# Kabarak University

**School of Science Engineering and Technology**

**PROJECT TITLE:**

**INVESTIGATIGATION OF LOCATION AS A FACTOR AFFECTING VARIATION OF CELLULAR PHONE SIGNAL STRENGTH, A CASE STUDY IN KABARAK UNIVERSITY.**

**SUBMITTED BY:**

**CHEPKEMOI MERCY – TLCM/MG/1338/09/19**

**SUPERVISOR’S NAME:**

**Dr. CHRISTOPHER MAGHANGA**

In partial fulfillment for the award of Degree in;

**BSC. TELECOMMUNICATIONS**

# PREFACE

This report is written partially for the award of Bachelor’s degree in telecommunication and also for the purpose of fully documenting a project that was undertaken by the author. To understand what this report entails, the reader must be well acquainted and also have a clear understanding of the factors affecting variation of cellular signal strength.

# ACKNOWLDGEMENT

I would like to thank to the almighty God; giver of all knowledge, for the gift of life. My sincere gratitude goes to my family especially my parents and siblings who have been supportive and encouraging throughout the course of my study.

I also acknowledge Dr Maghanga for his invaluable knowledge and insight in the preparation of this work.

# DECLARATION

**STUDENT:**

I hereby declare that this project entitled; INVESTIGATION OF LOCATION AS A FACTOR AFFECTING VARIATION OF CELLULAR PHONE SIGNAL STRENGTH, A CASE STUDY IN KABARAK UNIVERSITY. Submitted as my undergraduate project, is a record of an original work done by me under the guidance of Dr. Maghanga.

The results embodied in this report have not been submitted elsewhere.

Name: CHEPKEMOI MERCY

Reg No: TLCM/MG/1338/09/19

Sign: Chepkemoi

Date: 22-11-2022

**SUPERVISOR:**

I hereby declare that I have checked this project and, in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor in Telecommunications.

Supervisor’s Name: Dr. Maghanga

Sign: Christopher

Date: 22-11-2022

# DEDICATION

I dedicate my project to my family who have been a constant source of strength and inspiration throughout the course of this work. I also dedicate this to my supervisor; Dr Maghanga without whose insight this work would not have come to fruition.

# ABSTRACT

There are various factors affecting mobile signals strength. They include; weather, distance from the network service base station, obstacles such building towers, transmission power, efficiency of the transmitting antenna and network congestion. Cellular phones are made in a way that they have a set of increasing bar heights to display the signal strength received by the user’s mobile. In this project, the signal strength values were recorded at the same time each day, same location every day for three different locations determining the signal differences and got a maximum signal strength.

# CHAPTER ONE

# INTRODUCTION

* 1. **Background information**

Communication is defined as the process of conveying information through the exchange of thoughts and messages by speech, visuals or signals. It has been a quintessential part and parcel of the human race since time immemorial. The cellular phone has played a major role in revolutionizing communication by making it much more efficient in conveying information from one person to another.

A cellular phone is a portable device that uses the low powered radio technology transmitters to convey information. First cellular phone was invented by Martin Cooper the Motorola engineer in the year 1973. There has been gradual advancement in the manufacturing of cellular phones giving a rise to different phone types like basic cellphones, feature phones and smartphones.

The past few years, technological advancement has been a major subject of global interest. In the telecommunication industry; the phone sector in particular, has piqued much interest. This can be clearly depicted in the gradual rise of different telephone companies to satisfy the demands of the increasing population. This has resulted in tight competition amongst industries for customers, equipment and new service promotion.

In the modern society, most services offered are widely networked making people to heavily rely on the network connectivity for better services. Consequently, a major part of our life can be termed as wireless. For higher efficiency and better access of the wireless connectivity, the signal strength of the devices for example the phone plays a greater role. A cellular phone signal strength is the signal received by a phone from a cellular network that enables it to access the network connectivity.

Signal strength is the transmitting power output as received by a reference antenna at cell phone or cell data device. Phones operate on signal strength and quality measured in decibels (dB). Decibels are given in negative format, the closer to zero the number is, the better the signal.

