.

### 1. INTRODUCTION

The increase in the mobile devices utilization recently has resulted with the tremendous increase in dataflow causing congestion in the network. The tremendous increase in the flow of data has paved for the necessity of the effective management of the network. This effective management could be achieved using the proper off-loading, the data offloading is a prominent solution applied to bring down the burden faced in the cellular network due to the heavy flow of data from the mobile devices [5]. It is an approach to access the unused bandwidth that are available across the different wireless technologies [11]. The off-loading technique is an option to mitigate the surge found in the traffic in the cellular network [12].

The mobile computing is an approach that enables information conveyance in the form of either data, voice or video through a wireless device. The fundamental concept involved in it are the (i) infrastructure- that provides with a seamless connection, incorporating the protocols, services, bandwidth and the portals that essential for the

provisioning of the uninterrupted communication. (ii) Mobile components- the portable devices such as the laptops, tablets, Personal digital assistance etc. (iii) Software- The actual program that operates the mobile component, it takes the vital role in the mobile hardware by functioning as the engine of the mobile device. As portability serves as the main factor in the mobile computing, it guarantees that the users of the mobile devices are not held up in a particular place, but are free to use the device from anywhere. The mobile computing integrates all the aspects of the wireless communication.

The utilization of the mobile computing has modified the complete scenario of our daily lives by providing a location flexibility, improved productivity, entertainment and reduced time consumption. The advantages in turn has caused a multitudes to use the mobile device causing a heavy flow of data that results in the network congestion. The entailment for the network management leads to the offloading techniques, in order to help through the congestion and facilitate a seamless and quick communication. The Wi-Fi offloading is very commonly used as most of the mobile device are equipped with it and many experts rely on the Wi-Fi off-loading as the very effective way to elude the congestion in the network and ensure the scaling as well as the optimization of the network along with the enhancement in the customer service. Despite the merits of the offloading it necessitates an authentication to protect the data being off loaded.

So the paper puts forward a secure way of offloading utilizing the advanced encryption standard for the encrypting of the data being offloaded and uses the whale optimization in the optimal key selection for the decryption of the information.

The remaining of the paper is organized with the related works in the section 2, the proposed work in the section 3, the performance analysis in the section 4 and the conclusion in the section 5.

## **2. RELATED WORKS**

Srinivasan, et al [1] the author puts forward the methods of the data offloading for the mobile operators to enhance the network efficiency and strengthen the QOS of the network.

Hinger et al [2] the author in this paper explores the “architectural perspective of the mobile data off-loading that takes place from the LTE to the trusted Wi-Fi access networks along with the survey on the of the various off-

loading techniques that are utilized by the operator” the fig.1 below gives the local Wi-Fi architecture used in off-loading.

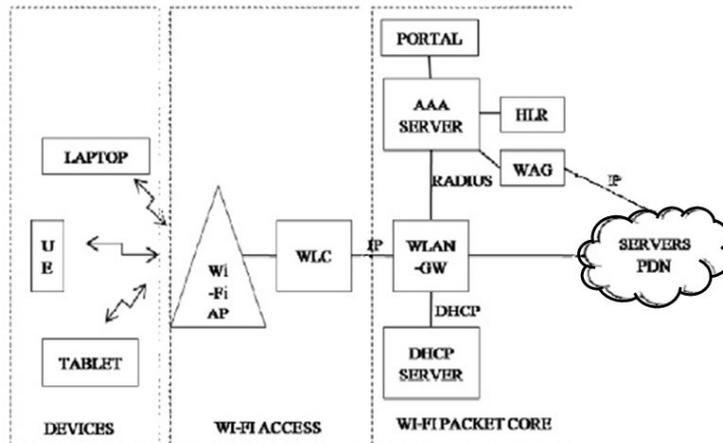


Fig .1Public Wi-Fi Architecture for Off-Loading [2]

Aijaz, et al [3] the author elaborates the “technical and the business perspectives of the mobile data offloading to over the problem of the increased data traffic and the network congestion experienced in the cellular network” the survey provides the over view of the fundamental off-loading techniques that are t( Wi-Fi, femtocells and the IP flow mobility) that are used in managing the network. The table.1 below provides the overview of the various offloading techniques available for proper management of the network with heavy traffic.

