

# TELECOM INFRASTRUCTURE SHARING AS A STRATEGY FOR COST OPTIMISATION

By

KNUST  
Samuel Derban

PG 3057209

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## DECLARATION

I hereby declare that this submission is my own work towards the Commonwealth executive MBA and that, to the best of my knowledge it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Samuel Derban( PG 3057209)

KNUST

Signature

Date

Certified by:

Dr. Bernard Tetteh-Dumanya

Signature

Date

Supervisor

Signature

Date

Certified by:

Prof. I. K. Dontwi

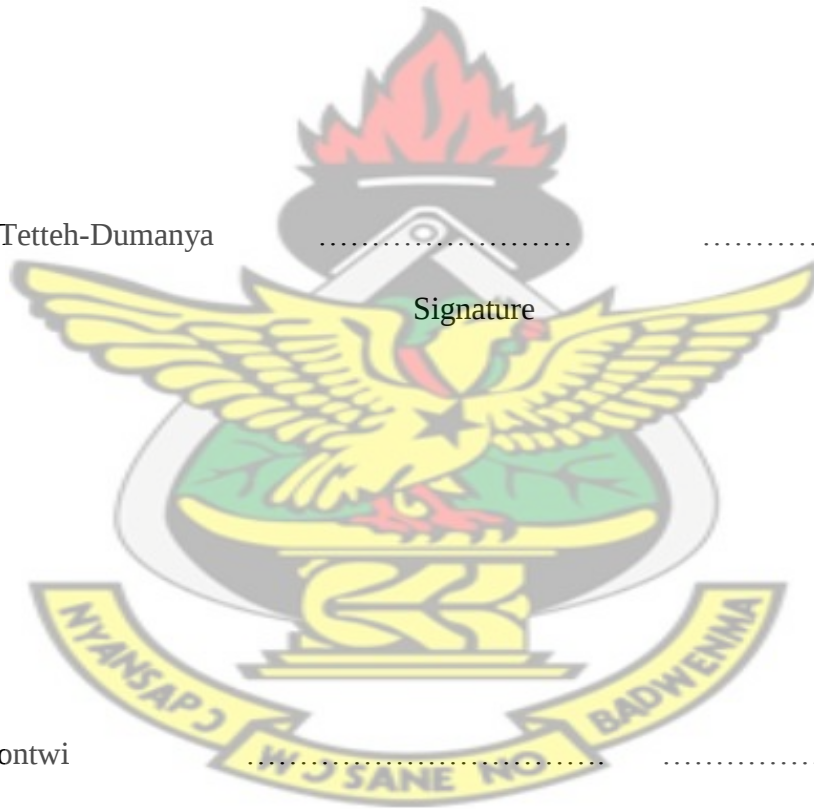
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## ABSTRACT

There is a growing need for telecom operators in Ghana to drive down the cost of network expansion. This has been expressed in recent times by many operators who now come together, on basis of mutual agreement, to consider sharing infrastructure. The National Communications Authority has also given its backing to this initiative by providing the legal and technical guidelines that would facilitate this collaboration.

This research aims at exploring the benefits of the infrastructure sharing deal between engaging parties. It uses questionnaires and interviews of thirty respondents drawn from key departments of two telecom operators involved in this sharing deal. The data collected was analysed using Microsoft Excel spreadsheet. The work revealed that telecom companies in Ghana indeed participate in infrastructure sharing and that this really leads to a reduction in CAPEX and OPEX and also increases the speed of network rollout. Again, the findings also showed that infrastructure sharing does not have any negative impact on quality of service. It is recommended that this type of collaboration should be continued in order to further develop the telecoms sector in Ghana.

## ACKNOWLEDGMENTS

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## ABBREVIATIONS

|        |   |                                         |
|--------|---|-----------------------------------------|
| GSM    | - | Global System for Mobile Communication. |
| Telco  | - | Telecommunications company              |
| NCA    | - | National Communications Authority       |
| EMF    | - | Electromagnetic field                   |
| BTS    | - | Base Transceiver Station                |
| GBT    | - | Ground-based towers                     |
| RTT:   | - | Roof-top towers                         |
| 1G     | - | First Generation                        |
| 2G     | - | Second Generation                       |
| 3G     | - | Third Generation                        |
| 4G     | - | Fourth Generation                       |
| (QoS)  | - | Quality of Service                      |
| MoU    | - | Minutes of Use                          |
| RoCE   | - | Return on Capital Employed              |
| RF     | - | Radio Frequency                         |
| ARPU   | - | Average Revenue per User                |
| CAPEX- | - | Capital Expenditure v                   |
| OPEX   | - | Operating Expenditure                   |
| Telco  | - | Telecommunications Company              |



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## CHAPTER ONE

### INTRODUCTION

#### 1.1 OVERVIEW OF THE TELECOMMUNICATIONS INDUSTRY

Ghana recognized the need for efficient and reliable telecommunication services and subsequently deregulated the telecoms industry in 1987 in order to enhance economic advancement. The monopoly of the former Post and Telecommunications Corporation was abolished with the enactment of the National Communications Authority Act, 1996 (Act 524), which established the National Communications Authority (NCA) as a sector regulator. Even as at the end of 2003, the total number of fixed and mobile lines was just a little over eight hundred thousand (800,000). Since then many other Mobile and Fixed network operators have made an impressive entry into the telecoms market and competition has been fierce with number of subscribers rising sharply thereafter. Currently, there are five Mobile telecom operators in Ghana, namely, MTN, TIGO, AIRTEL, EXPRESSO and VODAFONE as they are ordinarily referred to. Incidentally all of them are either wholly or largely owned by foreign multi-national telecom companies. While MTN is currently the largest operator in the Mobile sector having over 8 Million subscribers, Vodafone leads the fixed network providers with about 300,000 subscribers. Most of these lines are mainly concentrated mainly in the urban areas, leaving the rural areas largely un-served. (NCA, 2009).

The telecom market in Ghana is driven by growing demand for telecommunications services like Voice, SMS and quite recently Data services. These telecom companies, like many other enterprises, are struggling to find a solution that will help them control costs while taking advantage of the growing market. In Ghana, most telecom operators have constructed their

network largely on their own effort, independent of each other. However, building the telecom network involves, among many other things, construction of several towers, otherwise called masts. These masts host the radio equipment that are necessary for transporting signals used in providing telecom services. Densely populated areas require more radio equipment in order to handle both the volume and the quality of calls. This may lead to a requirement for more masts to be set up as there is a limit to the number of radio equipment that can be hosted by each mast. However the cost of constructing a mast is quite high. The construction of a single mast is estimated at USD 250,000 and it is estimated that an operator would need about one thousand towers in order to have network coverage in the whole of Ghana. Market liberalization has led to placement of infrastructure where the operators focus mostly on commercially attractive areas leaving the poor segments of the society deprived.

With the high demand for quality service by telecom users, combined with the heated competition of a gradually maturing telecoms market in Ghana, some telecoms operators are led to explore ways of reaching their potential customers in very cost efficient and cost effective way. Collaboration is one of them and it is expected that this will reduce the cost of rolling out telecom infrastructure while at the same time achieving the numbers through effective network coverage.

This has been expressed in recent times by some operators who now come together, on basis of mutual agreements to consider sharing infrastructure. Also, the telecoms regulatory body in Ghana, NCA (National Communications Authority) has also given its backing to this initiative by providing the legal and technical guidelines that would ensure fair play and enhance fair competition.

## 1.2 STATEMENT OF THE PROBLEM

Indiscriminate installation of towers in Ghana has congested the skyline the cities in Ghana with towers. There have been several calls by residents in Ghana for a ban to be placed on the mounting of towers. However, these masts form a necessary infrastructure that telecom operators need in order to carry signals that are necessary for communication to take place. Remarkably, these masts are expensive to construct and it is estimated that the construction of a single mast can cost as much as USD 250,000. An operator may need over one thousand towers in order to have fair network coverage in the whole of Ghana. This amounts to huge investment outlay.

There is therefore the need to find an efficient way of expanding the network while maintaining a limited number of towers.

## 1.3 OBJECTIVE OF THE STUDY

This study, aims at examining the benefits that can be derived from infrastructure sharing. It also seeks to explore the extent of collaboration between and among operators while identifying any risks involved as well as any benefits in cost optimisation.

The specific objectives are to

- (a) Appraise the extent of infrastructure sharing agreements among Telecoms operators in Ghana.
- (b) Analyze the impact of engaging in infrastructure sharing in Ghana.
- (c) Assess infrastructure sharing and its impact on customers.

The research questions that this thesis seeks to answer, are as follows;

1. What is the extent of infrastructure sharing agreements among Telcom companies in Ghana?
2. Do engaging operators experience significant reduction in the cost of capital expenditure employed in Network rollouts/deployments?
3. Can Network Infrastructure sharing have a negative impact on customer experience and quality of service?
4. Can Network infrastructure sharing lead to faster network rollouts.

#### **1.4 SIGNIFICANCE OF THE STUDY**

The growth of the telecoms market in Ghana has been tremendous. This growth has however, brought with it a huge cost burden on telecoms investors and operators as they continue to expend huge capital expenditures on telecoms assets and infrastructure in a bid to gain and sustain competitive advantage.

Today, as the telecoms market in Ghana nears maturity, the average revenue per user (ARPU) and revenue-on-assets (ROA) indices begin to dip, telecoms operators in Ghana are beginning to desperately explore new ways of reducing their capital expenditures (CAPEX) and operational overheads/cost on telecoms infrastructure.

Also, the independent National Regulatory Authority, the NCA has given its support to infrastructure sharing and has also developed a regulatory framework for potential collaborators to share infrastructure in order to promote fair competition while promoting infrastructure sharing amongst telecoms companies.

The purpose of this research is to explore and investigate the profitability and practicality of this infrastructure sharing strategy in Ghana.

### **1.5 SCOPE OF WORK**

The scope of research on infrastructure sharing will be limited to co-location of telecom towers by mobile telecommunications operators.

### **1.6 METHODOLOGICAL OVERVIEW**

Experimental analysis involved interviewing thirty key personnel (both technical and managerial) of two major telecoms services providers, namely MTN and Vodafone, on a case study basis on the benefits of the infrastructure sharing model.

### **1.7 ORGANISATION OF THE THESIS**

This is structured in five (5) sections as outlined below:

Chapter One introduced the trend of private investments growth in the telecommunications landscape of Ghana and highlights the drivers for telecoms operators to seek infrastructure sharing initiatives as means of cutting down the cost of capital and operational expenditures. It also outlines the research purpose, motivations, scope as well as the organisation of the thesis.

The contents of the subsequent sections are as shown below:

Chapter 2: Literature Review

Chapter 3: Research Design and Methodology

Chapter 4: Research Findings and Interpretations

Chapter 5: Summary of Findings, Conclusions and Recommendations

Chapter Two highlights the main drivers for telecom infrastructure sharing as well as the various models of telecoms infrastructure sharing prevalent in the telecoms industry. Global trends in Infrastructure sharing is discussed as well as health, safety and environmental concerns.

Chapter Three discusses the research approach employed in the study. It also highlights the data collection methods used to obtain primary data as well as the data analysis approach employed. It also details issues and limitations to research such as time and subject matter experts as well as the sampling method/approach employed for field interviews and surveys.

Chapter Four consists of a set of findings and interpretations of data analysis performed on the data collected from surveys, interviews and field observations.

