REDUCING DATA COST FOR INTERNET USERS IN THE MIDDLE EAST: EGYPT AS A MODEL

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ABSTRACT

Nowadays, the usage of the internet has become a necessity to nearly every household. However, the developing countries remains to suffer from the costs of internet services especially through mobile wireless networks (Third generation network (3G) and Forth generation network (4G)) when the majority of the internet users in those countries are of low-income. This has elevated the need to reduce costs through different ways; however, not without limitations as one of the biggest obstacles in this field was finding data and information on it. The aim of this work is to moderate downloads between mobile internet and Asymmetric digital subscriber line (ADSL) in order to reduce the costs for the consumer through using the offloading techniques to manage the data consuming behavior for the customer to achieve our goal. This research will prove that we can reduce data consuming cost by more than 93% as shown in the experimental results.

KEYWORDS

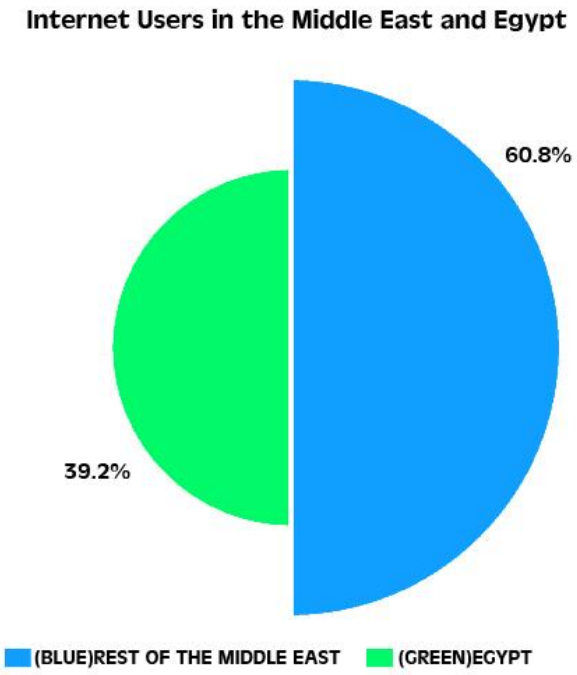
Offloading, 3G, ADSL, data costs, Wi-Fi, cloud computing

المستخلص:

في الوقت الحاضر ، أصبح استخدام الإنترنت ضرورة لكل أسرة تقريبًا. ومع ذلك ، تظل البلدان النامية تعاني من تكاليف خدمات الإنترنت وبالخصوص تلك المقدمة خلال الشبكات اللاسلكية المتنقلة (شبكات الجيل الثالث 3G وشبكات الجيل الرابع 4G). وعندما يكون غالبية مستخدمي الإنترنت في تلك البلدان من ذوي الدخل المنخفض. فقد أدى ذلك إلى زيادة الحاجة إلى خفض التكاليف من خلال طرق مختلفة ؛ ومع ذلك فلا يمكن الوصول لتلك النتيجة من دون قيود وذلك لان احدى أكبر العقبات في هذا المجال هو العثور على البيانات والمعلومات المطلوبة . ان الهدف من هذا البحث هو إجراء عمليات تنزيل معتدلة بين شبكات الإنترنت عبر الجوال و خط المشترك الرقمي غير المتماثل ADSL من أجل تقليل تكاليف المستهلك. من خلال استخدام تقنيات التفريغ لإدارة سلوك استهلاك البيانات للعميل بما يحقق هدفنا. سيثبت هذا البحث أننا نستطيع تقليل تكلفة استهلاك البيانات بأكثر من 93٪ كما هو موضح في النتائج التجريبية.

INTRODUCTION

The technological field has been developing rapidly where every day new inventions, concepts and hypotheses are brought to life. The Internet has become one of the needs everywhere. One of the biggest challenges that face people who require internet services is the cost. Between over 250 million people in the Middle East, there are over 146 million internet users as of June 2017 [1]. Those represent 58.7% of the population in the area as shown in Figure (1). Therefore, upon focusing on Egypt, it is clear that 39.2% of its population use the internet. Taking in consideration that Egypt is a low-income country, this elevates the importance of this work.