Mobile Offloading Techniques	Description	Merits
Wi-Fi (Wireless Fidelity)	It is a Wireless connectivity based on the IEEE 802.11 standards	Provides higher data Limited coverage and mobility
Femtocells	It is a Small cellular base station that is specifically designed for the indoor utilization.	Very attractive to operate Enhances both the coverage and the capacity in the indoors applicable to all standards eg : GSM , CDMA,WCDMA, LTE etc.
IP flow Mobility	Standardized in IETF (internet engineering task force)	Better traffic management , seamless connection , high bandwidth connections
Wi-Max	It is a communication technology that relies on the IEEE 802.16 standards , used over large geographical areas.	Reduces latency and improves reliability and the performance of the network .

Table .1 Off-Loading Techniques [3]

Pawar, et al [4] the paper presents the different various strategies in the data off-loading along with the issues and the benefits found in each of them.

Rebecch et al [5] the paper presents the “comprehensive survey on the data offloading techniques in the cellular networks and presents the essential requirements to incorporate the offloading capabilities.

Ding, et al [6] the author proffers a “designing of energy aware algorithm basically for the energy constrained devices to assist in the offloading decision making. The design developed ensures the smart phones with the most energy efficient Wi-Fi AP for Off-Loading.

Zhou et al [7] the paper presents the survey on the effective approaches to manage the mobile data traffic that grows explosively and reduce the severe burden on the mobile network operators.

Wang et al [8] The author provides a comprehensive survey on the data offloading techniques that provides a complementary service for the handling the heavy data flow in the cellular network.

Dbouk et al [9] the “intelligent resource aware off-loading is proposed by the author for the security services provided by the mobile edge cloud. The proffered method utilizes the Wi-Fi direct access to share the information’s and uses the integrated multi objective resources aware optimization and solution based decision to formulate a intelligent decision making for the off-loading that is smart.

Hernandez, et al [10] the proposes the Wi-Fi offloading for the extending the coverage and the conveyance of the data from the cellular network for the via wireless communication network for a part at Soledad Atlántico with the intention to provide an alteration for the internet access in order to reduce the burden in it.

Jose et al [11] the paper proposes the modelling of the delayed type mobile data off-loading using the Wi—Fi off-loading technique and analysis the competence of the method in terms of the optimality, packet arrival rate, and the average delays.

Khoshnoudi et al [12] the paper concentrates on the proper localization and the structuring of the access points and the Wi-Fi network respectively to influence the overall performance of the Wi-Fi off-loading , the paper presents “the numerical analysis of the access points in the single rate and the multi rate of IEEE 802.11 WLAN and compares the same. All the above paper concentrate on the perfect method to offloading and does not mind the authentication entailed before offloading, so the paper put forward a methods to secure the offloading in a cost efficient way for the mobile communication.

Premalatha et al [13] the author proffers a secure way of offloading the mobile application to the cloud computing using the RSA for the generation of the key and the encryption and the ABC for the decryption of the information, to protect the data from the unauthenticated users.

Feldhofer, et al [14] the paper about the utilization of the advanced encryption standard for the “strong authentication of the RFID systems”

Mirjalili, et al [15] the “whale optimization algorithm based on the social behavior of the humpback whales is proposed in this paper as a novel nature inspired meta-heuristic algorithm and found to be very competitive compared to the other methods”

### 3. PROPOSED WORK

The necessity for the authentication of the off-loading techniques in the mobile communication has led to the formulation of the secure way of data off-loading in the mobile computing. The proposed method put forwards optimal method to authenticate the offloading by encrypting following the advanced encryption standard [14] and decrypting using the whale optimization algorithm[15] for the optimal selection.

#### 3.1. AES FOR ENCRYPTING THE DATA OFF-LOADED

The Advanced encryption standard aids the data of 128 bits and keys with varying lengths of 128, 192 and 256 bits. The process does a ten round of computation with the keys of 128 bits, the computation taking place in the each round is unique except the last four rounds, it follows the principle of the substitution and permutation and found to be effective both in the software as well as the hardware. The algorithm of the AES is as follows.

Step 1: Expansion of the Key: uses the Rijndael’s key schedule to derive the round keys from the cipher key.

Step 2: The initial round key addition takes place, by combining the each byte in the state with the blocks in the round key by performing a bitwise XOR.