Chapter Five discusses the justification, based on data analysis of the hypothesis and the conclusions on findings and recommendations for stakeholders and policy makers on ways of improving the existing telecom infrastructure sharing model in Ghana.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 GROWTH OF TELECOMMUNICATIONS IN GHANA

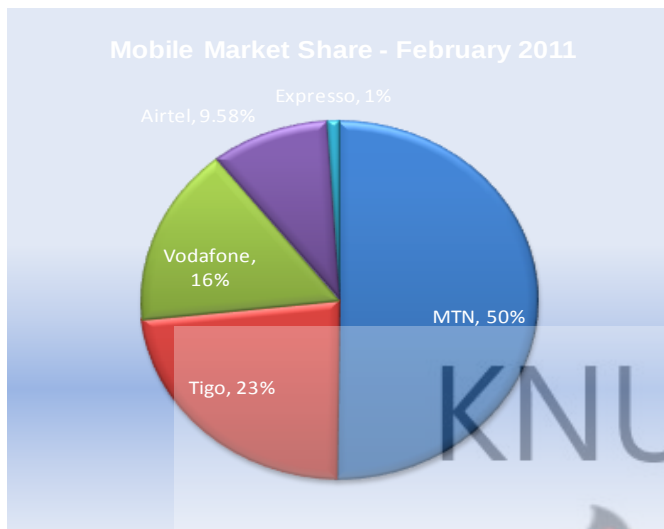
The telecommunications industry in Ghana has been on a very progressive journey and it has covered a great distance in a very short period of time. From less than one million telecom lines in the country in 2003, the current number of telephone lines has crossed 17 million at the end of 2010. This constitutes about 75 per cent mobile penetration of a population of 23 million. In the first quarter of 2011, out of the total number of 17,436,949 mobile subscribers, MTN has 50 % market share, while the other operators share the rest. Details are shown below (NCA, 2011).

Table 1: Mobile Market Share (Jan. 2011)

| Mobile Operators | No. Of Subscribers | Market Share |
|------------------|--------------------|--------------|
| MTN              | 8,721,249          | 50%          |
| Tigo             | 3,999,262          | 23%          |
| Vodafone         | 2,722,364          | 16%          |
| Airtel           | 1,754,259          | 10%          |
| Expresso         | 239,815            | 1%           |
| <b>Total</b>     | <b>17,436,949</b>  |              |

Source: NCA, 2011

Figure 1: Mobile Market Share (Jan. 2011)



Source: NCA, 2011

The tremendous increase in mobile penetration has been a result of the establishment of the National Communications Authority (NCA) in 1997 and the subsequent deregulation of the telecom industry, which brought about the growth of wireless telephony due to significant investment by operators. For the consumer, being in touch simply means being able to purchase a mobile handset and subscribing to a wireless service which are now very affordable to the lower class in society.

The growth in the mobile communications sector over the past few years has been remarkable. It has spread rapidly to meet the growing demand for better communications at home, in business, in public services and quite recently in support of electronic commerce. Modern telecommunications are an essential and beneficial element in the life of the people of Ghana and of the economy at large. Very few people can stay comfortably without a phone for just day.

## 2.2 IMPLICATIONS OF SUBSCRIBER GROWTH ON PLANNING

Mobile phones and other ICT facilities are vital communication tools for both business and societal development. The growing demand for mobile services have necessitated the increase in communications infrastructure such as towers and radio equipment which are needed to ensure that there is adequate network coverage and access that guarantee minimum quality of service (QoS).

Densely populated areas require more radio equipment in order to handle volume, as well as the quality of calls. This may lead to a requirement for more masts to be installed as there is a limit to the number of radio equipment that can be hosted by each mast. It is recognised that the economic and social benefits of advanced telecommunications can only be achieved if the necessary infrastructure is developed, including the networks of base stations which are necessary for carrying signals.

Also, with continued growth in demand for the use of telecommunications services and anticipated changes to the nature of the industry, it is envisaged that the trends listed below will have specific and general implications for planning.

Demand for additional 2G base stations will continue – Most of the telecom operators in Ghana currently employ 2G technology. In order to facilitate the continuing roll-out of 2G mobile networks, new radio equipment will be needed. There will therefore be the need to increase the number of radio equipment on each mast. However, due to the set limit on the number of equipment that can be conveniently handled by each tower, new base stations will likely be needed.

Demand for 3G base stations will increase significantly – Most of the telecom operators in Ghana have intentions of migrating to the new 3G technology in order to offer faster data speeds to their customers. However, in order to facilitate the roll-out of the 3G mobile networks, a completely different type of radio equipment are needed to form a network coverage which then leads to the need for more base stations. It is estimated that 3G may require potentially 3-4 times as many base stations as 2G services. It must be noted that a certain proportion of the 3G equipment will be accommodated by sharing existing 2G structures.

### 2.3 INFRASTRUCTURE SHARING AND COLLABORATION MODEL

Collaboration is nothing new and goes back to the days of caveman where teams had to work together in hunting animals as this resulted in a better find.

Strictly speaking, collaboration is at the very heart of every business on the planet. It's very rare that you find someone that is isolated from the rest of the company. Most people are a part of a team that needs to work together to achieve the best possible results; that team is a part of many teams that all need to work together to help grow an enterprise. Collaborate is pretty much part of everything done at work.

The principle behind co-location, if adhered to with a spirit of fairness and a mindset of putting development of the information and communication sector and national interest first, will assist the government, regulators, operators, investors, and even workers to look into how best to use available resources to get maximum result for the industry in all important matters of business interest.

There is an inverse relationship between costs which are going up and profits which are coming down. These twin factors, according to the experts, should drive the operators to share resources and facilities in order to reduce cost and raise operating profit. This means co-location needs to be taken seriously by the operators.

Collaboration impacts on profitability, sales growth, profit, productivity, product quality, product development and innovation. Infrastructure sharing is capable of reducing operating cost by sharing out the cost.

#### **2.4 GLOBAL TRENDS IN INFRASTRUCTURE SHARING ADAPTATION**

Tower sharing also known as co-location is thought to be the panacea to reducing rollout costs, and also provide good investment opportunities for companies that rent out tower space.

Globally, Infrastructure sharing started materializing in 2001. With the hype of 3G licensing (i.e. technology that allows for high data speeds) in Europe and the big investments made in license acquisition, many operators were under pressure to share deployment costs and thus share infrastructure as means of reducing their rollout costs. Today, Infrastructure sharing agreements are very advanced in developed countries. An interesting example of infrastructure sharing is a tower company in India, Indus Towers, which claims to be the world's largest independent tower company having over 100,000 towers and having the capacity to rent out to the numerous operators in India. (India Telecom, 2010)

## 2.5 TELECOM INFRASTRUCTURE SHARING MODELS ON THE AFRICA CONTINENT

It is believed that Telecommunications tower sharing may very well be the next pot of gold in Africa's telecom industry. The Industry watchers believe that as the sector continues to grow, infrastructure requirements and demand will also grow. This high demand will then be solved by co-location which will save operators millions of dollars in capital and operational expenditure over the years.

Coming out of dealing with unreliable contractors, it was hardly surprising that mobile operators did not trust others to do things like provide network infrastructure for them. So a number of mobile operators have poured money into acquisitions and fiber network roll-out. Although the concept of infrastructure sharing is new in Africa, the potential is enormous.

A 2008 report by International Telecommunication Union (ITU) urged governments to create the right regulatory framework to encourage and allow operators to engage in infrastructure sharing. It is also urged governments to identify market failures and those areas that could benefit most from infrastructure sharing. Also, in 2007, ITU's global symposium for regulators focused on infrastructure sharing in order to raise awareness and to highlight regulatory possibilities, technicalities and advantages.

But 2010 will probably go down as the year when many of Africa's telecommunications companies realised that it was not possible to dominate the national or international fiber space in Africa. It is just too big and will cost too much. Infrastructure sharing then comes to the rescue (AllAfrica, 2010)

There are various examples in the area of infrastructure sharing in Africa:

In Nigeria, Africa's current biggest telecom market, for instance there is the need of over 10,000 additional masts to address network expansion. These masts will cost more than \$2.5 billion. With co-location, this high cost will be greatly reduced. At the moment, there are 11 companies with co-location licenses in Nigeria. Capital requirement is \$250,000 per tower/mast and local banks have offered to support the idea by helping to provide finance.

Also in Tanzania, the national regulator allowed Zanzibar Telecom Ltd (Zantel) to provide a mobile service to the mainland from its base in Zanzibar using Vodacom Tanzania's mobile network. This has lowered costs for Zantel's subscribers on Zanzibar who travel to the mainland and also provided mainland users with additional competition.

In addition to cost savings, another motive for infrastructure sharing relates to environmental concerns. The Nigerian Communications Commission has issued guidelines on shared infrastructure stating that one aim is to protect the environment by reducing the proliferation of infrastructure and facilities installations. (ITU 2009)

In many African countries, a lack of cooperation among operators has resulted in a proliferation of backbone transmission infrastructure. Two consequences of this are that, nationwide connectivity has often been neglected as the networks often consist of bits and pieces clustered around urban areas, and that in many instances, backhaul infrastructure is just microwave and not higher capacity fiber optic.

## 2.6 THE GSM TECHNOLOGY

To understand the research work better, it may be helpful to have a fair understanding of how the GSM mobile technology works.

### 2.6.1 HOW MOBILE PHONES WORK

It is important to understand how mobile phones work so as to appreciate the needs for the necessary infrastructure.

Fundamentally, a radio base station is the first link in the connection between a mobile voice or data device and other telephone (whether fixed or mobile) or an information source.

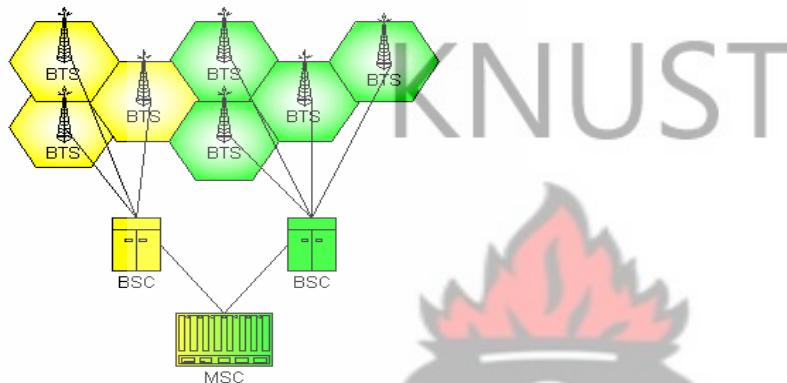
Mobile devices and base stations communicate with each other by radio signals transmitted through the medium or air between the mobile phone and the antenna or the base station.

Mobile communications involves two-way radio transmissions and transmit on a local basis between 2 and 250 watts. While in theory radio signals can travel for tens of kilometers, in reality, the landscape, trees or buildings will severely restrict this. In heavily built-up areas, a single small base station might cover as little as a few hundred metres. For this reason, it is essential that base stations are located where people need to use their mobiles and other data devices i.e. where they live, work and travel.

To provide mobile communications across the country, a network of many low powered base stations (BTS) is deployed, with each base station providing radio coverage over a limited range referred to as a cell.

A cell is the basic unit of a cellular system and is defined as the area of coverage given by one Base station (BTS) antenna system. Each cell is usually assigned a unique identification number known as the Cell Global Identity in a specific GSM network. It is a number of cell systems that constitutes a base transceiver station (BTS) in a GSM network.

Figure 2: Network design of Base Stations



Source: Vodafone, 2011

The coverage provided by each cell must partially overlap that of its neighbour, to ensure that there are no breaks in radio coverage. As you travel, the base station in one cell detects a weakening of the signal and hands the call over to the next one. A gap between cells would result in a dropped call mid-conversation or a break in data transmission.

Each radio station can only carry a relatively small number of calls or data downloads simultaneously and additional base stations are needed to meet demand from users.

The base stations operate at a lower power when they are nearer to the mobile devices with which they communicate.

This is true of mobile devices too. Radio frequency fields from your mobile phone or data device are much lower when there is good signal from a nearby base station. (Vodafone, 2011)

### **2.6.2 HISTORY OF GSM**

GSM stands for Global System for Mobile Communication. GSM technology is sometimes misunderstood as a cellular phone technology but technically speaking, GSM was originally set up as standards to create a common European Mobile Telephony system.

Over the years, GSM technology has undergone a lot of improvements. The primary benefit of using the GSM standard is the fact that it allows customers to roam. In other words, it allows subscribers to have network connection outside their home country.

The basic architecture of GSM uses the narrow band Time Division Multiple Access (TDMA) method for allocation of channels. Each cellular channel is divided into three time slots. This helps in increasing the amount of data that can be carried. Also, multiple users can share the same frequency channel because the signal is divided into multiple time slots. In simple words, each conversation is transmitted alternately over short lengths of time. (Ashutosh, 2010)

### **2.6.3 GSM FREQUENCY BANDS**

The GSM frequency bands are the radio spectrum frequencies that the GSM system for mobile phones operates on.

