

**IMPACT OF OUTSOURCING ON QUALITY OF SERVICE ON CELLULAR  
MOBILE PROVIDER: A CASE OF AIRTEL ZAMBIA**

**By**

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Requirements for the Degree of Masters in Engineering in Wireless Telecommunications

**THE UNIVERSITY OF ZAMBIA**

**LUSAKA**

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**APPROVAL**

This dissertation of Macarthur Simalumba Mudenda is approved as fulfilling in the partial requirements for the award of the Degree of Masters of Engineering in Wireless Telecommunications by the University of Zambia

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## **ABSTRACT**

This dissertation looks at the impact of outsourcing on the quality of service of a cellular mobile network service provider. Outsourcing is when any operation or process that could be or would usually be performed in-house by an organisation's employees is sub-contracted to another organisation for a substantial period. The outsourced tasks can be performed on-site or off-site. To investigate this impact of quality of service on a cellular mobile network provider, a case study was conducted on Airtel Zambia Limited. The aspects of the network that were investigated were the radio and transmission functionalities. Under these functionalities, the major Key performance Indicators (KPIs) which are an agreed measure of the quality of service for both the passive and active elements were investigated. These KPIs were the Radio Network Availability (RNA), Traffic channel Drop (TCH drop), Traffic Channel Congestion (TCH cong) and Stand-Alone Dedicated Control Channel Congestion (SDCCH Cong). The results of this investigation indicated that, there has been an increase in power outages from 84% before outsourcing to 95% after outsourcing and a reduction in transmission outages from 33% before outsourcing to 16% after outsourcing of the network. This increment in power outages invariably had an effect on the RNA of the network. There was very little change on the KPIs of TCH drop, CSSR, TCH cong and SDCCH after outsourcing. The RNA was the most visibly affected KPI after outsourcing. This particular KPI affected the availability of the network to the subscriber and therefore limited access to the network. Although these results would quantify the benefits of outsourcing to decision makers and various service providers when conducting this business model, it is very difficult to distinctively state the comparative benefits with the conventional business model since it was only one particular KPI which was affected. Therefore, outsourcing did not have any adverse impact on the quality of service on a cellular mobile network service provider, in this case Airtel Zambia.

## **DEDICATION**

I would like to thank my wife Kapembwa, for inspiring and encouraging me to “go for it”, thank you kaps, I love you. To my kids, Luumuno, Themba and Ndinawe for the patience, guys, you will understand in years to come, I love you all.

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To Airtel Zambia for the permission to access the required information in the various databases that are already existing on the Network.

## ACRONYMS

BSC	Base station Controller
BSS	Base station Subsystem
BTS	Base Transceiver Station
Capex	Capital Expenditure
CSSR	Call Setup Success rate
D.G.	Diesel Generator
Epcn	Evolved Packet core Network
IN	Intelligent Network
KPI	Key Performance Indicators
MNP	Mobile Network Provider
Opex	Operation Expenditure
OSS	Operational system support
QoS	Quality of Service
RNA	Radio Network Availability
RNC	Radio Network Controller
	Standalone Dedicated Control
SD DROP	Channel
SLA	Service Level Agreement
TCH CONG	Traffic Channel Congestion
TCH DROP	Traffic Channel Drop

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## **CHAPTER 1: INTRODUCTION**

In this chapter, the background to the research is given in the next section. Section 1.2 discusses problem statement and the following section discuss the aim of the research. The research objectives are explained in section after followed by the associated research question in section 1.5. The significance of the study is the explained and then the scope and limitation of the research discussed therefore after in section 1.7. Finally the organisation of the dissertation is highlighted in the last section.

### **1.1 Background**

Outsourcing is increasingly becoming a popular optional business model for most telecommunication companies. Due to the ever increasing pressure of high customer expectations combined with the rapid pace of technology migrations and the strong desire by operators to reduce the operational and capital costs (Opex and Capex), the traditional way of in house operation is slowly being taken over by a new breed of partnerships between operators and new business models including suppliers and third parties hoping to deliver a high quality of service to meet the customer demand on one side and be able, on the other hand, to reduce capex and opex in a very competitive environment. The telecommunication industry has turned into a maturity phase in its cycle and the focus has changed due to new challenges, from a desire to maintain a high number of subscribers and growing revenue growth base to wanting to hold and protect these gains, Fricanso (2010, p.763).

Outsourcing was officially introduced to then Zain Zambia (Now Airtel) in 2010. It was gradually implemented in stages of which the Technical section was first to be outsourced, under this section the operation and maintenance of the Mobile Cellular network was outsourced. This meant that maintenance of the Base Station Subsystem (BSS) which is mainly composed of the Base Transceiver Station (BTS) and the Base station Controller (BSC) were to be maintained and operated by Nokia which was contracted in this outsourcing agreement. Apart from the BSS, the Core network was also outsourced to Nokia, under the core network, the switching sub system which is mainly composed of the Mobile switching center (MSC), the packet core network (PC) and the Mobile Packet Backbone Network(MPBN) were to be maintained and operated by Nokia as well. Outsourcing is done for various reasons, however, the tasks for this dissertation was to assess and investigate the impact that outsourcing has had on the quality of the network of a cellular mobile provider.

To investigate this impact of quality of service on a cellular mobile network provider, a case study was conducted on Airtel Zambia Limited. The aspects of the network that were investigated were the radio and transmission functionalities. Under these functionalities, the major Key performance Indicators (KPIs) which are an agreed measure the quality of service for both the passive and active elements were investigated. The passive elements relate to those components of the network which are not involved actively in the originating and terminating of a call, whereas the active elements refer to those components that are directly involved in the originating and termination of a call. These KPIs were the Radio Network Availability (RNA), Traffic channel Drop (TCH drop), Traffic Channel Congestion (TCH cong) and Stand-Alone Dedicated Control Channel Congestion (SDCCH Cong).

### **1.2 Statement of the problem**

What has been the impact of outsourcing on the quality of service of a mobile cellular network service provider? Have the major key performance indicators of the active elements been affected after outsourcing? Has the major key performance indicator of the passive elements been affected after outsourcing? How has the quality of service been comparatively before and after outsourcing of the radio and transmission functionalities of the network?

### **1.3 Aim of this research**

The study investigates the impact of outsourcing on the quality of service of a cellular mobile network service provider.

### **1.4 Overall research objectives**

The overall objectives of this research is to advance an understanding of the impact of outsourcing on the quality of service on the cellular mobile network service provider in a very competitive environment of the telecommunication industry in Zambia. The Airtel Zambia network will be used as a case study.

Further, this research will assess comparatively, the performance of the quality of service of the network before and after outsourcing. In turn, two main research vehicles will be exploited to facilitate this study: an in-depth review of relevant literature and the collection and analysis of empirical data. The section entitled Research methodology contains the details of both the research strategy and the data collection techniques to be used to obtain the

empirical data. Specifically, within the context of outsourcing and the impact on the quality the network in Airtel Zambia, the objectives of this research are :

- i. To understand the outsourcing model and how it differs with the conventional model
- ii. Analyse the performance of the major KPI for passive elements before and after outsourcing.
- iii. Analyse the performance of the major KPIs of the active elements before and after outsourcing.