Figure(1): Internet users in the Middle East

Upon developing this work, the first question that was raised to mine is whether this work could truly achieve the hypotheses proposed in order to reduce data costs and to have an impactful result. All these questions were raised as no works directly touched this point before. All the works that touch this field tackle topics such as power consumption [2][4] while others discussed cloud computing benefits in e-learning [5]. In addition to that, the dependency of this article on scarce data sources which is presented by providers' official website data and internet offers that are directed as an advertisement

for existing network subscribers and also for targeted subscribers has been the source. In this work, we propose a different look to the system proposed by [2] who used cloud computing services and offloading framework to reduce power consumption by creating a system with three components (two clouds and a smart phone), they developed a mobile cloud computing model, provided the environment specifically designed for smart device users. This system allows users to create virtual smartphone images in the public cloud and remotely run their jobs in these images as they would locally through offloading only non-critical jobs when sustainable networks exist to synchronization files. Both smart devices and the private cloud hosting computers are connected to the same wireless local area network). This work will use the same proposed system but with different equations which intend to be prove the validation of the theory proposed herein.

1. BACKGROUND

In this section, we introduce several of the techniques that aided in bringing this work together. Briefly, the section explains Cloud Computing, its cooperation with Mobile phones, 3G networks, offloading and the costs of using 3G networks.

2.1. Cloud Computing

Cloud Computing is a technology that has the ability to gain permission to the shared pools of configurable system resources and services which are updated frequently with the least management effort over the internet. It is considered to have made major changes in the computing industry. With that, the interest in Cloud Computing has rapidly increased in the past few years in both the academic and the industrial communities.

The demand on Cloud Computing has increased drastically due to the many applications of Cloud Computing. What Cloud Computing offers is massive levels of computing power that permit the user of using those applications without having the hardware or software necessary to run those applications. Primarily, there are a few layers for Cloud Computing, the three main ones that are offered as services which are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

Accordingly, the first of those services, Infrastructure as a Service (IaaS), allows the user to use computing storage space, computing and network resources to allow the user to run an application or a software through the Cloud. The second layer

is Platform as a Service which permits the user to use the Cloud as hardware in order to run applications and programming languages that would otherwise prove impossible to run through the user's hardware. Finally, Software as a Service presents an end-user of complete applications running on a cloud infrastructure offered as an on-demand service and uncontrollable by the user [6].

2.2 Mobile Cloud Computing (MCC)

Cloud Computing has witnessed a major increase in its uses and development. With that came dawn the Mobile Cloud Computing which resembles the familiar scheme of Cloud Computing only on handheld mobile devices. As previously defined, Cloud Computing refers to (applications as services, hardware as a service and system software as a service provided through the internet [7].

Accordingly, the trend of Mobile Cloud Computing has emerged to extend the boundaries of Cloud Computing and become the natural evolution of the field. Mobile Cloud Computing generally refers to the public cloud which is part of the four main divisions of Cloud Computing, namely: Private Cloud, Public Cloud, Hybrid Cloud and Community Cloud.

This field has tons of research through the past few years to permit smart phones to utilize the Cloud in the best mean possible [8].

2.3 3G Networks

Mobile Networking has been one of the fastest developing Information and communications technologies (ICT) in the recent years. It has witnesses several changes and upgrades where increases in the capacity of the networks have led to allowing mobile network capabilities to everyone. This comes in line with the abilities granted by wireless fidelity networks (Wi-Fi) [9].

3G stands for Third Generation which has evolved from the previous 2.5 G and 2G networks. They allow faster communication services with the likes of voice, fax and internet with a wider range of availability with continuous global roaming. Korea and Japan were the first to deploy those 3G networks and they have thus become more and more available throughout the world [10].

