



**Sudan University of Science & Technology**  
**College of Engineering**  
**School of Electronics Engineering**

**DATA OFFLOADING FROM 3G TO WIFI**  
**THROUGH VERTICAL HANDOVER**  
**ALGORITHM**

A Research Submitted In partial Fulfillment for the Requirements  
of the Degree of B.Sc. (Honor) In Electronics Engineering

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**September 2014**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَمَا أَوْتِيْتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيْلًا

صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ

## **Dedication**

*This thesis is dedicated to*

***My mother***

*A strong and gentle soul who taught me to trust in Allah, believe in hard work*

***My father***

*For earning an honest living for us and for supporting and encouraging me to believe in myself*

# Acknowledgment

First and above all, I thank God, the almighty for providing me this opportunity and granting me the capability to proceed successfully. This thesis appears in its current Form due to the assistance and guidance of several people. I would therefore like to offer my sincere thanks to all of them.

I would like to thank **Dr.RashidSaeed** the supervisor for advices and detailed review during preparation of this thesis.

**Eng. Ibrahim Mohammed**, thanks for your excellent technical assistance, and your kindly answers to my general questions.

I want to express my deep thanks to **Eng.NazarAbdalrhman** for his advices and assistance.

I warmly thank and appreciate my **parents, brothers, and sisters** for spiritual support in all aspects of my life.

Thanks to my **friends** for provided assistance in numerous ways.

## **Abstract**

The third generation networks are overloaded due to the proliferation of smart phones; hence the popularity of social networking and online applications, offloading mobile data traffic to a wireless network is a low cost and effective solution, this thesis proposes data offloading to wireless Wi-Fi networks through simple and robust vertical handover algorithm for heterogeneous networks by using Matlab simulation. Thus, this procedure increases the utilization of network's bandwidth up to 50% which eases the congestion of the 3G networks and enhances the performance of data delivery to the subscriber

## المستخلص

نظرا لانتشار الهواتف الذكية فإن شبكات إتصالات الجيل الثالث تعاني من الحمل المثلث عليها؛ من هنا جاءت شعبية الشبكات الإجتماعية وتطبيقات الإنترنت، يعتبر تفريغ حركة البيانات المتنقلة إلى شبكة لاسلكية حل منخفض التكلفة و فعال، هذه الأطروحة تقترح تفريغ البيانات إلى شبكة الإخلاء اللاسلكية من خلال خوارزمية بسيطة و قوية للتسليم العمودي للشبكات غير المتجانسة باستخدام محاكاة الماتلاب، و بالتالي فإن هذه العملية تؤدي إلى زيادة الإنتفاع من النطاق الترددي للشبكة بنسبة 50% للتخفيف من إزدحام شبكات الجيل الثالث وتعزيز أداء تسليم البيانات للمشارك .

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## LIST OF SYMBOLS

Q	Network quality
C	Cost of service
S	Security
P	Power consumption
D	Network conditions
F	Network performance
b	Available bandwidth
T	Estimated duration of MN staying on particular network
M	Minimum guarantee function
<i>th</i>	The threshold value
<i>i</i>	The number of the network
RSS	Received signal strength
WS	The weight of the network security
WC	The weight of the network cost
WD	The weight of the network condition
WP	The weight of the network performance.
WF	The weight of the network performance
$\mu_i$	Number of calls serviced per unit time

## ABBREVIATIONS

3GPP	3rd Generation Partnership Project
ABW	Available bandwidth
ANDSF	Access network discovery and selection function.
BS	Base station
BSSGP	Base station system GPRS protocol.
CDMA	Code division multiple access
CDPD	Cellular digital packet data
DNCBP	Dynamic new call blocking probability.
EVHDF	Extended vertical handover function
FEC	Forward error correction
GPRS	General Packet radio service
GGSN	Gateway GPRS support node
GMM	GPRS mobility management
GTP	GPRS tunneling protocol
GSM	Global system for mobile communication
HHO	Horizontal handover
LAN	Local area network
LLC	Logical link control
LLC PDU	Logical link control packet data unit
MAC	Medium access control