There are five major GSM frequencies that have become standard worldwide categorized as follows:

GSM 900, GSM 1800 , GSM 850, GSM 1900, GSM 400

GSM-900 and GSM-1800 are standards used mostly worldwide including Ghana.

#### 2.6.4 ANALYSIS OF THE DIFFERENT GSM GENERATIONS

The telecommunication service in world had a great leap within the last few years. Various generations of cellular systems have evolved in the evolution of mobile communications from 1st generation to 5th generation. In the present time, there are four generations in the mobile industry. These are respectively

1G – First Generation

2G - Second Generation

3G - Third Generation

4G - Fourth Generation

In Ghana, most operators use 2G while a few employ 3G.

##### **First Generation**

In 1G, Narrow band analogue radio signals are used. With this, one can have voice calls and also send text messages. These services are provided with circuit switching.

##### **Second Generation**

In the case of 2G, Narrow Band digital radio signals are used. It brings more clarity to the conversation and also uses the circuit-switching model.

Both the 1G and 2G have to utilize the maximum bandwidth in voice calls as well as sending messages i.e. SMS. The latest technologies such as GPRS, is not available in these generations. But the greatest disadvantage of 1G is that service is available only in that

country where the network resides whereas in the case of 2G the roaming facility is available enabling service to be made available outside the original country by means of connection through a foreign country's operator.

In between 2G and 3G there is another generation called 2.5G. Firstly, this mid generation was introduced mainly for evolving latest bandwidth technology with addition to the existing 2G generation.

### **Third Generation**

But to overcome the limitations of 2G and 2.5G the 3G had been introduced. Wide Band Wireless Network is used and clarity increases which gives the perfection to the degree of a real conversation.

It enhances services like wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment.

The data are sent through the technology called Packet Switching .Voice calls are interpreted through Circuit Switching. A more improved version is 3.5 G.

### **Fourth Generation**

A 4G system provides a comprehensive and secure all-IP based mobile broadband solution to laptop computer wireless modems, Smart phones, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia are provided to users. (Huawei, 2011)

## 2.6.5 SOME GSM NETWORK COMPONENTS

### Base Station

The base stations comprise infrastructure such as masts also known as towers, antennas and associated equipment. It must be noted that another name for a base station is “cell site”.

In GSM networks, the technically correct term is Base Transceiver Station (BTS).

A mobile network consists of a number of 'base stations', the task of which is to maintain contact with mobile telephones. Each base station is in turn linked to other nodes in the network (i.e. originating or terminating points of information transfer in a telecommunications), which makes it possible to make calls to people at entirely different locations. Each base station covers a certain geographical area, which means that it is possible for a mobile phone to make contact with the base station that is within that area and thus connection to the network. The more base stations an operator sets up, the better the coverage. In addition, each base station is dimensioned to cope with a certain number of calls being made at the same time. A large number of base stations in the same area also provide higher capacity and therefore more people can make calls at the same time.

The further a mobile phone is away from a base station the more power is required in staying in contact with the transmitting base station. Such a mobile phone will need to be recharged more frequently as the power is drained quickly.

### Components of a Base Station

Basically a cell site consists of electronic and non-electronic infrastructure.

The electronic infrastructure is referred to as active components while the non-electronic infrastructure is referred to as inactive components and includes base tower station, microwave radio equipment, Switches, Antennas, Transceivers for signal processing and transmission.

The non-electronic infrastructure includes tower, shelter, air-conditioning equipment, diesel electric generator, battery, electrical supply and premises. The non-electronic infrastructure accounts for nearly 60 percent of network rollout costs.

Table 2: Components of a Base Station

| Active Components         | Passive Components |
|---------------------------|--------------------|
| Base Stations             | Towers             |
| Microwave Radio Equipment | Shelters           |
| Switches                  | Electric Supply    |
| Antennas                  | Easements          |
| Transreceivers            | Ducts              |

Source: Vodafone, 2011

## TYPES OF TELECOM TOWER

A tower is a structure designed to support antennae that carry telecommunication signals.

There are two types of towers and these are broadly classified on the basis of their placement.

We have Ground based and Rooftop towers.

**Ground-Based Tower:** Erected on the ground, ground-based towers are taller (typically 200 to 400 feet) and are mostly used where there is land available. Ground-based towers involve a capital expenditure in the range of USD 200,000 -250,000 depending on the height of the tower.

**Roof-Top Tower:** Roof-top towers (RTTs), which are generally placed on the roofs of high-rise buildings, are shorter than ground based towers and are more common in urban and highly populated areas, where there is scarcity of land. Roof-top towers involve a capital expenditure of USD 90,000 to 150,000.

Typically, a site where towers are put up also has regular and back-up power arrangements as towers function on electricity.

## 2.7 TYPES OF INFRASTRUCTURE SHARING

There are multiple possible options of sharing amongst telecom service providers. However, the options available also depend on telecom regulatory and legislation applicable in that country.

**Passive Infrastructure sharing** is sharing non-electronic infrastructure at cell site. Passive Infrastructure is becoming popular in telecom industry worldwide.

An example of this is **base station sharing** where each operator maintains control over electronic components so that it will be able to operate the frequencies assigned to the carrier, fully independent from the partner operator and retains control over their respective active base station equipment such as the transceivers that control reception/transmission over radio channels. Radio network controller and core network are not shared here.

**Active Infrastructure sharing** Active sharing involves the shared use of electronic infrastructure in a cell site, including the base tower station, switches, antennas, transmission, signal processing transceivers and microwave radio equipment. In other words, a single radio equipment can be shared across different frequencies, by different operators to deploy a completely shared radio network and in some case, a partly shared Core Network (i.e. Backbone network). The shared radio network consists of Radio Base Stations, Radio Network Controllers, transmission site etc.

Active sharing is not allowed by regulation in most of countries and has to be initiated amongst the operators themselves.

An example of active sharing is **Spectrum-sharing** concept which is based on a lease model and is often termed 'spectrum trading'. An operator can lease a part of their spectrum to another operator on commercial terms. This mechanism exists in the US, Europe, Singapore, India and Australia. (ICRA, 2010)

Passive infrastructure is estimated to reduce deployment costs by 60 percent and active infrastructure by 40 percent.

It is the height of a telecom tower that determines the number of antennas that can be accommodated (i.e. the capacity of the tower). Others factors such as location and geographical conditions (wind speeds, type of terrain, etc.) can also play a part in determining the capacity of the tower.

Hence, typically, while Ground Based Towers can accommodate up to six tenants, Roof-Top Towers can accommodate two to three tenants.

## 2.8 BUSINESS STRATEGY USING COST OPTIMIZATION

The global economy, our environment, and political institutions are undergoing rapid structural change. The Telecoms industry is a very competitive market in which business owners must constantly formulate an effective line of attack in the business industry in order to remain competitive. Cost optimisation is one of the means that can be used in achieving this.

It is, however also important for an organization to watch out for unnecessary budget slashes that cause long-term harm. Understanding the processes that are needed to reduce operating costs without increasing risk to the business are very important considerations to be made.

When this strategy is effectively implemented these could result in the improvement in reduction in Capital expenditures (CAPEX), Operational expenditures (OPEX) and Return on assets (ROA).

### COST OPTIMISATION

Cost optimization is not cost cutting. While cost cutting is solely focused on reducing expenditure, cost optimisation is broader in scope. It ensures that the maximum benefit is achieved at the minimum possible cost i.e. increasing network coverage at the lease possible cost resulting in efficient operation.

As well as cutting costs, cost optimisation activities can include, for example, the reallocation of funds so that an investment in one area leads to an even greater saving in another area. It is important to recognise that, in fact, all cost cutting requires an investment. Even the simplest cost cut requires some level of analysis and human effort. Cost cutting is

not free. In extreme cases, you may even make a decision that reduces revenue, in order to obtain an even greater reduction in expenditure. In the long term, cost optimisation is likely to be more economically responsible than simple cost cutting. For instance, cost cuts can be achieved in the short term which result in cost increases in the long term (An example of this could be, cutting the maintenance budget which leads to equipment failure and premature replacement costs). Fiscal responsibility means that it is vital to maintain a focus on the sustainability of any cost reductions. From this perspective, cost optimisation provides a more holistic and sophisticated approach to cost management.

## **OPEX**

One of the typical responsibilities that management must contend with is determining how low operating expenses can be reduced without significantly affecting the firm's ability to compete with its competitors. The term OPEX (Operating Expenditures) refers to on-going cost for running a product, business, or system. Constructing a base station for example, is a CAPEX but paying for security and electricity, fueling the generators and other maintenance task are all OPEX.

Reducing OPEX has become such a hot button among telecom operators and tower owners that some operators have introduced new energy saving and productivity enhancing products as part of its managed services offering. These include electronic controller devices that monitor the diesel generator and other sources of power and selects the optimal source for given conditions. This is said to reduce the diesel consumption by 20% – 40% depending on available sources of power. (Uptimeinfratel, 2010)

## CAPEX

CAPEX is a short form for capital expense. It refers to any capital expenditures that are used to acquire physical assets. The assets acquired as a result of this capital spending may be in the form of property such as Telecom base station or Switch, as well as buildings. Along with being related to the acquisition of new assets, CAPEX can also be associated with the decision to upgrade physical assets by adding additional capacity or otherwise refurbishing the property or equipment. Typically, telecoms operators would undertake to rollout more new 2G base transceiver station (BTS's) and new 3G BTS's to expand their coverages. This is usually driven by the need to gain more market share as well as increase turnover. There is however the need to balance this with the profitability as companies are constantly looking out for the best use of their money which will result in higher return on investment.

## CASH FLOW

Cash is the life blood of every telecoms business since its nature is primarily capital intensive requiring heavy financing of its operations through capital investments or expenditures.

Cash flow shows the amount of cash generated and used by a company in a given period. It is calculated by adding noncash charges (such as depreciation) to net income after taxes. It can be used as an indication of a company's financial strength and it usually arises from one of three activities - financing, operations or investing. Companies with ample cash on hand are able to invest the cash back into the business in order to generate more cash and profit. This in effect is an efficient use of money.

Cash flow is regarded as a revenue or expense stream that changes a cash account over a given period. Cash inflows usually arise from one of three activities - financing, operations or investing. Cash outflows result from expenses or investments. The net cash flow of a telecoms business is used by investors and financial analyst to judge its financial performance and this is important for any business.

### RETURN ON ASSET (ROA)

Return on Asset (ROA) also known as return on investment (ROI) is a famous ratio in financial statements. This ratio measures the ability of company to converting asset to returns and is used as a complement to make a business financial analysis accurate.

The formula of ROA is:

$$ROA = \text{Earnings before Interest and Tax} / \text{Total assets}$$

ROA tells investors what earnings were generated from invested capital. ROA can vary widely from one industry to another so it is best to compare it against a company's previous ROA numbers or the ROA of a company in a similar industry.

It is widely believed that the heavy investments that are made on acquiring tower assets will be reduced through infrastructure sharing and therefore lead to a higher return on assets.

### ECONOMICS OF THE INFRASTRUCTURE SHARING MODEL

It is believed that with the reduction in capital cost by over 50 % that accompanies co-location, the economic activity and efficiency of operation of the engaging organization may be increased. This eventually allows operators to lower tariffs and increase market

penetration. Operators can easily extend their network from urban to rural areas where the average revenue per user (ARPU) is much lower and therefore previous cost benefit analysis achieving unfavourable results.

There may also be an additional social benefit such as in reduction in energy which is desirable to the organisation on one hand and environmentalist on the other hand

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## **2.9 CONSIDERATIONS FOR PASSIVE INFRASTRUCTURE SHARING**

In the last few years, Telecom operators in Ghana have begun to realise the value of sharing infrastructure in maintaining profitability. In Ghana, the National Communications Authority (NCA) has endorsed passive infrastructure sharing among operators, which includes sharing of physical sites, buildings, shelters, towers, power supply and battery backup. By sharing, the cost burden on operators is expected to reduce significantly, improving the rate of mobile services rollout.