2.4 Offloading

What mobile data offloading presents is the usage of corresponding network technologies in order to deliver the intended data for mobile networks. It decreases the amount of data that is carried through the mobile bands in order to free bandwidth to other users who may attempt to use similar services. Offloading has captured the attention of many workers in the field in the past couple of years due to the implications it could have on the future of ICT regarding cost savings and mobile network flexibility. The idea in itself is not new as it has been discussed in various areas including distributed computing, collaboration and the development of decision-prediction metrics for offloading [11].

Accordingly, one of the biggest motivations that have inspired the excessive research performed on the field of offloading is cost-saving while at the same time fast [11]. This goes in line with the decrease in computation sought to achieve on mobile devices in order to reduce the excessive battery drain that occurs. However, with emphasis on high-performance and robustness, some security and privacy obstacles stand in the way of offloading [12]. This has led many researchers to learn

towards Cloud Computing as a mean to overcome those obstacles.

2.5 Data Cost

The costs of data in services such as cloud computing can be extremely high. This has turned the development of several branches of research inevitable in order to overcome the cost problem. Works have been developed to reduce the costs of services [13]. Accordingly, the scale of the cost could differ from one cloud to the other and from one service provider to the other. This has led many works to implement method that would help with dealing with those costs and lowering them accordingly [14].

2. PROPOSED METHODOLOGY

The proposed theory uses the system software presented by me in my previous research [2]; however, it employs a new equation for that. That section aims to prove the theory by proposing that the subscriber could reduce data costs by changing their data consumption behavior through offloading their uncritical downloads during mobility and urging them to be downloaded later when they connected to the internet

through ADSL and Wi-Fi connection. This theory was never been presented before and there are no related or previous research paper talked about that.

In Egypt, as any other country, there are two ways to get internet services: 3G and ADSL monthly subscription. We took the average subscription offer for each one of the two internet methods here. For this, we chose Etisalat Egypt as one of the biggest telecommunication companies in Egypt and because it provides internet services through both 3G and ADSL.

We first propose an equation that is wrote originally to calculate the cost for each GB of data as below.

Ec (EGP) = S/Ed. (1)

Ec: average cost (1GB/EGP)

Ed: average used data

S: subscription fees

EGP: Egyptian pounds

3G data cost for each 5GB of data costs is 50 EGP and here is where we apply the offer on our equation. We get:

Ec (EGP) = S/Ed.

= 50 EGP/5 GB=10EG P/1GB

ADSL data cost for unlimited data subscription is 69.5 EGP and here where we apply there offer on our equation we should choose a series of files with various data sizes if we put in consideration the data using behavior for users and the different data as in table[1] usage for each one. Here we choose 16 different file sizes to be experimented in validating our system as below [4].

(5, 10, 15, 20, 30, 50, 55, 67, 75, 79, 89, 100, 107, 122, 140, 150) GB data files

3.1. Proposed System

In figure [2], the proposed system works based on hypothesis that the subscription to the internet services is provided as both (ADSL and 3G). Initially, the user will determine the data files which need to be downloaded. Then, they should ask themselves if downloading this file is critical. If yes then, they should check their internet services if they exist and according to that if, the ADSL connection is available then they should download this file via ADSL. otherwise, they should download it via 3G network. The other scenario starts when the user decides to consider their download as uncritical. Therefore, they would offload their download to the public cloud, if the offload succeed then the file should be offloaded again to the

private cloud where it would wait until the availability of a Wi-Fi connection to send the file to the smartphones directly.

3.2. Proposed Android App (AHpower)

Many technologies were used to design that applications, such as Java Android Programming Language; Eclipse Android Emulator and Editor; Version: 3.7 Indigo Service Release 2 with Java Runtime Environment (JRE). In addition, Android Virtual Device (AVD) Manager and Android software development kit (SDK) that provide Application programming Interface (API) libraries and the developer tools necessary to build, test and debugging apps for Android. The main function for that part of the proposed system is to link the local smart device with clouds. That will update (add or remove) the downloading jobs and choose either to download them through the proposed offloading framework or by direct download through any available data network and to receive a downloaded file through Wi-Fi connection when it connects to the same data network with private cloud as shown in Figure (3) .