Phone signal strength is heavily dependent on the manufacturer’s end. Different phone companies have their signal strength averaged differently, making the signal strength of different phone models different. In this project the researcher aims to determine the cellular phone signal strength of diverse phones by examining various factors.

* 1. **Problem statement**

In the developing world, the use of mobile phones is highly regarded and considered the most efficient mode of communication. Good signal strength is recommended for effective use of the phone. Signal strength is dependent on various factors from the features of the phone to the surrounding conditions.

Challenges faced in cellular communication due to poor signal strength include slow internet, poor network connectivity and poor reception. This is brought about by different factors such as weather, time, location and building barriers.

This study examined location as a factor affecting the signal strength and the impact on communication, which in turn aided in the adjustment of various sectors in the telecommunication industry towards improving and advancing communication.

* 1. **Objectives**

The main objective was to examine factors influencing variation of cellular phone signal strength in Kabarak University.

* + 1. **Specific objectives**
* Define and establish the various environmental conditions for the study.
* To determine the impact of location on signal strength variation.
* Study effect of the environmental factors on the signal strength.
  1. **Justification**

This study imparted better understanding of the signal strength in this geographical area. This in turn eased increasing the signal strength after a clear understanding of the location as a factor affecting variation of cellular phone signal strength in this particular area.

The findings of the study were instrumental in correcting the current quagmire and formed a basis of knowledge and understanding of the local communication sector.

* 1. **The scope of the study**

The study site was at Kabarak university in Rongai subcounty, Nakuru county. It focused on examining the factors affecting the signal strength of the area. The study aimed to pave way for measures aimed at enhancing the signal strength of this particular geographical area.

This study examined phone-related factors as well as environment-related factors so as to determine their specific influence on signal strength variation in Kabarak University.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Introduction**

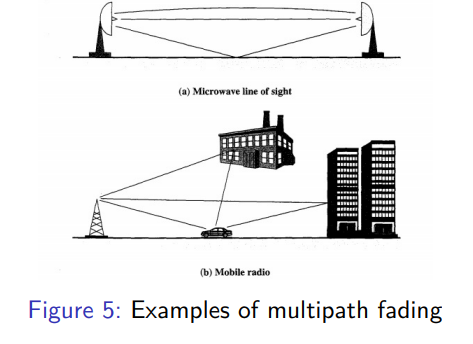
This chapter reviews information relevant to understanding of this particular study. It   
discusses history, technological advancement and previously discovered factors in relation to this subject.

**2.2 Mobile usage in Kenya**

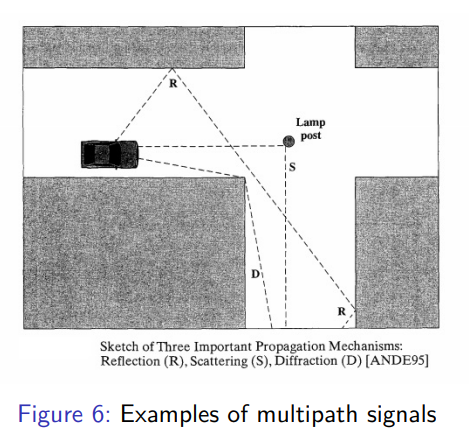
Kenya is one of the fastest technologically advancing countries in Sub Saharan Africa. The advancement is majorly attributed to telephone innovations. The ever-growing population contributes to the continuously rising demand for communication, internet usage and mobile money transfer. According to the Kenya National Housing and Population Census conducted in 2019, the population of Kenya was estimated at 47,564,296 persons. The mobile phone coverage out of the entire population was estimated at 20,694,315 users. A study conducted by the Kenya Digital Report in reported that 97 percent of internet users access the internet via mobile phones. However, a greater percentage of mobile usage is in the urban centers in comparison to rural areas and Kabarak University is a rural area.

**2.3 History of signal**

**2.3.1 Signal transmission**  
In wireless network, the receiver does not often receive the signal directly. This due to   
the transmitting power loss caused by attenuation or absorption by the intervening   
medium. The signal undergoes situations like reflection, diffraction and scattering in   
its path due to obstacles like trees, building, weather just to mention a few.   
  