With falling revenues due to price wars, the cellular companies are looking at means of cutting costs. The growing capital expenditure and the high operating expenses incurred by each telecom operator individually on a site ownership basis, is driving operators to consider the sharing of infrastructure. Sharing of infrastructure can lead to several benefits. Operators resorting to infrastructure sharing may reduce their payback time significantly by reducing both their operating expenditure and capital expenditure. Infrastructure sharing can be used in both the start-up phase (i.e. new entrants) to build coverage quickly and longer term, to build more cost effective coverage in rural areas. Sharing arrangements provide the highest savings in cases of low traffic demand and more efficiency is achieved by pooling resources.

For new telecom companies, such infrastructure sharing will mean not just faster roll out but also saving of millions of dollars. Setting up a tower is expected to cost between USD 200,000 and USD 250,000. In Ghana an operator may need about one thousand (1,000) towers for fair coverage. Thus the total savings from co-location could quite high. For the existing telecom companies who have invested in towers for the last 5 years, earnings from rentals could be high.

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## **FACTORS DRIVING GROWTH FOR PASSIVE INFRASTRUCTURE SHARING**

Apart from favorable industry prospects, there are several other factors too that drive the increase in tower sharing. These are outlined below.

### **VIABILITY OF BUSINESS AT LOW AVERAGE REVENUE PER USER (ARPU)**

After saturation of the market in the urban areas, incremental growth in the subscriber base is expected to come mainly from rural/semi-urban areas. However, in these areas, the ARPUs are relatively lower. Furthermore, network design and planning in rural areas is different from that in urban areas, given that the population in rural areas is widely dispersed, and this increases the tower requirements to cover the same number of subscribers (compared to the urban areas). But even at low ARPUs, business viability can increase significantly when infrastructure sharing is employed.

**HIGH USAGE:** High usage in the urban areas increases the number of base tower stations (BTS) required to handle the same subscriber base. Thus while on an average, a GSM BTS can handle around 1,100 subscribers, in the case of high usage areas the figure can be as low

as 600-700 subscribers, which means a larger number of cell sites would be required for the same area.

**QUALITY OF SERVICE:** In the past, domestic telecom operators competed largely on the pricing plank. However, as mobile tariffs in Ghana are currently one of the lowest in the world, with Vodafone charging as low as 8 Pesewas per minute, the scope for further tariff reduction is low. Given this fact, then quality of service (QoS) would become the prime distinguishing factor among the competing companies. Moreover, a rapidly increasing subscriber base and spectrum crunch would further add to the problem of telecom operators having to maintain the minimum level of QoS. Besides, with the likely introduction of mobile number portability, QoS will become more important as customers will then have a broader range of options available with limited switching costs. Thus to retain existing subscribers by preventing subscriber churn, operators will require additional infrastructure in their existing areas of operation to be able to offer better QoS.

**ENHANCEMENT OF PROFITABILITY:** Tower sharing helps operators lower their operating costs and capital expenditure and thereby earn better margins and higher Return on Investment (ROI); the overall impact on Profit and Loss is also positive. It is believed that there would be net annual cost savings for mobile operators if they opt to lease towers from a tower company rather than own them.

**ENTRY OF NEW PLAYERS AND EXPANSION PLANS OF EXISTING OPERATORS:** Given the significant expansion plans of new entrants over the medium term and the need for them to optimise investments in order to maintain returns, demand for towers is expected to report a sharp increase.

**SHORTER ROLLOUT TIME IS A KEY NECESSITY:** As the domestic telecom industry is highly competitive, doing business may not be easy for the new entrants. Moreover, given that the incumbents already have the competitive advantages of widespread distribution networks, established brand names and strong subscriber base, shorter network-rollout time would be a critical success factor for the new entrants; a longer rollout time could mean loss of substantial market share to other operators. Tower companies allow players to start operations in a particular region just by installing their electronics on the ready-to-use towers, thereby significantly shortening the rollout time.

**NEW TECHNOLOGIES TO FURTHER STIMULATE DEMAND:** 3G services have been recently introduced in the country by some operators. In order to augment their services, various operators may plan to launch Wi-Max services. Wi-MAX is an acronym meaning "Worldwide Interoperability for Microwave Access. This is used to provide data access on non-cellular networks. Wi-MAX is an IP based, wireless broadband access technology that provides performance similar to Wi-Fi networks with the coverage and QOS of cellular networks. (Wi-MAX). Thus Wi-Max would further increase the demand for sharing of passive infrastructure such as base stations as they are required to be installed on antennas.

**HIGH INITIAL CAPITAL INVESTMENTS – CAPEX:** The cost of constructing of a single mast is estimated at USD 250,000. Operators need thousands of these to have a good coverage.

**LOW RETURN ON INVESTMENT - (ROI):** The financial commitment involved is high, adding that the return on investment (ROI) is slow after a huge amount of money have been spent on these infrastructure.

**FOCUS ON CORE COMPETENCIES** - The cost of sharing facilities and co-locating is reasonable, compared to the cost of building one's own infrastructure; hence a faster return on investment and an opportunity to focus more on the core business of the companies, that is, providing telecoms services.

## 2.10 INFRASTRUCTURE SHARING THROUGH TOWER COMPANIES

A tower infrastructure company is a company that is setup for the purpose of providing passive infrastructure on a sharing basis to telecom operators.

Sometimes it is very hard for two or three telecom companies that have been competitors for several years to suddenly start working together. In such a case working with a third party is helpful, i.e. someone that is neutral and can help engaging parties to ensure that decisions are taken fairly, properly and appropriately. This is where a tower company comes in. The role of a tower infrastructure company may be summarized as follows:

Site planning, keeping in view the network rollout plans of prospective customers.

Obtaining of necessary regulatory approvals.

Erection and commissioning of tower and allied equipment.

Provision of support services such as back-up power, air-conditioning and security.

Provision of turnkey solutions to telecom companies such as sourcing of equipment, testing and maintenance.

The agreement between a telecom operator and the tower company usually results in a win-win situation. The profitability of a tower company is linked to the tenancy ratio this is the number of operators hosted on a tower.

A few issues sometimes associated with this model is that, the moment a tower company is seen as being backed by an operator, other operators may become sceptical about that company.

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### 2.11 CO-LOCATION LEASE AGREEMENTS

Tower collocation is where a wireless carrier installs or co-locates their equipment on another carrier's or tower company's tower. The wireless carrier will lease ground space in the tower owner's lease area for placing of their equipment and also lease space on the tower for their antennas and coaxial cable.

For companies engaging in co-location, there is usually a lease agreement between them. A typical tower collocation lease is structured in one of two ways. First, a carrier leases each tower site individually and signs separate collocations leases for each location. Alternatively, a wireless carrier signs a master lease agreement with the tower company or wireless carrier which defines the terms and conditions upon which future individual leases will be agreed upon. The master lease can either specify the price and the lease terms or just the lease terms for future collocations. When the carrier wants to use a specific tower, they execute a site license agreement or site lease agreement which contains the specific information relevant to that location. For instance, the carrier may specify that they are allowed a certain number of antennas and a certain number of lines for a specific price. The price in the master lease

agreement may be structured as a one-size-fits-all whereby the collocating carrier pays one price regardless of the number of antennas/lines, or it may be structured with a fee per number of antennas and lines. Factors influencing price include;

Size of the lease area required.

Number and thickness of coaxial cables.

Weight and size of antennas.

Height of antennas.

Generator placement.

Availability of space.

Location of site.

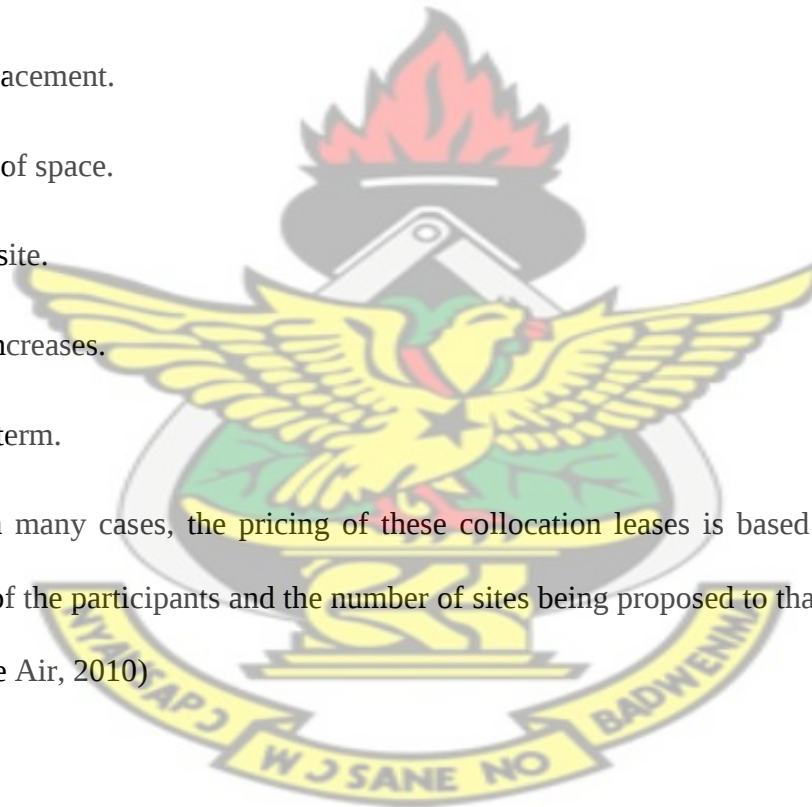
Escalation increases.

Guaranteed term.

However, in many cases, the pricing of these collocation leases is based upon the market knowledge of the participants and the number of sites being proposed to that tower company.

(Steel In The Air, 2010)

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## BUSINESS CONSIDERATIONS OF TOWER INFRASTRUCTURE COMPANIES

The telecom tower business is very lucrative with long-term growth prospects as the agreements are signed with the mobile operators for a minimum period of 10 years. Thus the tower infrastructure companies are insulated from the volatility of the telecom service business which is currently going through a phase of declining revenue and profit.

The key points relating to the tower infrastructure companies are illustrated below.

1. High initial capital investments: Given the high capital investments required in the business, tower companies are generally highly leveraged.
2. Stable and predictable cash flow business: Once a tower asset is rented out, it usually generates a stable and predictable cash flow in the form of tower rentals from occupants over the term of the agreement between the two parties.
3. Low working capital requirement: The tower business is also characterised by low working capital requirements, as most of the operating expenses (such as electricity and fuel and other variable operating expenses) are reimbursable by the tenants on accrual basis. Moreover, the larger companies having a bigger and geographical spread out portfolio of networks may be able to get rentals for the towers in advance and also obtain better credit terms from their suppliers, thus further improving their working capital cycle.
4. High incremental profitability: The costs of operating a tower, particularly the ones borne by the tower company such as security and maintenance and ground rent, are largely fixed in nature. Thus each increment in tenancy is accompanied by a minimal increase in costs. This leads to a more than proportionate increase in profits for every increase in occupancy. And it's here that the industry sees the largest opportunity for growth.

## 2.12 MENACE OF TOWERS IN URBAN AREAS OF GHANA

Following the indiscriminate installation of towers in the country by all the major telecom companies in Ghana i.e. Vodafone, MTN, Airtel, Tigo and Expresso mounting of telecommunications masts and towers was temporarily banned in Ghana, in January 2010 by the Government of Ghana and Environmental protection Agency. The NCA and other related organisations were asked to streamline the erection of towers all over the country.

The reasons given to this indiscriminate erection of masts were that many parts of the country had no mobile phone coverage and the quality of service in certain areas where there was already coverage needed improvement. It was widely believed by the EPA of Ghana that about 50% of all communications masts in the country were erected by service providers who did not obtain the required permit. Rampant installation of telecommunication masts throughout the country often raised concerns over public health and safety. The rush for land for that purpose had stirred some land disputes, sometimes sparking public protests and conflict.

In 2009 a mass protest was staged in Accra, the capital city of Ghana, when a telecommunication mast erected by one of the service providers collapsed and killing one person and injuring another. A number of similar occurrences had been followed by petitions against the unregulated mounting of masts in residential areas.