The first objective, understanding the outsourcing model and how it differs with conventional model will be achieved through mostly literature review. Objective 2 will focus on the quality of passive elements. By analyzing the performance of the passive elements which are the bigger aspect of rollout. Objective 3 will help bring out the network behavior as perceived from the user experience. It is this impact that will mostly bring out the effects of outsourcing on the quality of service of the network. This will provide meaningful insight in unpredictable impairments which might occur in the network and how it could affect the perception of the final beneficiary of the network, the user. These are the main measure of the quality of service of the network, main drivers of quality and therefore the performance of the passive elements will ardently affect the KPIs. Objective 2 and Objective 3 will be achieved mostly through the data collection and analysis, since these are a direct measure of quality of service which will need to be quantified. It is in objectives 2 and 3 where this research will make key contributions to the quality of service in a telecom industry before and after outsourcing. The objectives are not to be seen as independent of each other, but rather as all linked to issues surrounding the quality of service of a network before and after outsourcing.

### **1.5 Research questions**

The following are the research questions that this case study seeks to answer:

- i. How does this outsourcing business model differ from the conventional business model?
- ii. How does the major KPIs of the active elements been affected by outsourcing?
- iii. How does the major KPI of the passive elements been affected by outsourcing.

## **1.6 Significance of this study**

This research work will contribute to the understanding of the quality of service in a network in an outsourced environment in a number of important ways: firstly by providing a critical review of aspects of the network in Airtel Zambia that may have an indirect impact on the measures of quality, secondly, since Airtel Zambia is a telecom outsourced company and one of the biggest, if not the biggest in Zambia, it will comparatively provide a fresh perspective of the performance of the network in an outsourced environment, before and after implementation of a new business model and lastly by understanding the impact of the new business model through the empirical data that will be later collected on the end user, whether there is a good user experience as demanded by the ever increasing subscriber expectations not only in Airtel Zambia but as mobile service providers in Zambia. The chapters to come will look at issues and review of related literature, examining of literature pertinent to the objectives of this research, and beginning with an investigation of what is meant by the by outsourcing and what are some of the drivers of outsourcing and the impact on the quality of service

in a Wireless Telecommunication Service provider.

## **1.7 Scope and limitation of the study**

To investigate this impact of quality of service on a cellular mobile network provider, a case study was conducted on Airtel Zambia Limited. The aspects of the network that were investigated were the radio and transmission functionalities. Under these functionalities, the major Key performance Indicators (KPIs) which are an agreed measure of the quality of service for both the active and passive elements were investigated. These KPIs were the Radio Network Availability (RNA), Traffic channel Drop (TCH drop), Traffic Channel Congestion (TCH cong) and Stand-Alone Dedicated Control Channel Congestion (SDCCH Cong).

There are limitations in this research which mostly relate to the collection of data. The data collected is for a period of two years before the outsourcing and two years after outsourcing. The databases have a limited storage capacity and the data is replaced after a period of two weeks. This applies to the storage on the base station controllers (BSC) as well. This data was indeed back-up but during the transition period, most responsibilities changed and other employees left so some of the data could have been lost. This, therefore, might have a few

months of data missing a one to one data comparison of the before and after trends in a way that would give a better understanding of the holistic performance of the quality of service of the network under the period in review. Nevertheless, the data collected did suffice for this research. Also it would be been more conclusive with regards to the effect of outsourcing if data concerning the capex, opex and revenue was available. This would have given an idea of how much money was invested and spent on operations before outsourcing and the revenue thereafter and this being contrasted with the after trends of outsourcing. Unfortunately, this financial information is not available to this research, probably it would be looked at as a potential area for future financial research and analysis. Not having full permission to all the data on the network because of privacy policy of management is another source of limitation to the collection of data. The data that was collected is only in accordance with the level of permission granted in accessing the data sources, mainly technical information.

### **1.8 Organization of the dissertation.**

Chapter 1 discussed the introduction to the dissertation. The background to this case study was given under section 1.1 of the first chapter. The problem statement was given in section 1.2 and the aim of the study was stated in section 1.3 of the same chapter. The research objectives were listed in section 1.4 and the research questions stated in section 1.5 of chapter 1. Section 1.6 and section 1.7 described the significance and scope of the study respectively. Chapter 2 reviewed the literature, where the comparison of the conventional model and outsourced model was made, the drivers of outsourcing were highlighted and Airtel as an outsourced model was discussed. The third chapter discussed the methodology of the research. The research area and site of data collection was stated and the sampling technique highlighted. The data collection methods and the techniques employed were explained. The framework for the data analysis under both the active and passive elements were also discussed. Chapter four discussed the findings and results of this research. The results of the various key performance indicators of the active elements were highlighted and explained. The performances of the various passive elements and how they affected the quality of services were also discussed. Finally the fifth chapter highlighted the conclusions of the research and made recommendations.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 Introduction**

In the first chapter, the aim and objectives of the dissertation were discussed. The problem statement was given and the overall objectives followed by the research questions were stated. The significance of the study was highlighted together with the limitations and scope of the study. The organisation of the dissertation was also explained.

In this chapter, the literature was reviewed to determine the comparative advantage and disadvantage of the conventional over outsourcing business model. The reasons for outsourcing together with the drivers of outsourcing will also be explained and discussed. There was also a focus on Airtel Zambia as an example of an outsourced business model and how the active and passive elements have been affected by this transition

### **2.2 Conventional Vs Outsourcing Business model**

The telecom network infrastructure typically involves a number of network elements which could be broadly classified under core network and access network. The core network is sometimes referred to as the evolved packet core network (ePCN) which include billing systems, intelligent network (IN), switching network, the packet and circuit switched networks, Mobile switching center (MSC), the Mobile Packet Backbone Network (MPBN), customer care systems, business process management systems, and decision support. The BSS involves radio access networks and microwave networks which includes the base station transceiver (BTS) which is commonly called the cell site, the base station controller (BSC) and the radio network controller (RNC). These network elements are provided by the system manufacturers and are installed and commissioned by them. The infrastructure providing companies install and commission network elements nodes and once the network is tuned and optimized, it is handed over to the operator staff. The staff of the operator maintains this network. This model, which is the conventional model, has changed in recent years and most telecom operators have started outsourcing installation, commissioning, and maintenance of network elements to the system providers themselves. The model has evolved in which the client and vendor both share revenue and risk. In the earlier conventional model, infrastructure companies primarily used to sell hardware and software for the roll out of products and services by the operator. In this model, the operator is under tremendous pressure to invest large amount of money. In the new model an operator and system