The fluctuation in the received power causes signal fading and when the signal fluctuates in a very short time, it is referred to as short fading. The Received Signal Strength (RSS) is a measurement of the power present in a received radio signal or how well your device can hear a signal from an access point or router, a Received Signal Strength Indicator (RSSI) is device that helps mostly in localization of the signal. The RSS plays a role in determining the nature and characterization of a location fingerprints stored in a radio-map. It is a function of distance between the receiving the device and the transmitter which varies due to various obstacles in the signal’s path.   
  
Fading is the time variation of received signal power caused by changes in the transmission paths. There is different propagation mechanism in fading, these are;   
  
Multipath: This is where the signals are reflected by obstacles hence multiple copies of the signal with delays are received.



Refraction: Radio waves are bent when they propagate through the atmosphere due to   
Changes in the speed of the signal with altitude or any other spatial Changes in   
the atmospheric condition.   
  
Multipath propagation: Reflection occurs when an electromagnetic signal encounter   
A surface that is large, relative to the wavelength of the Signal.   
Scattering: The incoming signal is scattered into several weaker outgoing signals.   
  
Diffraction: Occurs at the edge of an impenetrable body that is large compared to   
the wavelength of the radio wave



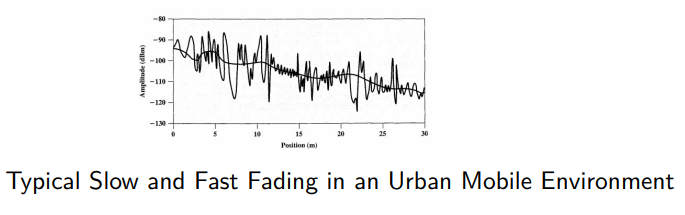
**2.3.2 Types of fading**

• Fast fading: This is the when the waveform is rapidly changing in amplitude   
between 20 to 30 decibels over a very short distance.

• Slow fading: When the waveform amplitude changes over longer distances.

• Flat fading: All frequency components of the received signal fluctuate in the same proportions simultaneously.

• Selective fading: Affects unequally the different spectral components of radio signal



**2.4 Factors affecting signal strength**

Various factors influence the variation of cellular phone signal strength. They include:

1. Location – Signals that have direct line of sight with the base stations are stronger compared to the ones that are obstructed by mountains or buildings.
2. Time - the signal strength is higher during the day than at night.
3. Distance - signal strength decreases as one moves farther away from the base station.
4. Weather - different weather affect the signal strengths, such rainy, sunny and cloudy weather.
5. Physical barriers - these include trees and buildings.
6. Type of phone – different phones models have their signal strength averaged differently.

**2.5 Impact of poor signal strength**

. Poor cellular phone signal strength will impede downloads of important documents from the internet, streaming of online content and cause buffering when surfing the web. A large portion of people living in the remote areas of the country often face this phenomenon hence hindering their communication.

**CHAPTER 3**

**METHODOLOGY**

**3.1 Introduction**

This chapter explains in details the methodology and components of this final year   
project report. Each part and component that has been selected has its own purpose   
mostly in the collection of data.

**3.2 Definition of methodology**

It is defined as:

• “The systematic study of methods that are, can be, or have been applied within   
a discipline”

• “The analysis of the principles of methods, rules and postulates employed by a   
discipline.”

• “A particular procedure or set of procedures.

**3.3 PROJECT OVERVIEW**

This section will briefly explain the mode that was used in determining the   
variation of signal strength in this project.

**3.4 Study area**

This study is carried out in Kabarak University. The larger population in this environment majorly comprises the students. Technology has a great contribution to communication among the student and this is clearly depicted by the use of phones that each and every student has to own for proper communication and for educational purposes.

**3.5 Data collection instrument**

Instrument used in the collection of data for this particular project was a specific type of smartphone that is Infinix. The phone had varied signal strength when it was exposed to different occurrences. The component of getting good signal strength is the phone antenna, for this project the signals were measured at specific time, specific location for six consecutive days. The same procedure was carried out for two other locations for six days again.