However in other jurisdictions such as France, Belgium and Canada, the increasing public rejection of telecommunications masts in residential areas had produced landmark rulings against the sitting of such structure at places of inhibition, as well as legal precedents requiring mobile phone network operators to provide evidence that they had done what was

required to minimise public exposure to their base stations because of the alleged associated health hazards.

I was believed that while some of the telecommunications operators did not obtain permits before putting up their structure, others went ahead with work on such structures prior to starting the procedure for acquiring the permit, thereby violating the EPA's Environmental Assessment Regulation. Some even changed the mast specification approved by the EPA. This led to about 50% of the telecommunications masts put up in Ghana having no permits.

It was expected that in order to mount a mast, a telecom operator obtained separate permit from the EPA, metropolitan, municipal and district assemblies in addition to written neighbourhood approval from the people living close to the location, where the mast would be erected.

Some cities outside Ghana require that cell sites be disguised or somehow blended with the surrounding area. In such areas, preserved tree scapes are used to hide cell towers inside an artificial tree or preserved tree. These installations are generally referred to as concealed cell sites or stealth cell sites and are meant to preserve the beauty of the city while enhancing communication. (Daily Graphic, 2010)

### **2.13 HEALTH, SAFETY AND ENVIRONMENTAL CONCERNS OF BASE STATIONS**

While admitting that mobile phones have transformed people's lives since they appeared in the west in 1985, every mobile phone network operator needs an infrastructure of masts, antennas and base stations to transmit and receive calls.

There have been many concerns raised on the health effects of base stations.

This has often been expressed by those who have found equipment erected on land or buildings near their homes and sometimes in their homes. There have been complaints in Ghana, about a mast falling down and destroying property, and also some masts posing aviation risks, where aircraft found it difficult when approaching landing because of telecom masts in their way.

Of the myriad of complaints from the public about telecom masts; 40 per cent were health related concerns, 33 were about closeness to homes and schools while 27 per cent were about lack of neighbourhood consent before erection of masts as well as noises and fumes from standby generators.

It is believed that Electromagnetic field (EMF) radiation poses a health hazard and exposure to EMF radiation increases the risk of cancer. Though this claim has not been proved it still remains the belief of many. Available information on the World Health Organisation website concerning base stations and wireless technologies states that “considering the very low exposure levels and research results collected to date, there is no scientific evidence that the weak Radio Frequency (RF) signals from base stations and wireless networks cause adverse short or long term health effects. It however urged national authorities to adopt international standards to protect their citizens against adverse levels of RF fields. WHO advises that there was the need to restrict access to areas where exposure limits might be exceeded by specifying the minimum allowable distance between a live antenna and a human being.

Some perceive the public as being ironic in expecting high quality service from the operators and yet complain about telecom base stations in their neighbourhoods which are expected to improve quality of service.

While it is acknowledged that badly sited or poorly designed telecommunications equipment can have a negative impact on the environment, it can also be noted that modern telecommunications can bring environmental benefits. They can help reduce the need to travel and hence reduce vehicle emissions and congestion, for example by enabling 'home working'. They have also enabled the development of 'real time' driver information systems which can lead to better use of roads and reduced congestion. (Daily Graphic , 2010)

### **NCA'S BACKING OF CO-LOCATION IN GHANA**

In Ghana, the NCA took keen interest in co-location in early 2009, when a tower which was alleged to be poorly constructed, collapsed and killed a passerby. The inhabitants in that area then prevented telecom operators from constructing new towers. Prior to that, there were wide spread belief that telecom towers were indiscriminately sited.

Specifically, issues related to health, aesthetics and safety were rife. Some of these concerns particularly, with regard to health are not supported by existing scientific findings. That notwithstanding, the NCA deemed it important, through education and public awareness, to address the concerns of the public and also take appropriate action to harmonise growth and development on one hand and public safety, perceived or otherwise on the other.

Accordingly, to address growth and environmental sanity, an Inter-Ministerial Committee (IMC) was inaugurated to champion the development and implementation of a solution

framework. The IMC instituted an Industry Technical Committee (ITC) headed by the National Communications Authority (NCA) to collaborate with industry and other stakeholders. Environmental Protection Agency (EPA), Ghana Civil Aviation Authority (GCAA), Ghana Atomic Energy Commission (GAEC), Metropolitan, Municipal and District Assemblies (MMDAs) to develop a set of guidelines for the institution of a one-stop-shop permitting scheme for the deployment of communication towers.

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The Terms of Reference for the ITC were as follows:

Provide clear standards and procedures for the installation of towers and also address the issues of environmental sanity.

Formulate a cost-effective and efficient mechanism to address administrative and bureaucratic bottlenecks faced by Operators.

Design a fair and open cost-based fee policy/structure which would ensure that all Operators are charged fairly by the relevant permitting authorities.

Facilitate the development of infrastructure to enhance the delivery of quality service and also promote the provision of competitive and affordable services nationwide.

The ITC in fashioning these guidelines reviewed all relevant bodies of laws and regulations of the institutions responsible for permitting and recommended the following:

1. Institutionalise a one-stop-shop mechanism which defined;

- a. Application and approval procedures,
  - b. Appellate process;
  - c. Harmonised fees structure;
  - d. Monitoring and enforcement.
2. Promotion of public awareness and education;
3. Encourage co-location to reduce the proliferation of towers.

### **GUIDELINES FOR TOWER CONSTRUCTION IN GHANA**

Following the work of the NCA and other interested parties, measures were put in place to ensure that a person/company intending to construct a tower demonstrates that all reasonable steps have been taken to investigate tower sharing before applying to the permitting agencies to construct a new tower within a specified radius of 400m of the proposed site. Specifications for tower construction as well as operational issues were specifically prescribed and penalties put in place for noncompliance. These measures seek to ensure that operators collaborate as much possible. It also stipulates safety requirements in the constructions of towers. Timelines are provided within which engaging parties are to respond to requests/permits.

NCA currently maintains a regularly updated list of all such co-location agreements.

Requirements of the various permitting agencies are as follows;

Ghana civil aviation authority to ensure that the construction will not constitute a hazard to air navigation.

Radiation Protection Agency (RPI) to ensure that the public, workers and the environment are protected from any harmful effect of radiation.

EPA to ensure that such an activity may not have a detrimental effect on the environment and as such an environmental impact assessment shall be conducted.

The GCAA shall also carry out periodic inspections of towers to ensure compliance with lighting and marking requirements.

NCA maintains that sharing towers in no way gives away an operator's strategic advantage - particularly since the network has become a commodity and products and services are the only mechanisms that can differentiate one operator from another (NCA, 2010)

## 2.14 SUMMARY

Co-locations of masts may ensure that companies share the same masts mounted at designated places in order to ultimately reduce their setup and operational costs while reducing the number of masts that are mounted all over the place. Moreover, if mobile operators can reduce their costs of extending coverage to more rural areas by sharing sites, then regulators and governments will have a better chance of meeting all policy objectives they have for nationwide access to IT and telecoms services. This, conjoined with the environmental benefit of reducing the total number of towers, may facilitate infrastructure sharing as the way forward.

## CHAPTER THREE

### RESEARCH DESIGN & METHODOLOGY

Research is a process of collecting, analyzing and interpreting information in order to answer research questions. Although we engage in this process in our daily life, the difference between our casual day- to-day generalisation and the conclusions usually recognized as scientific method lies in the degree of formality, rigorousness, verifiability and general validity of the scientific method that is applied in research.

#### 3.1 RESEARCH APPROACH

This research can be classified as a combination of descriptive, correlational and exploratory type of research.

The descriptive aspect refers to that objective of systematically describing the concept of infrastructure sharing and the possible benefits that can be derived from it.

The correlational aspect refers to that objective of discovering or establishing the existence of a relationship/ interdependence between two or more variables relating to telecom infrastructure sharing such as extent of indulgence vis a vis cost savings.

The exploratory aspect deals with the investigation into why co-location was not engaged in much earlier and as to whether active infrastructure sharing is being considered in Ghana.

A deductive approach is used in making conclusions based on hypotheses drawn from the underlying research which is tested for an acceptance or rejection.

### 3.2 RESEARCH DESIGN

The Inferential statistics approach was adopted as most of the research process objectives, designs, samples, and the questions that were asked of respondents were all predetermined. This undertaken in order to provide deep insight into the extent of co-location engagements in Ghana and the calculation of other indicators that reflected benefits derived or otherwise.

### 3.3 RESEARCH METHODOLOGY

This research thesis is a case study based and the colocation/infrastructure sharing agreement that is being currently undertaken by Vodafone and MTN. Basically a case study is an in depth study of a particular situation rather than a sweeping statistical survey.

Case study research design is useful for testing whether scientific theories and models actually work in the real world. One may come out with a great model for describing how a system works but it is only by trying it out in real life that it can be established whether it is a realistic simulation.

#### 3.3.1 SAMPLE DESIGN

Generally, researchers usually draw conclusions about large groups by taking a sample. A Sample is a segment of the population selected to represent the population as a whole.

In determining what type of information is needed and which telecom operator is most likely to have it, a combination of nonprobabilistic sampling methods such as Convenience sampling and Judgmental sampling was used.

Convenience sampling was used in identifying Vodafone as the researcher works for Vodafone and will find it more convenient to obtain information from there.

Judgmental sampling was used in identifying MTN which is the Telecoms company having the largest network and therefore information obtained from that company will be reflective of the behaviour of the industry.

### 3.3.2 DATA COLLECTION STRATEGIES

The construction of a research instrument or tool for data collection is the most important aspect of a research project because anything that is said by way of findings or conclusions is based upon the type of information collected, and the data collected is entirely dependent upon the questions that are asked of respondents.

Data may be described as Primary or Secondary Primary data. Primary data refers to data collected by the researcher himself while Secondary data refers to data collected by others to be "re-used" by the researcher. For this research, both primary and secondary data have been used to achieve our purpose. A total of thirty (30) questionnaires were administered.

The Primary data use in this study is through survey. Questionnaires were given out to carefully selected respondent. The set of questions were clear and unambiguous in order to solicit the right information. The questionnaire was tested carefully before being deployed.

Contact was established with personnel from the selected telecom companies and interviews were conducted to identify the current levels of engagement in co-location and also ascertain its benefits or otherwise to the engaging parties. The interview format was semi-structured. This involved close ended questions to allow for fixed responses and also open-ended

questions to allow the respondent liberty to discuss their opinions on the subject matter. These interviews were indepth, lasting from 30-60 minutes, and explored areas of interest in the hypotheses postulated above. Financial performance data was also be collected from key divisions.

This research made use of secondary data by obtaining data from various websites in order to help in understanding and analyzing the subject area as well as answer the research questions. Other secondary data sources that were utilized are literature review from company brochures, newspapers and textbooks.

### Profile of Respondents

Below are the profile of the various kinds of individuals who provided some information for this research.

Table 3: Profile of Respondents

| Item | Role                                 | Responsibility                                                                                           |
|------|--------------------------------------|----------------------------------------------------------------------------------------------------------|
| 1    | Radio Frequency Planning Coordinator | Identifies the need for cell sites and also locates suitable sites                                       |
| 2    | Site Colocation Manager              | Performing feasibility studies and coordinates all colocation                                            |
| 3    | Radio Frequency Engineer             | Provides details of site sites i.e coordinates (longitudes,                                              |
| 4    | Site Acquisition Manager             | Undertakes visitations, surveys and also negotiations with site                                          |
| 5    | Site Sharing Manager                 | Provides requirements for tower, space, power etc and                                                    |
| 6    | Rollout Manager                      | Undertakes BTS rollouts in terms of actual implementations and installations of towers, civil works etc. |
| 7    | Transmission Planning Engineer       | Handles Frequency interference on the microwave links.                                                   |
| 8    | Network Operations Manager           | Ensures that the GSM network is monitored and controlled for                                             |
| 9    | Network Measurement/Performance Eng  | Manages Quality assurance                                                                                |
| 10   | BTS Finance Manager                  | Financial management of Base Station activities                                                          |
| 11   | NCA representative                   | Monitoring of activities of Telecom companies (Base Station)                                             |

Source: Field data 2011

### 3.4 PROBLEMS AND LIMITATIONS

This research faced some problems and limitations which might influence the validity and reliability of the results of the study.