infrastructure provider work as partners ensuring that infrastructure will be ready as per the roll out requirements of an operator well ahead of time. This model provides win-win for both system manufacturers as well as an operator. Outsourcing is increasingly becoming a popular optional business model for most telecommunication companies. Due to the ever increasing pressure of high customer expectations combined with the rapid pace of technology migrations and the strong desire by operators to reduce the operational and capital costs (Opex and Capex), the conventional and traditional way of in house operation is slowly being taken over by a new breed of partnerships between operators and new business models including suppliers and third parties hoping to deliver a high quality of service to meet the customer demand on one side and be able, on the other hand, to reduce capex and opex in a very competitive environment, Fricanso (2010, p.768). Nowadays, companies and firms face many challenges that come with the desire for growth and the pressure from investors to see a healthy return on their investment. There are many issues such as the competitive pressures, business difficulties, limitation of sources, technologic complexities and specialization of tasks, acceleration of environmental changes, uncertainty about future, price increase, excessive enlargement of some organizations and legal considerations, which leads organizations to reconsider their managerial models to reach competitive advantages. One of these strategies is to focus on the core competencies and to entrust most of the activities to out-side suppliers or to outsource them. So in order to obtain the possibilities to do the tasks and simultaneously to give desirable services to the customers and to enable firms to react to various demands, outsourcing strategy is a necessary tool used by many progressive firms, Nazeri et al.( 2012, p. 245). Outsourcing, therefore, is when any operation or process that could be or would usually be performed in-house by an organisation's employees is sub-contracted to another organisation for a substantial period. Nazeri et al. (2012, p. 245).The outsourced tasks can be performed on-site or off-site. Most of the active companies and firms, including telecommunications companies in telecommunication industry need to be competitive and to keep their competition within their particular industry, to achieve this, they have to use new and modern technologies Sunil et al (2013, p. 176). They also need to gain ability to meet the company's increasing needs through reducing costs and increasing flexibility in delivering services and outsourcing is one of the important ways to reach these goals.

### **2.3 Why Outsourcing?**

Outsourcing is done for various reasons as already stated above, and therefore it is very important to look at the drivers of outsourcing and how there are considered as relevant and understand their impact on the quality of service in a MNP, although, the tasks for this dissertation was to assess and investigate the impact that outsourcing on the quality of service of the network of a cellular mobile provider.

### **2.4 Drivers of Outsourcing**

It has already been stated that outsourcing is done for various reasons. Sunil et al (2013, p. 176), has cited a number of parameters that may cause a company or firm to consider the whole issue of outsourcing. Outsourcing being a highly strategic decision, has serious impacts at various levels of the organization. Fricanso (2010, p.822). Drivers of outsourcing at strategic level in an organization could be savings in overall operational cost or forming a strategic relationship, monitoring service level agreements (SLAs,) quality of service (QoS), and having flexibility in resources or inter organizational relationship management, Tadelis (2007, p. 522). These may form part of the decision to outsource in any given organisation as already mentioned by sunil. These drivers of outsourcing will now be discussed and see the impact that they have on the overall organization or firm.

#### **2.4.1 Saving in opex**

It is noted that savings in operational cost (opex) has been a key driver for outsourced companies in the past and it still continues to be one of the key drivers even today in most telecommunication companies, Fricanso (2010, p.822). Over a period of time MNPs have realised that expected savings in cost is much higher than what is actually realized during deployment of various nodes as agreed in the contracts.

#### **2.4.2 Access to skilled resource or core competence**

Many companies have realized that they simply don't have the required set of skills among their present employees or they don't have luxury of time to train employees to acquire new skills in which case, and according to Frayer et al (2000, p268), working with a vendor who could provide required skill sets becomes a preferred option for outsourcing the talent. As much as most of the previous employees do become part of the new outsourced team, technology has evolved and the training cost have increased. The vendors usually have a pool of resource worldwide to simply tap into the ready existing resource and has been able

to provide the desired resource, Li et al. (2006, p.2088). The only negative aspect to this access to skilled resource has been that, employment can be affected the locals in the sense that most of the recruitments are not local but from the vendor pool which has proved to be cheaper for the vendor. This invariably brings about some animosity and division in the team as the locals are looking at their new colleagues as people taking away their jobs.

### **2.4.3 Non-core services**

The discussion in outsourcing usually is about outsourcing non-core services while retaining core services in-house. The discussion in outsourcing must be based on competencies and not simply cost, Sunil et al (2013, p.4311). For product or service companies core competencies provide competitive advantage. Outsourcing can provide a shortcut to a more competitive product, but the benefits could be short term only. In the long term it may be difficult to maintain product leadership for companies if core competencies are not built in-house but outsourced, Sunil et al (2013, p.4011).

There has been a change with this thinking that MNP provision of communication is the core business, operations is no longer the core business in outsourced MNPs. It's the services, like provision of data and airtime and the selling of mobile phones that seems to be the core business. Hence networks and the entire operations have been outsourced. The implication of such a change is yet to be seen particularly on the impact of the skilled resources and the ability to attract and identify the best talented local resource to work in this environment.

### **2.4.4 Flexibility in Contract and resource management**

Companies are looking for flexibility in resource deployment. As the companies become more agile, resource flexibility is of prime. Many times it may not be possible to meet this requirement faster and efficiently due to several internal factors such as delays in the process, bureaucracy, and lack of proactive planning of learning and development Kedia, B. L., & Lahiri, S. (2007, p.436).

The observation has been that, a vendor, at the request of the MNP, could bring required skills or train employees to acquire new skills usually locally and on site. The employees may not be fully engaged or focused because at the same time they are required to attend to other work related matters since this training is on site and local.

#### **2.4.5 Management Control**

This happens to be one of the major concerns in the decision making process for outsourcing. Offshoring of projects leads to several factors such as time difference, cultural distance, value system, and difference in management styles which need to be addressed and could potentially have serious impact on execution of contracts, Tadelis (2007, p. 522).

This has been observed in most management meeting with the MNPs and vendors, be it an operational review meeting or root cause analysis meeting at a big outage of the network. Each time there is an outage, the vendor has to ascertain the cause of such an outage, apart from what is on the system, more information may be required on site and for offshore outsourcing this becomes a challenge. When dealing with different vendors, a clear process of how to handle an outages that has different responsibilities among the vendors is required for quick and precise resolution of the outages and eliminate “passing the back”.

#### **2.4.6 Impact on Service Level Agreements (SLA) or Quality of Service (QoS)**

This is one of most serious issues which get discussed post transition. Mostly SLA’s form a key part of the contract which is extensively negotiated and agreed upon only after careful study and due diligence by both parties, Domberger et al (200, p. 107).

Due to competitive age technology and the desire to secure a contract ahead of the competition, a vendor could price the contract much lower than what it should be priced at. During the deployment and execution of contract, the vendor will start reducing on the actual node deployment in order to increase the margins Scannell, & Thomas, W. (2000). This invariable will have an impact on the quality of service (QoS) when the agreed SLAs are not met. Once it is clearly observed that the vendor is having serious challenges in meeting SLA’s as per the contract, MNPs need to renegotiate SLA’s and the contract amount with the vendor.

#### **2.4.7 Maintain competitive position and Gain competitive advantage**

Fjermestad (2008) says that in order to maintain a competitive position or to gain competitive advantage, the company needs to do many things mostly to do with opex reduction.

Most MNPs are forced to come up with different products and services to hold on to the lead of the market share, promotions are done from time to time so that there is always some new services for the subscribers.