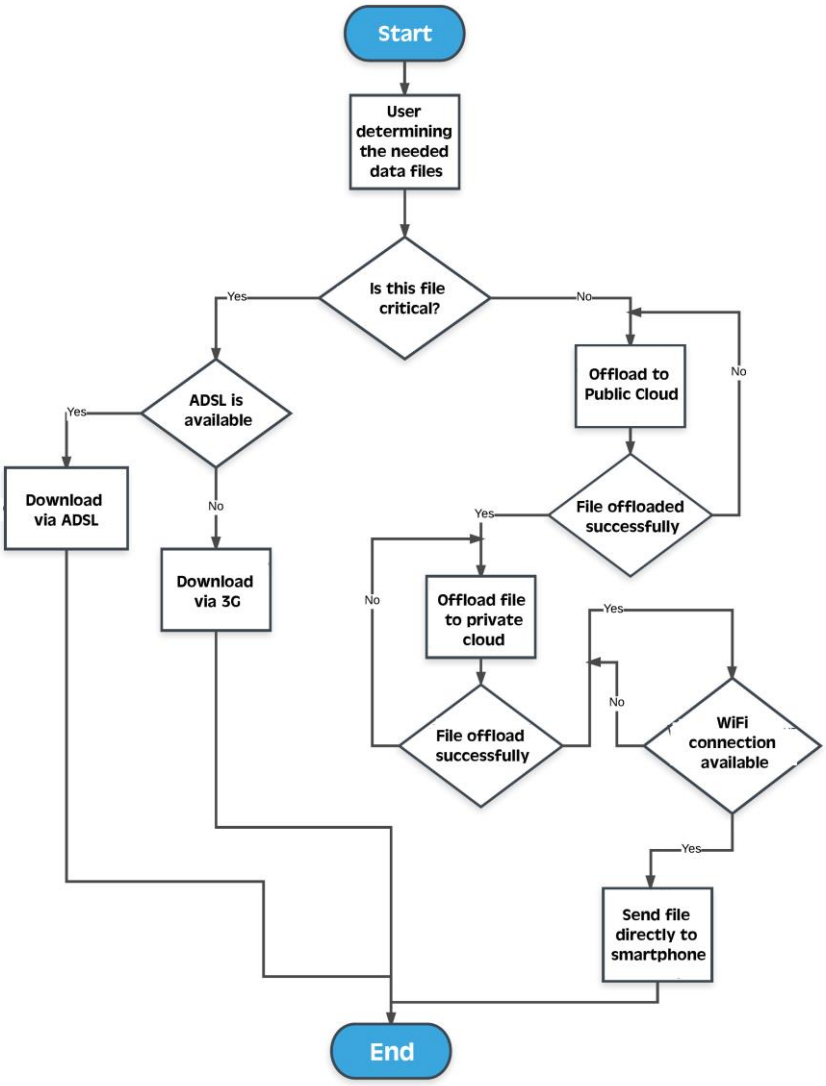


Figure2: Proposed System Scenario

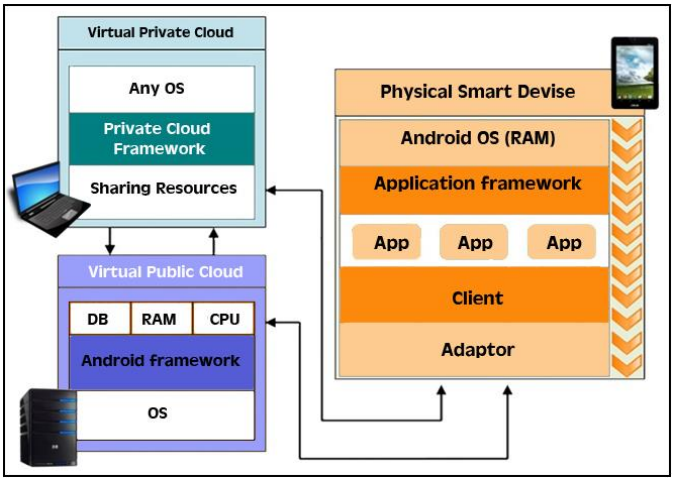


Figure 3: proposed system structure

3. EXPERIMENTAL RESULTS

In this section, we test the hypotheses through comparing between the costs of using 3G and ADSL. The only materials needed in this experiment are the data packages, which are going to be tested on the equations shown previously, which propose the many advantages of using cloud computing and offloading to minimize the internet costs for the users in low-income countries. In this work, Egypt is taken as an example upon which the work was based.

4.1 Comparison Method

In this section, we will measure the effectiveness of our hypotheses by applying the equation (1) on the chosen data files. The results will prove the validity of this method. In table

(1), it shown that different data files starting from 5GB to 150GB for a fixed period of time (1 month) and fixed service speed (1MB/s). Upon applying the equation on the 3G internet, the subscription which offers 5GB of data for 50 EGP by Etisalat Egypt (one of the biggest telecommunication companies in Egypt). Moreover, the same company offers to provide the internet