- a. Problems were encountered with the process of gathering information and data for this study. Infrastructure sharing is relatively new in Ghana and the number of people who are technically familiar with this subject are relatively few hence the sample space of the research was reduced to a convenient sample.
- b. Additionally the two companies that were selected are all multi-nationals who engage their employees in tight work schedules consequently the selected respondents were hard pressed for time leaving very little time to answer questionnaires or to be interviewed.
- c. Getting sufficient supporting financial data was challenging as respondents viewed financial information as confidential in spite of the fact that the researcher was bound by a non-disclosure agreement.
- d. The researcher was also constrained with time as personal work schedule had to be combined with undertaking the research .

## CHAPTER FOUR

### RESEARCH FINDINGS AND INTERPRETATION

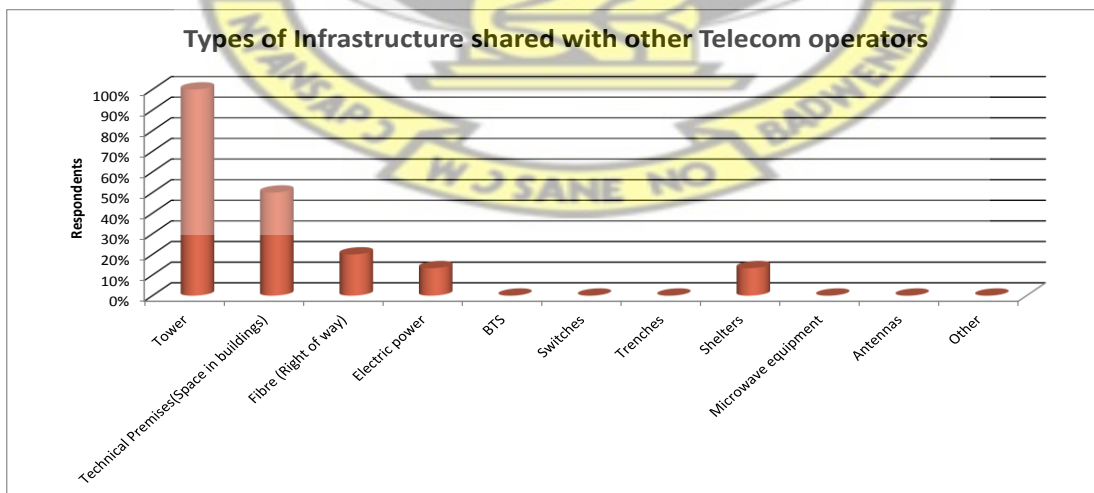
#### 4.1 INTRODUCTION

In this section the results of the research are summarized and discussed. The results of the interviews were categorized by hypothesis area and analysed using Microsoft Excel and other inferential statistics methods. The interview guide that was used during the interviews can be seen in Appendix A at the end of this thesis.

##### 4.1.1 EXTENT OF INFRASTRUCTURE SHARING AMONG TELECOM OPERATORS IN GHANA.

One of the objectives of this research was to discover what kinds of infrastructure are shared, if any, among the telecom operators. A summary of the results of the investigation are shown below.

Figure 3: Types of Infrastructure shared with other Telecom Operators



Source: Field data 2011

It was observed that indeed some infrastructure was shared by all the five telecom companies in Ghana and the infrastructure shared was mainly towers, space in buildings, electric power and shelters. Tower sharing was the most shared infrastructure and this was attributed its high cost of setup. Most of the people interviewed confirmed that cost of set up was reduced by about 50 per cent through infrastructure sharing. The mode of sharing was mainly one-for-one i.e. trade by barter kind of model where an operator will allow another operator to place their equipment at the site of the latter for free while agreeing to do same in return . In other cases where this reciprocation could not be agreed on, regular fee payment otherwise known rental was agreed.

It was also found out that most of the operators have contracted out the management of their base stations to tower companies. These agreements ranges from sale and lease back to operation and maintenance.

Table 4: Types of contracts engaged with Tower companies

| Types of Contracts with Tower Companies |                 |                           |
|-----------------------------------------|-----------------|---------------------------|
| Operator                                | Tower Company   | Contract Type             |
| <b>Tigo</b>                             | Helios          | Sale & lease back         |
| <b>MTN</b>                              | American Towers | Sale & lease back         |
| <b>Vodafone</b>                         | Eaton Towers    | Operation and Maintenance |

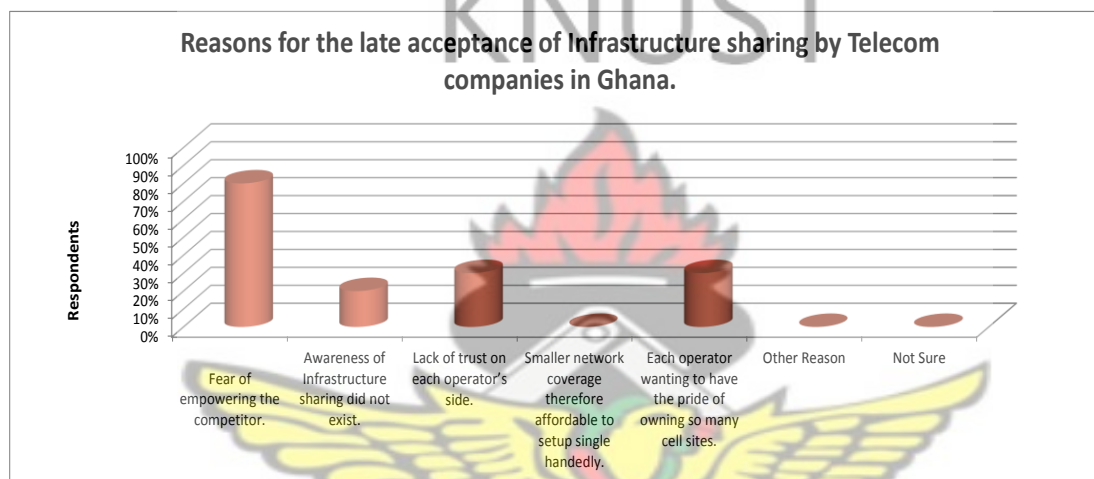
Source: Field data 2011

Out of the seven hundred base stations owned by Vodafone, fifty of them representing 7 % are shared with other operators. Vodafone on the other hand also co-locates with other operators at 30 sites.

#### 4.1.2 DELAYED ACCEPTANCE OF INFRASTRUCTURE SHARING BY TELECOM COMPANIES IN GHANA

Another objective of this research was to discover why telecom companies in Ghana did not take advantage of infrastructures sharing much earlier. The results obtained from the questionnaires are shown on the next page.

Figure 4: Reasons for the late acceptance of Infrastructure Sharing in Ghana



Source: Field data 2011

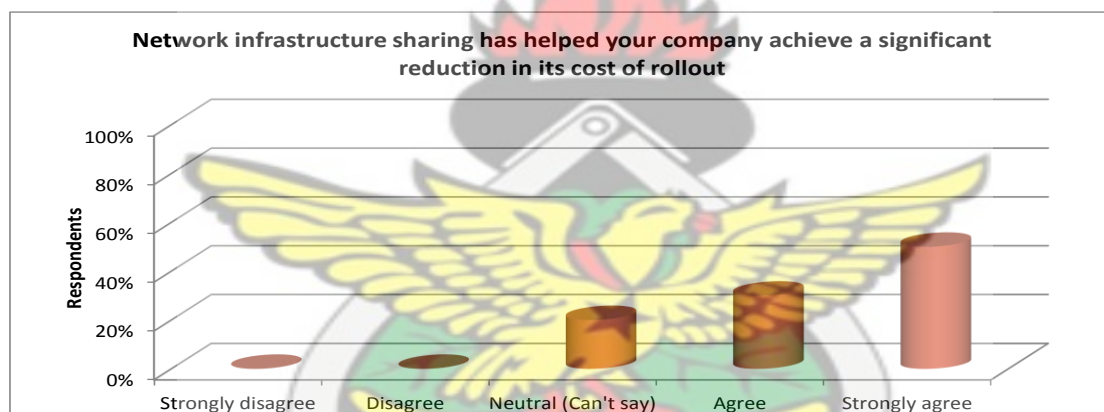
It was confirmed that in spite of the apparent advantages of co-location, the willingness of the service providers to share towers was initially low. Apprehensions were that sharing of towers with their competitors would result in huge churn as the later will have almost same coverage area and QoS. Some service providers ironically assumed that denying sharing may give them advantage over their competitor by delaying competitor's service rollout in that area. Such denials took the form of constantly changing the requirement for co-location and also spending too much time to process forms resulting in frustration and consequently abandoning of the idea to co-locate. This idea is contrary to current business models being

propounded which emphasizes on collaboration among business organizations in order to remain viable in these current times of globalization.

#### 4.1.3 INFRASTRUCTURE SHARING AND REDUCTION IN COST OF ROLLOUT.

Also this research sought to find out whether cost of network rollout is reduced through infrastructure sharing. The results obtained from the questionnaires are shown below.

Figure 5: Effect of Network Infrastructure sharing on cost of rollout.



Source: Field data 2011

From the results of the responses obtained as shown we notice that more than 80% of the respondents are in agreement with the proposition that infrastructure sharing would lead to significant reduction in CAPEX cost of rollout by over 50 per cent.

By engaging in infrastructure sharing, land acquisition cost, civil works cost, tower construction cost, generator set cost etc. were all eliminated entirely. Long and tedious bureaucratic processes of seeking permits are also eliminated.

This helped in rapid rollout to new areas while drastically reducing cost of network expansion cost by over 50 per cent. Network coverage had expanded at a faster rate after co-location was adopted. Network had expanded to rural areas where previously having a dedicated tower was not financially justified due to lower ARPU.

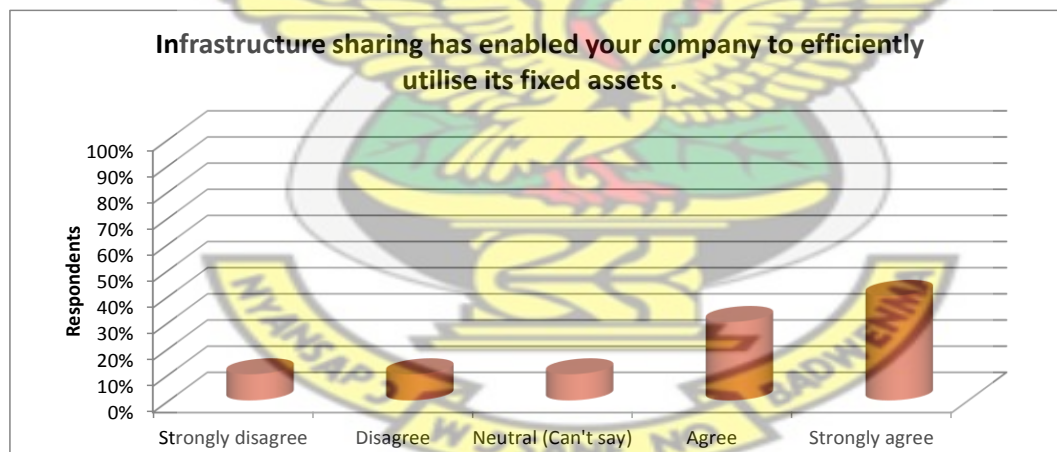
There is therefore an improvement in time to market due to faster rollout times.

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## 4.1.4 INFRASTRUCTURE SHARING AND EFFICIENT USAGE OF ASSETS

Also this research sought to find out whether cost of network rollout is reduced through infrastructure sharing. The results obtained from the questionnaires are shown below.