#### **2.4.8 Risk and Returns Sharing**

There has been a serious discussion on risks involved in outsourcing as several surveys indicate that there are number of problems at the execution stage of the contract, Jurison (2010, pp. 239-247). Airtel in Zambia has signed a contract with Ericsson to modernize the network. Ericsson who provides required radio network to Airtel based on their projections. In this modernization, Ericsson does not have to sell or market their products (Radio Network) to Airtel as Airtel expects Ericsson to install required infrastructure at their own cost in the geographical area that is provided by Airtel. This definitely saves Airtel initial investment needed in infrastructure and Ericsson enjoys guaranteed market share. Since Radio networks requires heavy capital investments and recurring operational expenses, outsourcing helps in controlling these factors by asking vendors to provide both.

#### **2.4.9 Hidden Cost**

Hidden cost is incurred from day one when the decision is taken to outsource. Cronk et al (2010, p. 203) Most of the vendors declare a basis configuration of the capacity of the network that needs to be installed. Each time an upgrade is required, the basic configuration will need additional software increase, the hardware equipment has the required capacity as per contract, but that capacity would need to be unlocked through the software upgrade which the MNP would need to pay. This has be noticed with the vendors that Airtel Zambia has been dealing with. This also adds to the hidden costs that the MNP was not aware of during the signing of the contract.

#### **2.4.10 Strategic partnership**

The desire or the expectation on the part of management is always to create a win-win situation so that vendor and the service provider both fulfil their expectations. Usually that is the bottom line in creating a strategic partnership. Kern et al (2002, p. 203).

MNPs do have major partners like Huawei, which is mostly dealing with 3G network as the managed services Partner, Nokia which deals with 2G network as the managed service partner, Ericsson which has the intelligent network (IN) managed service partner and I.H.S towers which is currently managing the towers and all the passive elements in the network.

#### **2.4.11 Tower Management**

Outsourcing in telecom continues to evolve. Towers (mostly the passive elements) constitute almost 70% of the networks, according to the Deloitte global outsourcing insourcing survey

report (2014). Active parts involve antenna and the electronics that is installed in the sites next to the tower or mast while passive parts involve power system that is supporting electronics. It is the maintenance of these power plants that tower companies have now taken over. This infrastructure used to be managed by the staff of the operators but in recent years this has been outsourced to an independent tower management companies. Basically, the tower companies have to make sure that the BTS and transmission equipment, power is terminated and supplied to the active equipment. Also they have to make sure that the space, both on the tower and on the site is rented, that there is a balance of the load of the mast and provide space to any other client that desires to rent as long as they are within the load balance. There are a number of challenges in this working model as they exist in a multi-sourcing arrangement.

## **2.5 Renewable power resources**

The other form of power, green power to be more specific, is the Fuel cells energy. “They are energy conversion devices producing electrical current and commonly run on hydrogen they operate electrochemically, like batteries, but have an external source of fuel like an engine were Individual cells are combined to form a fuel cell stack to provide the required voltage Fuel and the cell stacks are then integrated into a system with other components.” Crouch (2014, p.5).

Further “Fuel cells are used in the role often played by diesel generators or batteries: to provide backup for an unreliable power source, or in a limited number of cases, as the sole power source, Crouch (2014, p.15). This might seem to be a real solution for the current challenges with the traditional power supply but it also poses a few challenges, for instances the supply and movement of the hydrogen itself is a very big logistical issue particularly for a developing country like Zambia. The capital expense of setting up the hydrogen system itself is a great challenge. As much as this might be a solution in that, it reduces fuel theft problems, no moving parts hence a reduction operation and maintenance costs, the above highlighted challenges or barriers outweighs these benefits to implement this system.

The current limitations of grid power infrastructure has made most telecommunication companies to deploy D.Gs in sites without grid power particularly in rural areas and even were grid is available, but very unreliable. The limitation of grid power and the unreliability

of grid power has made the dependency of diesel generators either as a primary or secondary supply of power, in most case it is the sole primary supply of power.

## **2.6 Outsourcing- A case study of Airtel Zambia**

Outsourcing activity in the telecom sector has been around for the past couple of years. The trend always has been outsourcing IT or radio network management or non-core services. In the case of Airtel, operations Support Systems (OSS), evolved Packet core network (ePCN) and Base station subsystem Support Systems (BSS) form the backbone of the network operations. Most radio networks related systems come under OSS. These systems are used to provide customer support, enable employees to interact with the equipment and do their tasks, support various layers of communication in the organization, provide transactional support, etc. The ePCN include billing systems, intelligent network (IN), switching network, the packet and circuit switched networks, customer care systems, business process management systems, and decision support systems, etc. the BSS system includes the base station transceiver (BTS) which is commonly called the cell site, the base station controller (BSC) and the radio network controller (RNC). In the past all these systems and subsystems have been managed by the Airtel employees. The new trends have emerged over the past years were operators have signed mega contracts for outsourcing network management, billing processes, marketing and branding, and tower infrastructure management.

## **2.7 Airtel Network**

Outsourcing was officially introduced to then Zain Zambia (Now Airtel) in 2010. It was gradually implemented in stages of which the Technical section was first to be outsourced, under this section the operation and maintenance of the Mobile Cellular network was outsourced. This meant that maintenance of the Base Station Subsystem (BSS) which is mainly composed of the Base Transceiver Station (BTS) and the Base station Controller (BSC) were to be maintained and operated by Nokia which was contracted in this outsourcing agreement. Apart from the BSS, the Core network was also outsourced to Nokia, under the core network, the switching sub system which is mainly composed of the Mobile switching center (MSC), the packet core network (PC) and the Mobile Packet Backbone Network (MPBN) were to be maintained and operated by Nokia as well. Outsourcing is done for various reasons, however, the tasks for this dissertation was to assess and investigate the impact that outsourcing has had on the quality of the network of a cellular mobile provider.

The case study looked at the performance of the network in terms of the quality of the service of the network in the context of outsourcing and not necessary as a whole unit's performance after outsourcing. The idea is to look at a comparative analysis of the way the network was performing in terms of quality before and after sourcing. It is therefore only one section, the technical section of the mobile network provider which was the focus of the various forms on data that will was collected and analyzed. This data was collected through the already existing secondary data on the Network. Primary source of this data is the MNP. The company which took over the managing of services, technical services is NOKIA.

## **2.8 Network Infrastructure -Active Elements**

The Airtel network infrastructure typically involves a number of network elements which could be broadly classified under core network and access network. The core network is sometimes referred to as the evolved packet core network(ePCN) which include billing systems, intelligent network (IN), switching network, the packet and circuit switched networks, Mobile switching center (MSC), the Mobile Packet Backbone Network(MPBN) , customer care systems, business process management systems, and decision support. The BSS involves radio access networks and microwave networks which includes the base station transceiver (BTS) which is commonly called the cell site, the base station controller (BSC) and the radio network controller (RNC). It is the components that largely make up the active elements of the network. They are active elements because they have a significant role in the originating and terminating of a call, although the measurable KPIs are under the BSS section.