through ADSL with unlimited data for 69.5 EGP a month. Through applying our equation to these offers, we will find that the fixed price in 3G is 10 EGP for each GB of data. However, upon applying the equations(1) on ADSL starting from 5GB then it is shown that the price is higher than 3G (13.9 EGP) for ADSL compared to (10 EGP) for 3G so the price here and if calculate the percentage between the two results as

Percentage of cost = (ADSL cost/ 3G cost)* 100 (2)

Ex: (13.9/10)*100= 139%

Which leads to say that the user should download at least 10GB of data monthly as shown below in Table (1) also in Figure (3).

Table 1: Data cost ADSL vs 3G

Data consumption in GB/month	Line speed MB/s	Data cost Using ADSL unlimited (EGP) FOR 1GB	Data cost Using 3G LIMITED 5GB (EGP)	The percentage of the cost ADSL vs. 3G
5	1 MB/S	13.9	10	139.00%
10	1 MB/S	6.95	10	69.50%
15	1 MB/S	4.63	10	46.30%
20	1 MB/S	3.48	10	34.80%
30	1 MB/S	2.32	10	23.20%
50	1 MB/S	1.39	10	13.90%
55	1 MB/S	1.26	10	12.60%
67	1 MB/S	1.04	10	10.40%
75	1 MB/S	0.93	10	9.30%
79	1 MB/S	0.88	10	8.80%
89	1 MB/S	0.78	10	7.80%
100	1 MB/S	0.70	10	7.00%
107	1 MB/S	0.65	10	6.50%
122	1 MB/S	0.56	10	5.60%
140	1 MB/S	0.50	10	5.00%
150	1 MB/S	0.46	10	4.60%