Step 3: Performs nine rounds of nonlinear substitution, shifting of the rows (shifting last three rows of the state cyclically for a specified number of steps, mixing of columns (combines four bytes in each column), and adds round key.

Step 4: Repeats the step 3 in the round 10 for 128 bits and optimizes the cipher.

The flowchart below show in the fig.2 provides the over view of the steps involved in the advanced encryption standard (AES).

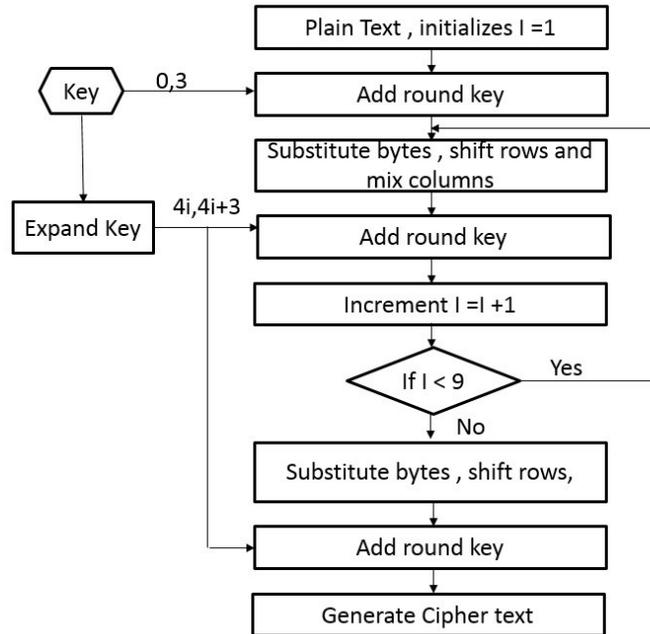


Fig.2 Advanced Encryption Standard

### 3.2. WOA DECRYPTION

The WOA [15] relies on the life of the humpback whales that follows a very different hunting method. The whales produce a bubbles around the prey along a path that is circular or nine shaped to hunt its food. The select the current position of the prey as the optimal position of the prey until its best position is finalized. The equation (1) is framed in this regard.

$$W(t) = W_{best} (t - 1) - X.Y$$

(1)

Where the 't' is the present state and the 'w' and the 'wbest' are the position and the optimal position respectively, and the 'X' and the 'Y' are the coefficients. The hunting continues in two phase (i) shrinking of the encircling prey by reducing the value of 'X' and updating of the spiral position as shown in the equation (2)

$$W(t) = Y \cdot e^{ab} \cos(2\pi n) + W_{best}(t - 1) \quad (2)$$

Where ‘a’ and ‘b’ are the constants value ranging between  $\{-1, 1\}$  and used in changing the shape, and the ‘Y’ represents the distance between the food and the whale. After identifying the optimal position of the prey each agent produces its optimal position and updates the best position.

This procedure in the decryption process that is just the reverse of the encryption process is done to decode the original information, the optimal key selection for retrieving of the data is done employing the WAO. Avoiding the misuse of the data offloading in the mobile computing.

#### 4. PERFORMANCE ANALYSIS

The analysis of the proposed method of encryption and decryption for securing the data offloading in the mobile in the MATLAB proves the enhanced capability of the proposed method against the existing method of RSA-ABC [13] in the terms of security, cost and the delay in offloading. The table.2 below shows the comparison of the proposed AES-WOA with the existing method for files of different sizes.

File size (KB)	RSA-ABC			AES-WOA		
	Security %	Cost %	Delay ms	Security %	Cost %	Delay ms
40	65	55	.8951	88	30	.5648
50	58	60	.8547	89	35	.5423
60	64	62	.8741	88	36	.4586
70	69	63	.8662	84	37	.3415
80	67	64	.8945	85	45	.3214
90	59	67	.9142	92	47	.3301
100	57	69	.9209	94	46	.2564

Table.2 Comparison of AES-WOA with the Existing

## 5. CONCLUSION

The paper provides a secure and a cost effective way of off-loading for the mobile computing by integrating the advanced encryption standard and the whale optimization algorithm for the encryption and the decryption of the information's offloaded respectively. This ensure the authentication for the information transmission to the appropriate person avoiding the circumstances of information misuse by the intruders and the attackers. The performance analysis of the proposed method evinces the competence of the AES-WOA in terms of security, cost and delay in the offloading against the existing methods

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