Figure 6: Effect of Network Infrastructure sharing on efficiency of asset utilisation



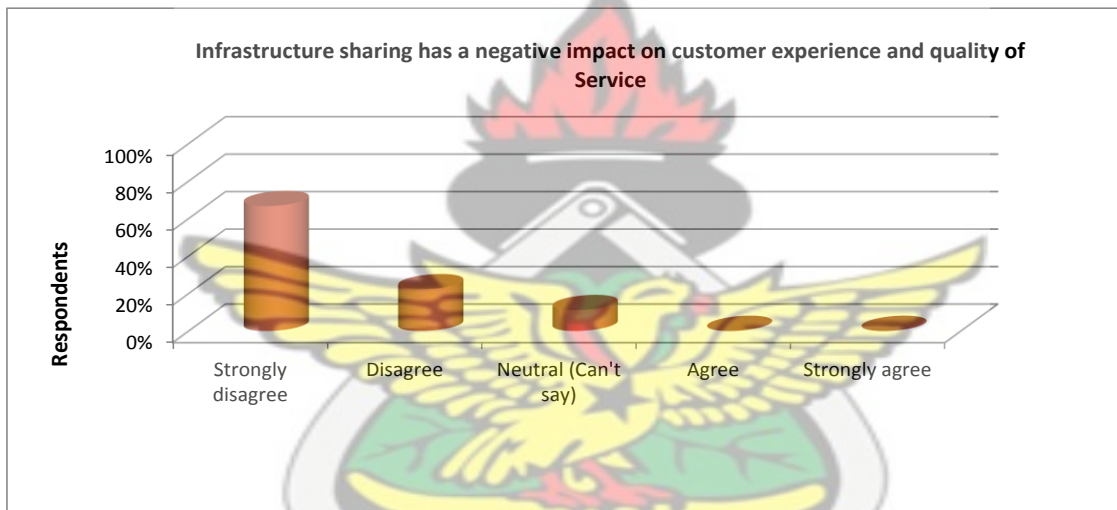
Source: Field data 2011

It was observed that free tower space , unused generated capacity free cooling air etc. which would otherwise have been unused are put to good use for revenue generation thereby sharing the operational cost. It was noticed that averagely, a tower has the capacity to host about three operators. It was estimated that by sharing the site the operators are saving around 20% of the operating expenditure.

#### 4.1.5 EFFECT OF INFRASTRUCTURE SHARING ON CUSTOMER EXPERIENCE AND QUALITY OF SERVICE

Another objective of this research was to find out whether infrastructures sharing had any negative impact on customer experience. The results obtained from the questionnaires are shown below.

Figure 7: Effect of Network Infrastructure Sharing on customer experience and Quality of Service.



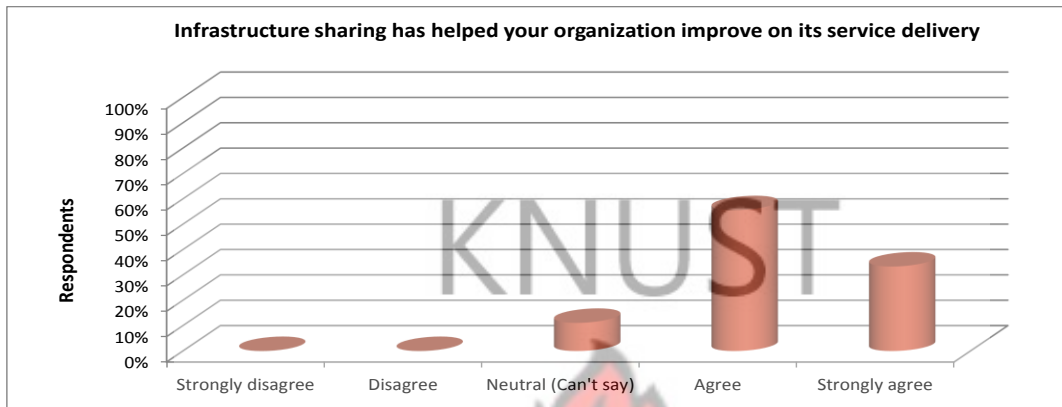
Source; Field data 2011

From the result depicted above we can see that 89% percent of respondents tend to be in agreement while 11% are neutral having no idea about the subject matter.

Hence it can be concluded that that there had been no negative impact on customer experience or network quality of service for customers who are served via sites that are shared with other operators. This information was confirmed by some staff from the marketing team. This confirms that infrastructure sharing, technically speaking, carries no significant risk.

#### 4.1.6 IMPACT OF INFRASTRUCTURE SHARING ON CUSTOMER SERVICE DELIVERY

Figure 8: Effect of Network Infrastructure Sharing on customer service delivery



Source: Field data 2011

89% percent of respondents tend to be in agreement while the rest were not sure about the improvement in service delivery following engagements in co-location deals.

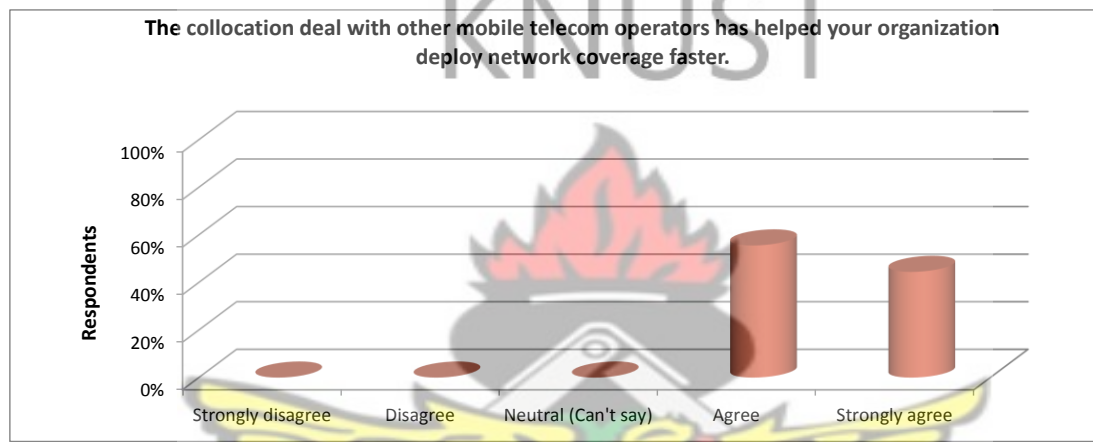
By alleviating pressure of network deployment, sharing allows operators to turn their attention to improved innovation, better customer service and eventually better commercial offerings and healthier competition

It can be concluded that capital saved from new rollouts are used to support other business ventures by introduction of many value added services which has become very prevalent among the telecom operators in recent times.

#### 4.1.7 THE EFFECT OF INFRASTRUCTURE SHARING ON THE SPEED OF ROLLOUTS

##### 4.1.8 The ability of co-location to cause faster network rollouts

Figure 9: Effect of Network Infrastructure Sharing on speed of deployment



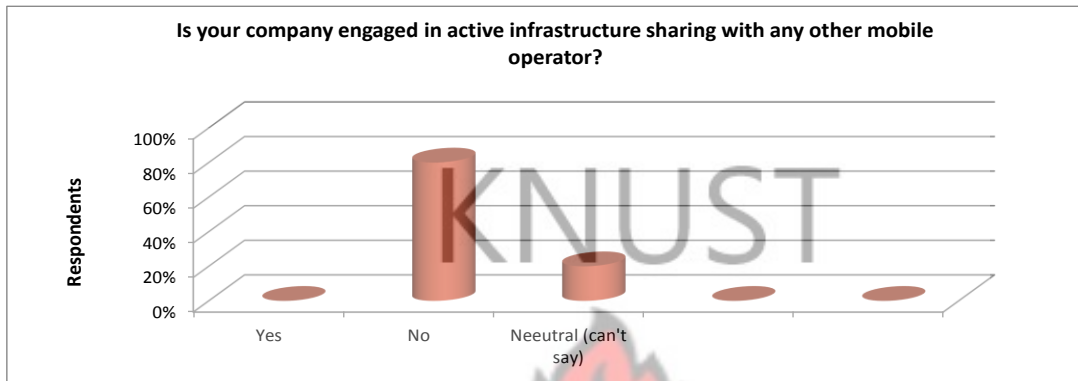
Source: Field data 2011

100% percent of respondents tend to be in agreement that collocation leads to faster network rollouts.

It was observed that it 90 days to look for greenfield sites and 90 days to acquire an EPA permit and more that 90 days for building permits and Civil Aviation Authority permits. However, with co-location all these are eliminated. This results in faster network rollout into rural areas and reduced costs.

#### 4.1.9 Possibilities of **Active** infrastructure sharing in Ghana.

Figure 10: Possibilities of Active Infrastructure sharing in Ghana.



Source: Field data 2011

From the results of the responses obtained 80 per cent of the respondents believed that their company was not engaged in any active infrastructure sharing with another operator while 20 per cent of respondents were not sure.

In Ghana, Active sharing, this is, sharing of the antennae's, frequency etc. has not started at all. It is believed that the time is not yet up since operators are just beginning to appreciate passive infrastructure sharing, that is, sharing of non –electronic components such as towers, electricity, shelter etc. More considerations have to be made with regard to active infrastructure sharing as it more complicated.

Active infrastructure sharing is usually restricted by the national regulators out of concern that it could enable anti-competitive conduct, such as collusion on prices or service offerings. In many countries, sharing of active site components (including spectrum i.e. radio frequency) is not allowed as the regulator wants to maintain full competition.

#### 4.8 SUMMARY

The summary of results of the hypotheses is as shown below.

Table 5: Summary of research findings

| Item | Research question                                                                                                                   | General Response                               |
|------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| 1    | What is the extent of infrastructure sharing agreements among Telcos in Ghana?                                                      | Mainly tower sharing -One-to-one kind of model |
| 2    | What accounts for the late acceptance of the concept of infrastructure sharing in Ghana among the Telecom Operators?                | Fear of empowering the competitor              |
| 3    | Do engaging operators experience significant reduction in the cost of capital expenditure employed in Network rollouts/deployments? | Yes                                            |
| 4    | Can Network Infrastructure sharing have a negative impact on customer? experience and quality of Service?                           | No                                             |
| 5    | Can Network Infrastructure sharing lead to improved service delivery?                                                               | Yes                                            |
| 6    | Can Network infrastructure sharing lead to faster network rollouts?                                                                 | Yes                                            |
| 7    | Are there plans to engage in active site sharing in Ghana?                                                                          | No                                             |

Source: Field data 2011



## CHAPTER FIVE

### SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

#### 5.1 SUMMARY OF FINDINGS

In this this research, the benefits of telecoms infrastructure sharing as a means of optimising cost was studied. The summary of the findings are presented below.

Network infrastructure sharing eliminates some setup costs such as land acquisition cost, civil works cost, and tower construction cost as well as long and tedious bureaucratic processes of seeking permits. This helps in rapid rollout to new areas while drastically reducing cost of network expansion cost by over 50 per cent. This helps in improvement on time to market.

Network infrastructure sharing reduces operational costs such as electricity and security among others leading to operational efficiency.

Network Infrastructure sharing has no negative impact on customer experience or network quality of service for customers who are served via sites that are shared with other operators. Therefore, there is no significant risk involved in co-location.

Network Infrastructure sharing alleviates the pressure of network deployment and rather allows operators to turn their attention to improved innovation, better customer service and eventually better commercial offerings and healthier competition.

In summary, network infrastructure sharing helps telecom operators to reduce cost while maintaining acceptable service levels in a way that does not undermine the operator's efforts to capitalize on future growth opportunities.

## 5.2 CONCLUSION

The results obtained clearly supported propositions that operators can obtain up to 50% savings on their CAPEX spendings by deciding to share telecoms infrastructure with other operators. Also, the cost of power, maintenance and security was reduced by up to 10%. Infrastructure sharing therefore promises to be critical lever in the growth of the telecom sector. By reducing these costs (i.e. CAPEX and OPEX), operators are able to extend their coverage to reach more subscribers, especially in remote areas. Not only is the cost of rollout reduced but also the time to rollout. Tower sharing also benefits the environment by reducing unnecessary duplication of masts and their associated infrastructure, thereby causing better city aesthetics.

Although infrastructure sharing has been known around the world since the year 2000, it was not until 2008 that telecom operators in Ghana got rid of the unwillingness to collocate by coming together to share masts. This collaboration has worked to their mutual benefit by making savings in both CAPEX and OPEX. Prior to that, marketing campaigns were even based on relative network coverage levels provided and operators were therefore unwilling to empower the other through co-location.