## **2.9 Network Infrastructure –Passive Elements**

Passive element infrastructure sharing can be in five different categories, namely Passive RAN Sharing – The Traditional Concepts: Site sharing or co-location, Passive RAN Sharing – Access Transmission Sharing, Active RAN Sharing – Multi-Operator RAN (MORAN), Active RAN Sharing – 3G Multi-Operator Core Network (3GPP MOCN) and Roaming-Based Sharing – Shared RAN with Gateway Core, and Full Network Sharing. The concept of RAN passive sharing seems to be the most popular currently. In this concept the battery bank, the generator and the main power grid are shared and co-located with the competition. In the upcoming agreements with Airtel Zambia and a company that is involved in the building of towers, the agreement only highlight passive sharing and not passive RAN

sharing. In this agreement passive sharing has been defined as the sharing of not only tower space and premises but the sharing of elements of the existing power plant on site, such as grid power termination point, battery bank and diesel generators. The understanding is that since that power plant is passive in as far as originating and terminating of a call is concerned, it is therefore not actively involved in the generating, transmitting and receiving of this communication. When sharing a site what will be common to operators is the site, mast, the premises and the power plant housing the D.G. and the grid power terminating point. It would be rather difficult to categories passive radio access network(RAN) share, because the moment RAN comes into the picture, invariable the active elements such as transmission and radios are included and this longer is passive since these active elements are involved in the processing of the call. The complexity of infrastructure sharing is further enhanced by entrant of a new MNO in the sharing arrangement. It might seem that the new entrant would have undue advantage on the already established infrastructure by the previous MNOs now sharing. More regulation would be sought and such scenarios taken into consideration. The other aspect of this complexity would be a situation where the infrastructure in owned by one independent company and all the MNOs have to rent space, in this case there must be regulation that would not allow colluding to fester. It is hoped that with this review of first objective, the findings to be discussed in the chapter to follow will further identify this gap and a final recommendation made on how best this gap can be bridged in order to improve the performances of MNOs particularly Airtel Zambia which is the main focus of the research. The method used in the research will now be discussed in the next chapter of research and methodology.

## **CHAPTER 3: REASERCH METHODOLOGY**

### **3.1 Introduction**

In the previous chapter of the literature review, the comparison between the conventional models and the outsourcing models were explained and reasons of outsourcing which are also the drivers of outsourcing were also discussed. The network infrastructure sharing described the different categories of the active and passive elements which are at the center of this infrastructure sharing and how these components are involved in outsourcing. The various components of the Airtel Zambia network which make up the outsourced functions were highlighted and discussed.

This chapter on research methodology will give an insight of the research strategy used to assess the research issues together with the manner of collecting empirical data and analysis which included site and sample selection, and the analysis approach which was adopted. It details the data collection techniques, how this data was collected and from which sites. The framework of the data analysis for both the active and passive elements is discussed.

### **3.2 Research area or site**

The site where the research will take place will be the Airtel Zambia Ltd, one of the leading mobile cellular Network providers in Zambia. Airtel presented as an outsourcing model and therefore qualifies to be the focus of this research. It also provides availability of data and hence suitable for this research.

### **3.3 Data collection**

This data was collected through the already existing data on the network. The primary source of this data was the MNP. In most mobile network providers, there is raw data which is generated to show the various performances of the KPIs on the networks at various measurement periods of time, whether it's in minutes, days, weeks, months or even years. This information was collected mostly in its raw form and then processed in various formats and interpreted to give a better understanding of the performance of the network.

### **3.4 Literature review of how conventional model is compared to the outsourced model**

In chapter two, it was disused that infrastructure providing companies install and commission network elements nodes and once the network is tuned and optimized, it is handed over to the operator staff. The staff of the operator maintains this network. This model, which is the

conventional model, has changed in recent years and most telecom operators have started outsourcing installation, commissioning, and maintenance of network elements to the system providers themselves. The model has evolved in which the client and vendor both share revenue and risk. In the earlier conventional model, infrastructure companies primarily used to sell hardware and software for the roll out of products and services by the operator. In this model, the operator is under tremendous pressure to invest large amount of money. In the new model, the outsourced model, an operator and system infrastructure provider work as partners ensuring that infrastructure will be ready as per the roll out requirements of an operator well ahead of time. This model provides win-win for both system manufacturers as well as an operator. Outsourcing is increasingly becoming a popular optional business model for most telecommunication companies.

### **3.5 Active Elements KPIs**

The active elements of the base station controller (BSC), base transceiver station (BTS) is where most of this data was collected from and it's mostly statistical data. Every event on the network is logged and stored for a period of 15 days then backup on the BSC. It is this data that was collected in its raw form and the processed to be analyzed. This raw data contains counters and events which defines the active KPIs. There were 11 BSCs from which the data was collected from and are located in various parts of the country. The rest of the data was collected from the logged events from all the BTSs dotted around the country.

### **3.6 Passive Elements KPI**

The passive elements of power plants i.e. the D.G, rectifier and battery bank is where most of this data was collected from and was mostly presented in even log form on the BSC. The event logs are saved on the BSC as alarm logs showing particular events that occurred on the network. The alarms inevitably affect one KPI is particular, radio network availability. These are fetched by the BSC from the BTS in intervals of 15mins and made available of the BSC on a daily basis.

### **3.7 Sampling technique**

Convenience sampling has been used because of the time constraint and access to the desired data.

### **3.8 Data collection techniques**

This data will be collected using the various tools that are provided for fetching data on the Airtel network. The Astelia performance tool was used to fetch the statistical raw data on the BSC and is also used to convert this data in familiar formats such as excel. The various raw data at site level for the major KPIs of accessibility, retainability and availability were collected using other tools called Netact and business object because of vendor specification. To have a holistic understanding of the performance of the network, the raw data at BSC LEVEL in each province was collected and analyzed as well. The following raw data composed the bulk of data to be analyzed:

- i. Daily busy hour statistical reports
- ii. MAP 2G Zambia report
- iii. RNA Daily report.
- iv. Daily BSC alarms for the passive elements report
- v. Monthly scorecard of the major KPIs report
- vi. Daily outage minutes and review report
- vii. Daily BSC alarm for the active element report
- viii. Network performance analysis and recommendation report.
- ix. Network performance report submitted to Zambia Information and communication Authority (ZICTA)

By selecting this data as the main source of data that shows a holistic performance of the network, pre outsourcing period and post outsourcing period, an enriched picture of the performance of the network emerged which gave a productive understanding of the performance of the network and was able to provide a more pointed recommendation on how to mitigate or sustain the gains of network performance after outsourcing.

### **3.9 Framework for data analysis – Active Elements**

In order to have a focus and a sense of direction in this study, the objectives are meant to be reflected in the raw data collected and analyzed from the MNP databases. This was achieved

through the small subheadings of retainability, accessibility and Availability. These subheadings are interconnected to the main objectives of this research and shading more light on the issues that were raised in literature review with regards to the objectives. Under each of these subheadings, the major Key performance indicators will be described and analyzed. This will be done as follows:

### **3.9.1 Retainability**

There are mainly two major key performances indicator under this subheading, Call drop late and Handover success rate. The raw data which is statistical in nature will be collected from the various databases and presented in various forms and will be measured against the agreed grade of service (G.O.S) of the network which is 2% in this case. The various thresholds will be applied in accordance to the agreed grade of service in this case the handover success rate of 98% and the call drop rate of 1.45% as the acceptable thresholds.