**3.6 Signal strength and measurement**

Signal strength is the transmitting power as received by the phone’s antenna. The values were measured in dBm, and the closer the value was to zero the stronger the signal and vice versa. Decibels are expressed as a negative number i.e. -60decibels.

Signal strength measurement scale

>= -70 dBm- Excellent- Strong signal with maximum data speeds   
-70 dBm to - 85 dBm- Good- Strong signal with good speeds   
-86 dBm to - 100 dBm- Fair -Fair but useful, fast and reliable data speeds may be attained, but marginal data with drop-outs is possible   
< -100 dBm -Poor- Performance will drop drastically   
-110 dBm -No signal- Disconnection

* 1. **Signal strength calculation**

To measure the signal strength received by the phone’s antenna, the values are taken in dBm. The values were taken from a controlled transmission line and an antenna making a need to use RMS voltage or current.   
example   
RMS voltage 2mV   
50-ohm antenna system

= (0.002V)2/50Ω   
= 810−8W

Typically, this is converted to decibels relative to 1mW, dBm:   
LdBm =

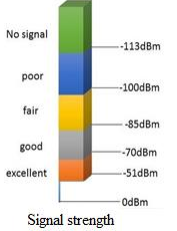
10log10(P0.001W) =   
10log10(810−8W0.001W)

= 10log10(810−5)   
= −40.97

Therefore, our signal strength is about -41dBm.

**3.8 Signal strength measurement scale**

The values closer to zero shows availability of stronger signal and those not closer to zero are considered to be weak signals



**3.9 Signal quality**

It is the observable change in the quality and quantity of a signal.

Signal quality Description

0 to -6 - Excellent - Strong signal with maximum data speeds.   
-7 to -10 – Good - Strong signal with good data speeds.

-11 to -20 – Fair - to poor Reliable data speeds may be attained, but marginal data with drop-outs is possible. When this value gets close to -20, performance will drop drastically.

# CHAPTER FOUR

# RESULTS

Location as a factor affected signal strength depending on the surrounding of the location where the data was taken. The following are the specific objectives of my project and the corresponding results obtained when I carried out my project;

1. Define and establish the various environmental conditions for the study. **–**The conditions affecting my study varied from location to location. The first location was 0⁰9`40`` S and 35⁰58`17``E and the conditions were;

I)presence of tall trees

II)the place was a higher altitude than the surrounding

1. To determine the impact of location on signal strength variation. -The following data shows the impact of location on signal strength. The first location was as follows;

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰9`40``S AND 35⁰58`17``E | 7:00 | -93dBm 47asu |
|  | 7:10 | -95dBm 45asu |
|  | 7:20 | -94dBm 46asu |
|  | 7:30 | -97dBm 43asu |
|  | 7:40 | -93dBm 47asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰9`40``S AND 35⁰58`17``E | 7:00 | -92dBm 48asu |
|  | 7:10 | -88dBm 52asu |
|  | 7:20 | -89dBm 51asu |
|  | 7:30 | -88dBm 52asu |
|  | 7:40 | -90dBm 50asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰9`40``S AND 35⁰58`17``E | 7:00 | -92dBm 48asu |
|  | 7:10 | -89dBm 51asu |
|  | 7:20 | -90dBm 50asu |
|  | 7:30 | -91dBm 49asu |
|  | 7:40 | -88dBm 52asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰9`40``S AND 35⁰58`17``E | 7:00 | -91dBm 49asu |
|  | 7:10 | -89dBm 51asu |
|  | 7:20 | -82dBm 58asu |
|  | 7:30 | -93dBm 47asu |
|  | 7:40 | -92dBm 48asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰9`40``S AND 35⁰58`17``E | 7:00 | -89dBm 51asu |
|  | 7:10 | -91dBm 49asu |
|  | 7:20 | -93dBm 47asu |
|  | 7:30 | -88dBm 52asu |
|  | 7:40 | -90dBm 50asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰10`6``S AND 35⁰57`59``E | 7:00 | -101dBm 39asu |
|  | 7:10 | -102dBm 38asu |
|  | 7:20 | -101dBm 39asu |
|  | 7:30 | -86dBm 54asu |
|  | 7:40 | -94dBm 46asu |