Infrastructure sharing may serve the Telecom industry well, especially in the face of the potential broad economic downturn by offering numerous potential business strategies.

At its best, Sharing will lower market-entry barriers by making it cheaper for new Telecom companies to enter the market and gain wide network coverage.

There is a growing recognition among operators that the rise of viable competition through co-location will force each operator to give of its best in service delivery. This has been intensified by the recent introduction of mobile number portability which allows subscribers to switch from one network to another while maintaining their number. This calls for high service quality, and telecom companies in Ghana are well poised for this competition by engaging in infrastructure sharing which allows any operators to easily extend their network coverage to areas that are covered by their competitor.

Regulators should continue to encourage infrastructure sharing by issuing the necessary policies to ensure the effective adoption and alignment by the competing operators.

The national communications regulator, NCA, has facilitated this co-location model by permitting towers to be constructed only after the requesting operator has demonstrated sufficient proofs that co-location is not feasible in a particular instance. This has forced many telecom operators to engage in co-location and this has actually been beneficial to the engaging telecom companies by reducing their setup and operational costs.

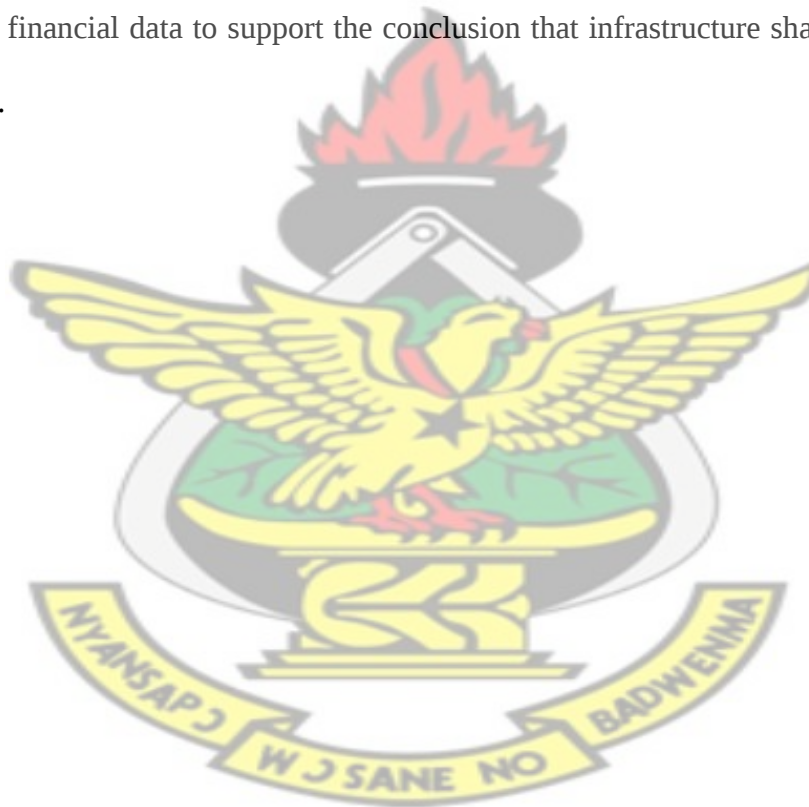
### 5.3 RECOMMENDATION

Telecom operators in Ghana should begin to plan for the more advanced model of sharing i.e. active infrastructure sharing. They need to ensure that radio equipment purchased are of high

quality and that the equipment can also be easily integrated with other systems. This may help overcome the possible future challenge of one operator perceiving the collaborating partner as using equipment of inferior quality and grade which might bring down their competitive advantage through poor service. The NCA can assist by putting in place a policy that enforces telecom operators to use only high quality equipment.

#### **5.4 DIRECTIONS FOR FUTURE RESEARCH**

Not much financial information was released to support this research. There is the need collect more financial data to support the conclusion that infrastructure sharing leads to cost optimisation.



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## APPENDIX

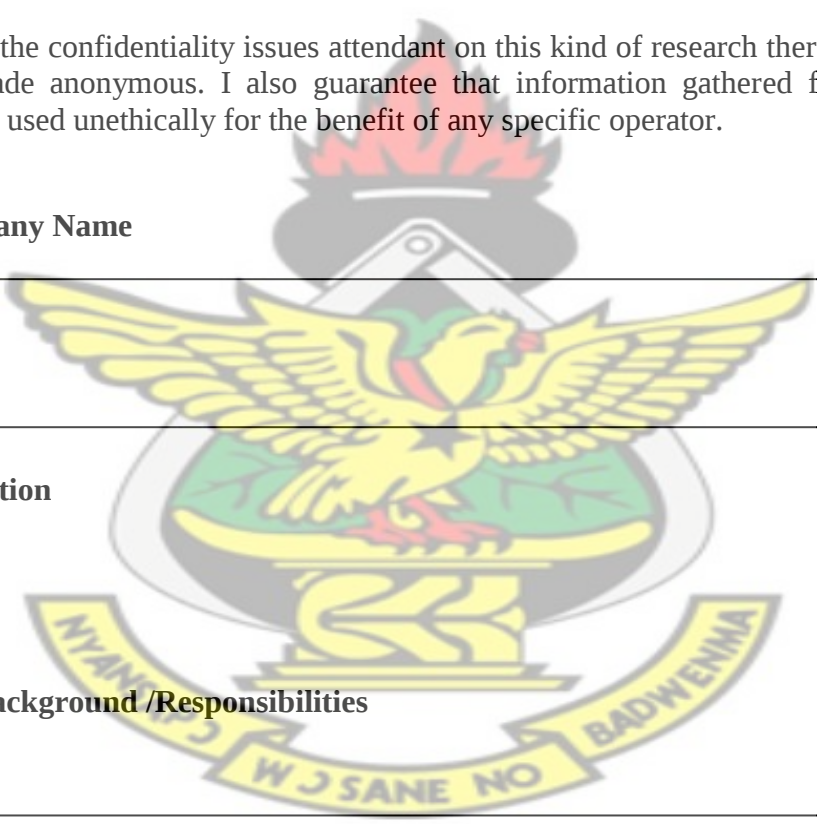
### QUESTIONNAIRE

#### Introduction

I am an MBA student at the Kwame Nkrumah University of Science and Technology Kumasi and I am currently undertaking a research in the telecoms industry to evaluate Collocation, otherwise known as Infrastructure sharing as a strategy for cost optimisation and revenue generation for telecoms providers in Ghana.

I understand the confidentiality issues attendant on this kind of research therefore this survey has been made anonymous. I also guarantee that information gathered from this survey would not be used unethically for the benefit of any specific operator.

#### Your Company Name



#### Job Designation

#### Your Job Background /Responsibilities

#### Extent of Involvement in Collocation

## Purpose of Interview

For the purpose of this study, telecoms infrastructure sharing is an arrangement whereby two or more telecom service providers (or operators) can agree to share passive or active infrastructure for the purpose of enhancing their business objectives and operations.

Passive infrastructure refers to all non-electronic components of a cell or BTS site such as towers, shelters, air conditioning equipment, diesel electric generator, battery, electrical supply, technical premises, easements and pylons.

Active infrastructure sharing involves sharing of electronic components such as electronics equipment, antennas, switches, BTS, microwave radios, and transceivers used for telecom signal processing.

## Questions

Q1. Presently what kinds of infrastructure does your organization share with other Telecom operators?

- ☐ Towers
  - ☐ Technical Premises (Space in buildings)
  - ☐ Fibre (Right of Way)
  - ☐ Electric generators
  - ☐ BTS equipment
  - ☐ Switches
  - ☐ Trenches
  - ☐ Shelters
  - ☐ Microwave equipment
  - ☐ Antennas
  - ☐ Not sure

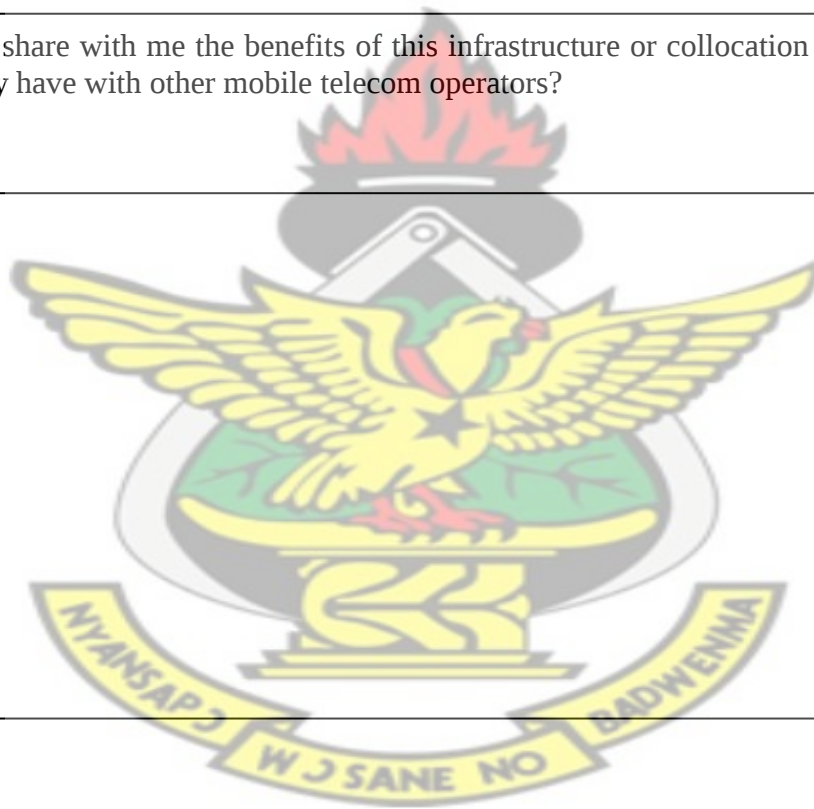
Q2. Please list the Mobile Operators that your company engages in collocation with.

|  |
|--|
|  |
|--|

Q3. What model of infrastructure sharing agreement does your company have with other mobile telecom operators? E.g. One for-one i.e. Trade-by-Barter kind of model etc.

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Q4. Kindly share with me the benefits of this infrastructure or collocation arrangement that you currently have with other mobile telecom operators?



Q5. Network infrastructure sharing (also known as Collocation) has helped your company achieve a significant reduction in its cost of rollout (or capital expended or invested).

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral (Can't say)
- ☐ Agree
- ☐ Strongly agree

If yes, how or in what ways?

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Q6. This collocation or infrastructure deal has a negative impact on customer experience and quality of Service .

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral (Can't say)
- ☐ Agree
- ☐ Strongly agree

Q7. This collocation or infrastructure deal has enabled your company to efficiently utilize its fixed assets such as BTS, Towers, Antennas, Floor space, electric generators, air conditioners or other infrastructure.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral (Can't say)

- ☐ Agree
- ☐ Strongly agree

In what ways?

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Q8. The collocation deal with other mobile telecom operators has helped your organization deploy network coverage faster, and helped achieve competitive advantage.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral (Can't say)
- ☐ Agree
- ☐ Strongly agree

In what ways?

Q9. This collocation (or infrastructure) pact has helped your organization improve on its service delivery through introduction of value added services (or introduction of innovative product) by means of using capital saved from otherwise completely new rollouts.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral (Can't say)
- ☐ Agree
- ☐ Strongly agree

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Please in what ways?



- ☐ Yes
- ☐ No
- ☐ Neutral (Can't say)

If yes please specify active infrastructure shared.



Q11. Which of the following in your opinion best accounts for the late acceptance of Infrastructure sharing by Telecom companies in Ghana. (You may tick more than one)

- ☐ Fear of empowering the competitor.
- ☐ Awareness of Infrastructure sharing did not exist.
- ☐ Lack of trust on each operator's side.
- ☐ Smaller network coverage therefore affordable to setup.
- ☐ Each operator wanting to have the pride of owning so many cell sites.
- ☐ Not sure.
- ☐ Other.

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If other, please specify.