### **3.9.2 Accessibility**

In accessibility the major key performance indicators are the call setup success rate and blocking rate or congestion. This is simply stated as the measure of the number of calls that are successfully established and radio resourced allowed when the subscriber makes a call from their devices. Blocking rate is a measure of the number calls that can't go through due to a lack of radio resources. The threshold for CSSR is 98% under the g.o.s of 2% and the blocking rate is 0.6% under the same rate of service.

## **3.10 Framework for data analysis – Passive Elements**

Further to achieving the objectives of the research, the performance of the passive elements will mostly be under one particular KPI, radio network availability

### **3.10.1 Radio Network Availability**

This is a measure of how available the network is each time access to the network is required. The Radio Network availability (RNA) threshold is 99.5%. This will include the assessment of the passive elements, in terms of the outages. This measure will also shade some light on compliance to the service level agreement (SLA) with the new Airtel partners.

## **3.11 Summary**

We have seen why Airtel was chosen as the site for conducting this research. The data collection sources were also described together with the sampling technique. The Astelia,

Netact, Business objects were the main tools used for collecting the data. The framework for data analysis was given under which the various KPIs for both active and passive elements were further described and explained.

## **CHAPTER 4: FINDINGS AND DISCUSSIONS**

### **4.1 Introduction**

In the previous chapter, the methodology of the research was discussed. The data collection and the site of this data collection was stated, namely Airtel Zambia. The sampling technique was explained and the data collection methods discussed. The framework of the data analysis was described under the two categories of active and passive elements.

In this chapter, the results are stated and explained through various graphs and tables. It is in this chapter that the findings of this research and how the major KPIs under the active and passive elements performed and are shown, to determine if the visible effect of this new business model of outsourcing was evident. Through these discussions and findings, it will be realized whether there was an impact, in a negative way, on the quality of service of a mobile service provider, in this case, Airtel. Zambia.

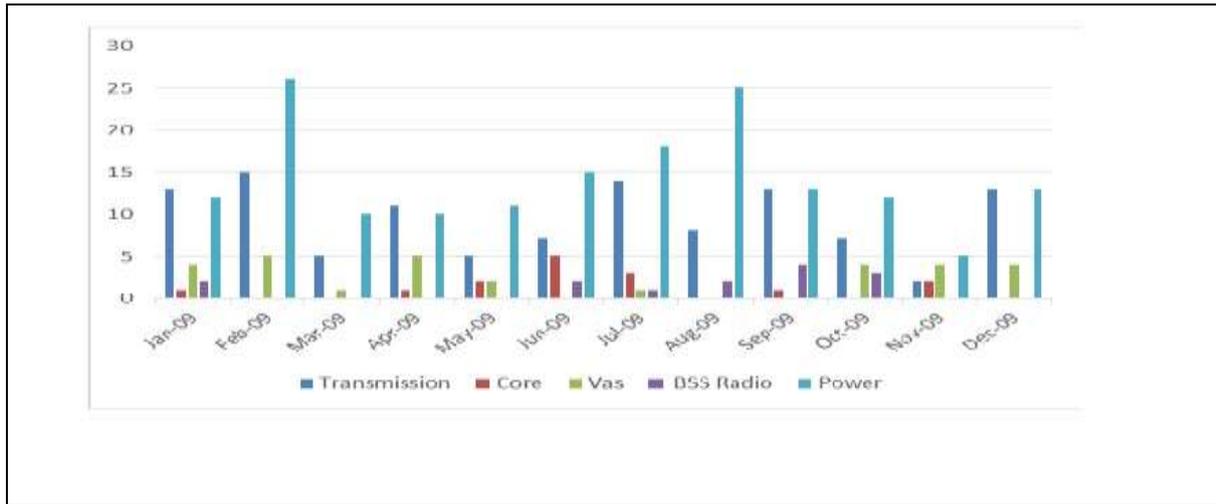
### **4.2 Network Outages for Active and Passive elements 2008-2009**

The passive elements are those nodes in the network that are mostly involved with the energizing of the network through the provision of electrical power. The KPI which is directly affected by these passive elements is radio network availability. Radio network availability is a standard way of measuring how available the network is to the subscribers. It is an internationally agreed measure of standards and is practiced in all networks. The counters of the KPI as set by the vendor, the manufacturers of the equipment which is comparatively the same for most vendors. There is a sense also in which they are called passive with reference to the overall network, in that they are not directly connected to the call flow, the call flow as to when an originating call is made through to the terminating end, these elements are passive with regards to this process. The elements which are included here are the diesel generator (D.G), the battery Bank, and the rectifier and main power supply to the grid.

Table 4-1 below shows the distribution of outages in that year. This was a count of how each category under transmission, core network, and value added services (VAS), BSS radio and power contributed to the outages experienced. It can be seen from the table 4-1 that the major contributor was power, this power was mainly at site levels. A typical site has a D.G, battery bank housed in a rack outside the container which mostly house the BTS and transmission equipment and rectifier. Most of the sites in cities and major towns do have grid supply as the main source of power supply. In recent years Zambia has not been spared from power outages and indeed there are still quite a number of areas without power supply, hence the reason of having autonomy on a site, the D.G and the battery bank. Ideally, when there is a power outage, batteries are supposed to take over energy supply to the whole site for a number of hours before a complete discharge (there is a minimum threshold set at which a D.G switch over is made) and a switch over to the D.G should be done. Since this power outages were experienced, it means that either fuel run out from the D.G or it failed to start for a number of assorted reasons after the switch over was done from the batteries which had completely discharged. Transmission was next to follow in the highest number of counts in that year of which the cause will be discussed below.

**Table 4.1 Airtel Network outage tracker 2009.**

Date	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
Transmission	13	15	5	11	5	7	14	8	13	7	2	13
core	1			1	2	5	3		1		2	
Vas	4	5	1	5	2		1			4	4	4
BSS Power	2						2	1	2	4	3	
Power	12	26	10	10	11	15	18	25	13	12	5	13