MN	Mobile node
MIH	Media independent handover
OFDM	Orthogonal frequency division multiple access
PDU	Packet data unit
PHY	Physical layer
PSN	Pocket Switched Networks
RAT	Radio access technologies
RSS	Received signal strength
RLC	Radio link control
SGSN	Serving GPRS support node
SM	Session management
SIM	Subscriber identity module
SDCP	Subnetwork dependent convergence protocol
SINR	Signal to interference and noise ratio
TLLI	Temporary logical link identifier
LAN	Local area networking
LLC	Logical link control
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS terrestrial radio access network
VHDF	Vertical handover decision function
VHO	Vertical handover
WLAN	Wireless local area network
W-CDMA	Wideband code division multiple access

# CHAPTER ONE

## Introduction

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# IMPROVE MOBILE DATA LOAD BY USING 3G

## OFFLOAD CONCEPTS

### Chapter One

#### Introduction

##### 1.1 Preface

A cellular network or mobile network is a wireless network distributed over land areas called cells, each served by at least one fixed-location transceiver, known as a cell site or base station. In a cellular network, each cell uses a different set of frequencies from neighboring cells, to avoid interference and provide guaranteed bandwidth within each cell.

When joined together these cells provide radio coverage over a wide geographic area. This enables a large number of portable transceivers (e.g., mobile phones, pagers, etc.) to communicate with each other and with fixed transceivers and telephones anywhere in the network, via base stations, even if some of the transceivers are moving through more than one cell during transmission.

In networking load refers to the amount of data (traffic) being carried by the network.

Due to the rapid growth of smartphones and tablets, data traffic on the Networks is on the rise and mobile connections are expected to reach the 2.74 billion mark by 2015 — surpassing the global population.

The popularity of data guzzling applications, social networking, video and online gaming will further drive data consumption creating tremendous strain on the networks. Next-generation network deployments promise to deliver higher bandwidth and speed but they also introduce new challenges for service providers such as a high cost of deployment and operations. The cost of delivering data continues to rise more rapidly than revenues, and is expected to grow seven fold from \$53 billion in 2010 to reach \$370 billion by 2016. [1]

##### 1.2 Problem Statements

The limited bandwidth and performance inferiority of 3G networks as a main effect of data traffic congestion, and also the deployment of wireless access technology can enable unnecessary automatic vertical handover (data offloading).

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### 1.3 Proposed Solutions

Introduce proactive and reliable triggers for the vertical handover procedure that have the ability to check the general network status in order to improve bandwidth utilization and cost reduction.

### 1.4 Aim and Objectives

The aim of this research is to improve the offload technique for 3<sup>rd</sup> generation networks, the objectives are:

- To reduce cost of plain internet access to all 3G and Wi-Fi devices.
- To Improve the bandwidth utilization rate.
- To Reduce the number of unnecessary handoffs.
- To avoid connection dropping.

### 1.5 Methodology

This research has gone through multiple steps which are:

1. Step 1: collect general data about the project.
  2. Step 2: the problems and solution are defined.
  3. Step 3: offloading to Wi-Fi by handover technique are introduced.
- Step 4: simulation codes are used to investigate the technique.
  - Step 5: result from simulation obtained.

### 1.6 Research outlines

This thesis is divided into the following chapters:

4. Chapter 1 presents background of mobile network growth. ~~introduction~~

Presents background of mobile network growth.

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Chapter 2 ~~s~~Shows the necessary theoretical and background aspects of the project such as offloading, handover, and Wi-Fi.

~~5.~~ 5. Literature review

~~Shows the necessary theoretical aspects of this project such as offloading, handover, and Wi-Fi.~~

~~6.~~ Chapter 3 presents the methodology of handover for heterogeneous wireless mobile networks (UMTS, and Wi-Fi).

Chapter 4 presents the simulation process and resulting graphs.

~~7.~~ **Chapter 5 : simulation and results**

~~Presents the simulation process and resulting graphs.~~

~~1.~~ Chapter 5 concludes the project and proposes some aspects that can be investigated for a future work. *conclusion and recommendation*

*the project and proposes some aspects that can be investigated for a future work*

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