The second location was as follows;

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰10`6``S AND 35⁰57`59``E | 7:00 | -107dBm 33asu |
|  | 7:10 | -105dBm 33asu |
|  | 7:20 | -101dBm 39asu |
|  | 7:30 | -94dBm 46asu |
|  | 7:40 | -100dBm 40asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰10`6``S AND 35⁰57`59``E | 7:00 | -102dBm 38asu |
|  | 7:10 | -94dBm 46asu |
|  | 7:20 | -101dBm 39asu |
|  | 7:30 | -105dBm 35asu |
|  | 7:40 | -103dBm 37asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰10`6``S AND 35⁰57`59``E | 7:00 | -94dBm 46asu |
|  | 7:10 | -98dBm 42asu |
|  | 7:20 | -101dBm 39asu |
|  | 7:30 | -98dBm 42asu |
|  | 7:40 | -97dBm 43asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰10`6``S AND 35⁰57`59``E | 7:00 | -105dBm 35asu |
|  | 7:10 | -103dBm 37asu |
|  | 7:20 | -104dBm 36asu |
|  | 7:30 | -95dBm 45asu |
|  | 7:40 | -99dBm 41asu |

The third location was as follows;

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰8`47.76``S AND 35⁰57`20.52``E | 7:00 | -77dBm 63asu |
|  | 7:10 | -80dBm 60asu |
|  | 7:20 | -79dBm 61asu |
|  | 7:30 | -81dBm 59asu |
|  | 7:40 | -83dBm 57asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰8`47.76``S AND 35⁰57`20.52``E | 7:00 | -80dBm 60asu |
|  | 7:10 | -83dBm 57asu |
|  | 7:20 | -78dBm 62asu |
|  | 7:30 | -81dBm 59asu |
|  | 7:40 | -88dBm 52asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰8`47.76``S AND 35⁰57`20.52``E | 7:00 | -88dBm 52asu |
|  | 7:10 | -85dBm 55asu |
|  | 7:20 | -79dBm 61asu |
|  | 7:30 | -86dBm 54asu |
|  | 7:40 | -82dBm 58asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰8`47.76``S AND 35⁰57`20.52``E | 7:00 | 83dBm 57asu |
|  | 7:10 | -75dBm 65asu |
|  | 7:20 | -77dBm 63asu |
|  | 7:30 | -80dBm 60asu |
|  | 7:40 | -79dBm 61asu |

|  |  |  |
| --- | --- | --- |
| LOCATION | TIME | SIGNAL STRENGTH |
| 0⁰8`47.76``S AND 35⁰57`20.52``E | 7:00 | -72dBm 68asu |
|  | 7:10 | -80dBm 60asu |
|  | 7:20 | -76dBm 64asu |
|  | 7:30 | -74dBm 66asu |
|  | 7:40 | -84dBm 56asu |

**CHAPTER FIVE**

**CONCLUSION**

The data collected clearly shows that location affects signal strength in a way that the strength changes because the signal varies depending on the coverage area.

At higher altitudes the signal strength is seen to be stronger compared to the lower altitudes that experience weak signals.

The presence of obstacles also plays a major role in the strength of the signal as seen in the location 0⁰9`40``S AND 35⁰58`17``E.

Tall trees, hills and low areas differ in signal strength. The location on a raised area had stronger signal because it experienced few obstacles as the network travelled from the nearest cellphone tower.

In conclusion location does affect the signal strength.

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**GANTT CHART**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stages of research | May | June | July | Aug | Sep | Oct | Nov | Dec |
| Selection of topic |  |  |  |  |  |  |  |  |
| Data collection from secondary sources |  |  |  |  |  |  |  |  |
| Literature Review |  |  |  |  |  |  |  |  |
| Research methodology plan |  |  |  |  |  |  |  |  |
| Selection of appropriate research techniques |  |  |  |  |  |  |  |  |
| Analysis and interpretation of data |  |  |  |  |  |  |  |  |
| Findings and recommendations |  |  |  |  |  |  |  |  |
| Final Research Project |  |  |  |  |  |  |  |  |