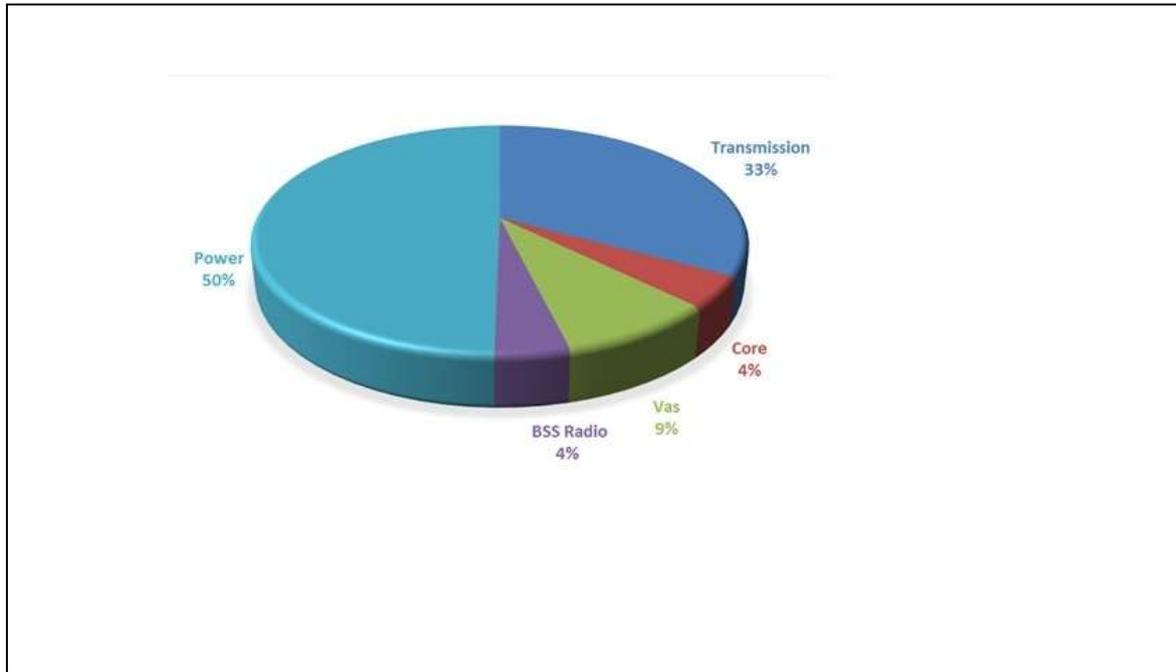


**Figure 4.1 Distribution of monthly network outages, Airtel Zambia**

It can be seen further from figure 4.1, that most of these power outages were in the month of February and August of 2009. There was a major power outage in the northern and north western provinces which were prolonged outages beyond the autonomy of the batteries and the diesel which was supplied to site. The challenge of distance since most of these sites are rural was also a major contributor to this particular outage. Can be seen from figure 4.2, that 50% of the outages on the network were due to power related issues with transmission at 33%. The rest of the categories were below 10%. It was noticed that power outages was the main contributor to network outages.

#### **4.2.1 Active elements-BSS Radio Outages**

Generally there was very little outages on the BSS during this period as can be seen from table 4-2. As expected mostly it was issues to do with the BTS outage, this was at site level. Figure 4.3 gives a little overview of these same contributors on the BSS site. This is the same reflection of the VAS outages as shown in table 4-3 and figure 4.4 as not having the high monthly counts. These two subsystems are relatively stable and very little outages are expected from these nodes.



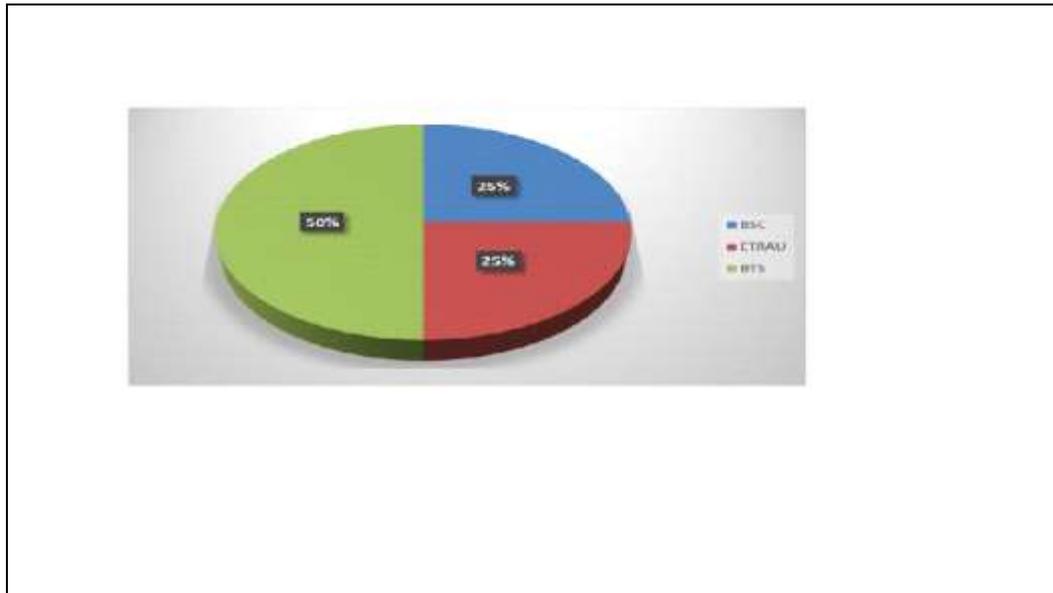
**Figure 4.2 Power was the major contributor of network Outages in 2009, Airtel Zambia**

**Table 4.2 Showing major BSS Radio contributors of outages, Airtel Zambia**

	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
BSC								1	1	1		
ETRAU									1	1		
BTS							1	1	1			2

#### 4.2.2 Active elements-VAS Outages

When it comes to the active elements, specifically the BSS radio aspect of the network since this subsystem has a standard measure of performance and give a real reflection of subscriber benefit. It has be said that the quality of the service of the Network is mostly measured from this subsystem and most of the subscriber experience is mostly evident from measured data of these nodes.



**Figure 4.3 Showing major BSS Radio contributors of outages, Airtel Zambia**

**Table 4.3 Showing major Value Added Services (VAS) contributors of outages, Airtel Zambia**

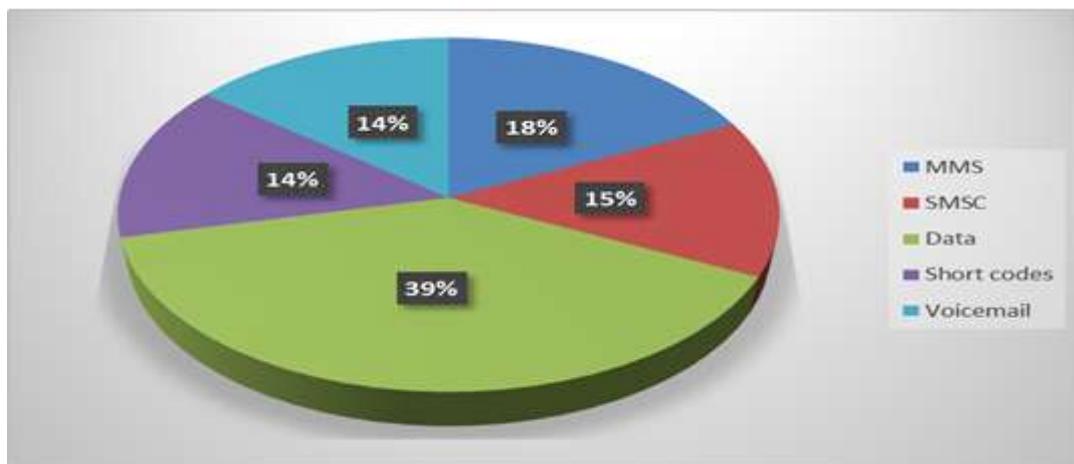
Date	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
MMS				5								
S-MSK		1							1			2
Data		1	1						3	1	4	1
Short ode		2			1					1		
Voicemail		1			1		1			1		

### 4.2.3 Active Key Performance Indicators (KPIs)

#### 4.2.3.1 Retainability

There are mainly two major key performances indicator under this subheading, Call drop rate and handover success rate. These are a standard measure of quality and are standards adopted internationally for all 2G networks. The raw data collected mostly looked at Call drop rate and was measured against the agreed grade of service (G.O.S) of the network which is 2% in

this case. Retainability is when an originating call is adequately able to access the network such that it is processed through to the terminating call and such a process is sustained without being abruptly terminated until such a time as the originating call has normal termination. The major measure of this key performance of retainability is TCH Call drop rate. The acceptable threshold of TCH CDR is 1.45% with a grade of service of 2%. As can be seen from figure 4.5, at the beginning of the year, TCH drop was increasing and high almost above the threshold and later improved and was well below the threshold. The graph further shows that towards the end of the year the performance of this KPI was even better. This could have been mostly due to the decline in traffic as most high traffic is experience in the festive season when there are a lot of promotions.