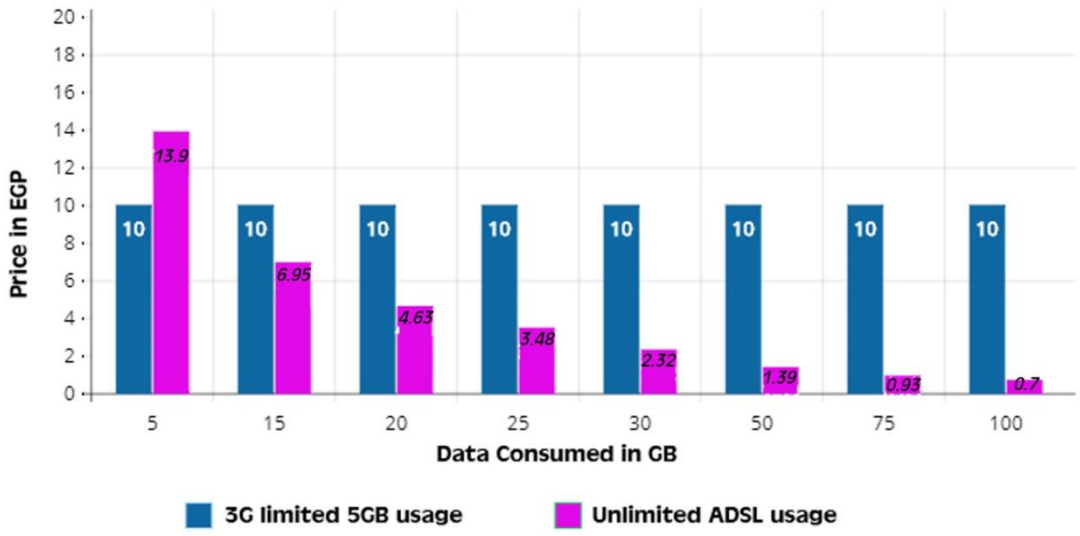


Figure 4: Data cost (ADSL vs. 3G)

We should note that the results confirm that the more data downloaded the more cost reduced, as shown in Table 1, Figure 4 and Figure 5.

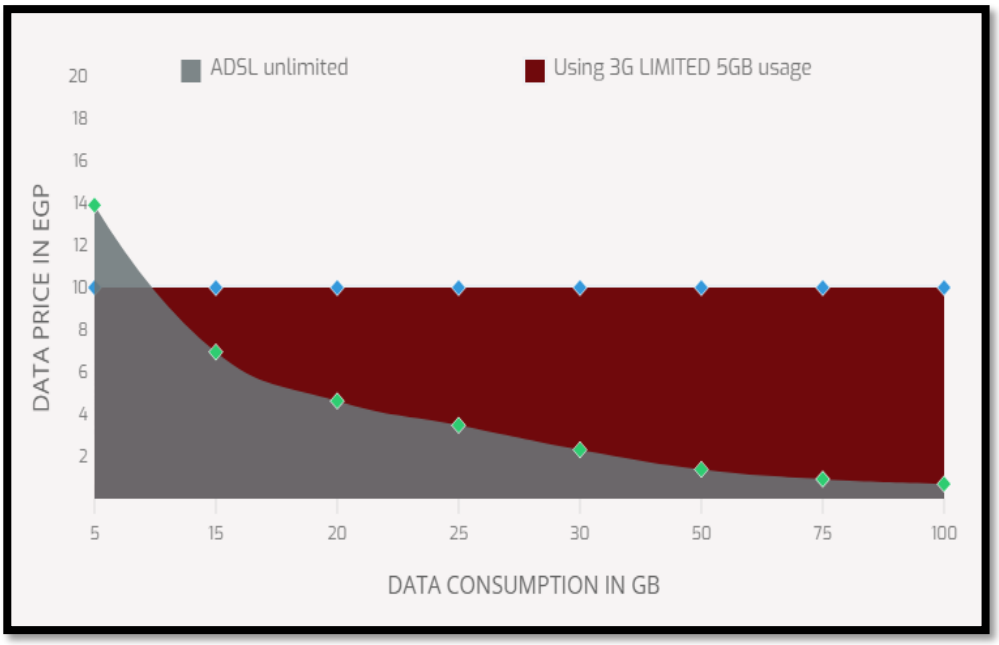


Figure 5: The inversed relationship between Cost and Data consumption

4. CONCLUSION

In recent decades, many of the emerging technologies remain to be under research and development. Two of the most important of these technologies are the technologies of offloading and cloud computing. There are many uses for these technologies. One of the most important problems in the developing countries is the limited income that stands between the user and the internet service.

This work has developed a mean to overcome the problem. It was proposed to decrease the power consumption for other uses and to reduce costs of using the internet for uploading

large data downloads in order to download them through ADSL instead of 3G networks. The results show promise as they could save the costs from 31.5% to 95.4%. This will be determined by changing the user's behavior as shown in table 1. With that said the work acknowledges that there are areas to access and explore to improve the results further.

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