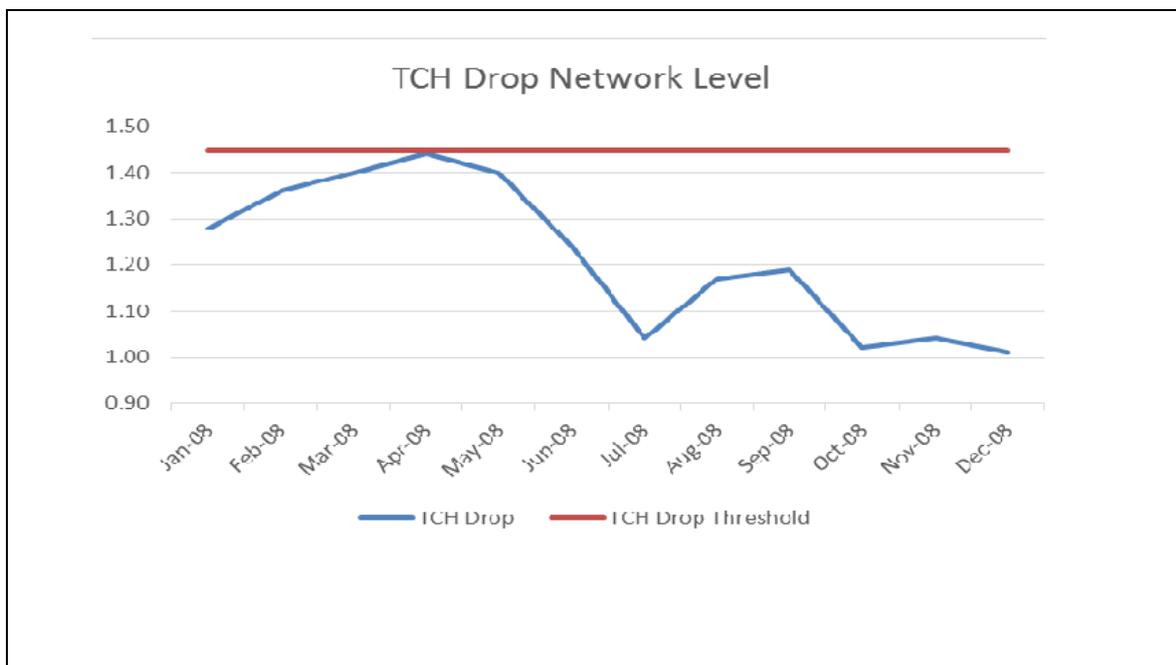


**Figure 4.4 Showing major Value Added Services (VAS) contributors of outages, Airtel Zambia**

#### 4.2.3.2 Accessibility

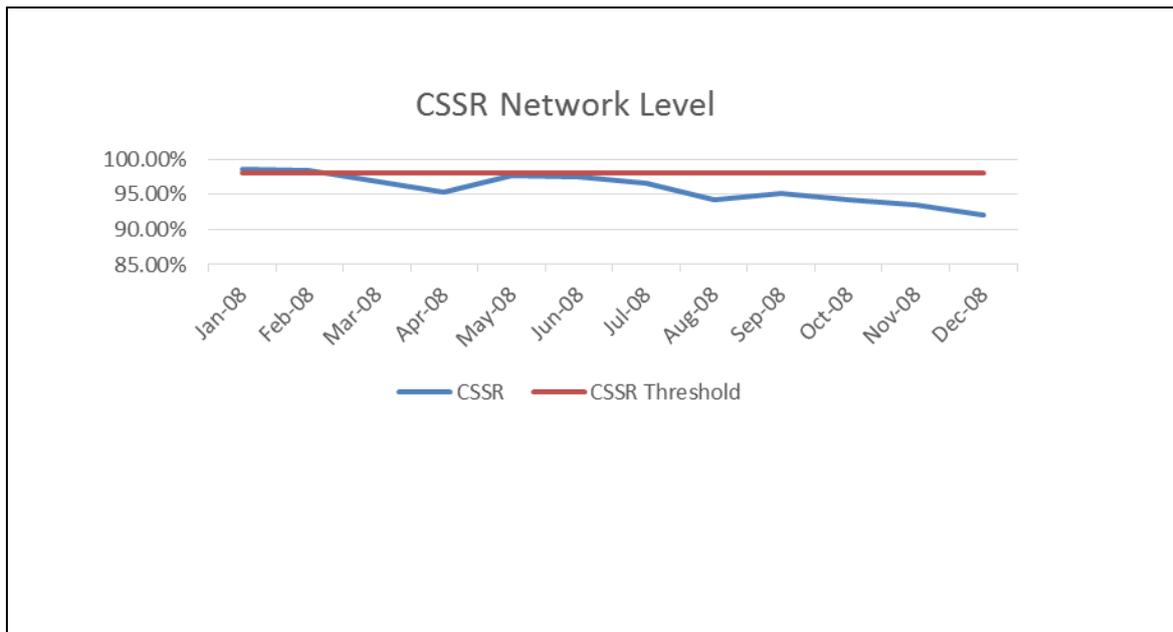
In accessibility the major key performance indicators are the call setup success rate (CSSR) and TCH blocking rate or TCH congestion. The CSSR simply states the measure of the number of calls that are successfully established and radio resourced allowed when the subscriber makes a call from their devices. Blocking rate is a measure of the number calls that can't have access to the network due to a lack of radio resources. The threshold for CSSR is 98% under the g.o.s of 2% and the blocking rate is 0.6% under the same grade of service.

Figure 4.7 shows the congestion level in the network in 2008. As can be seen, the congestion level where too close to the threshold in the middle of the year, meaning that although most of the subscribers where able to have access to the network, they did struggle to get through and that there was some experience of blocking. Figure 4.6 shows the call set up success rate, how successful the subscribers were in setting up a call on the network. It can be seen most subscribers struggled to setup a call as the call setup was below the threshold, meaning that a number of subscribers did indeed struggle to make calls as was stated earlier as blocking being a contributing factor. Another KPI that can help understand the CSSR is the SDDCH Cong rate.



**Figure 4.5 Showing TCH Drop at Network Level 2008, Airtel Zambia**

This is a channel resource needed in order to setup a call. If this control channel is not available, it is not possible to make a call. As can be seen from figure 4.9, the SDDH Cong was way below the threshold, meaning that this channel resource was never a bottleneck and was mostly available at call set.



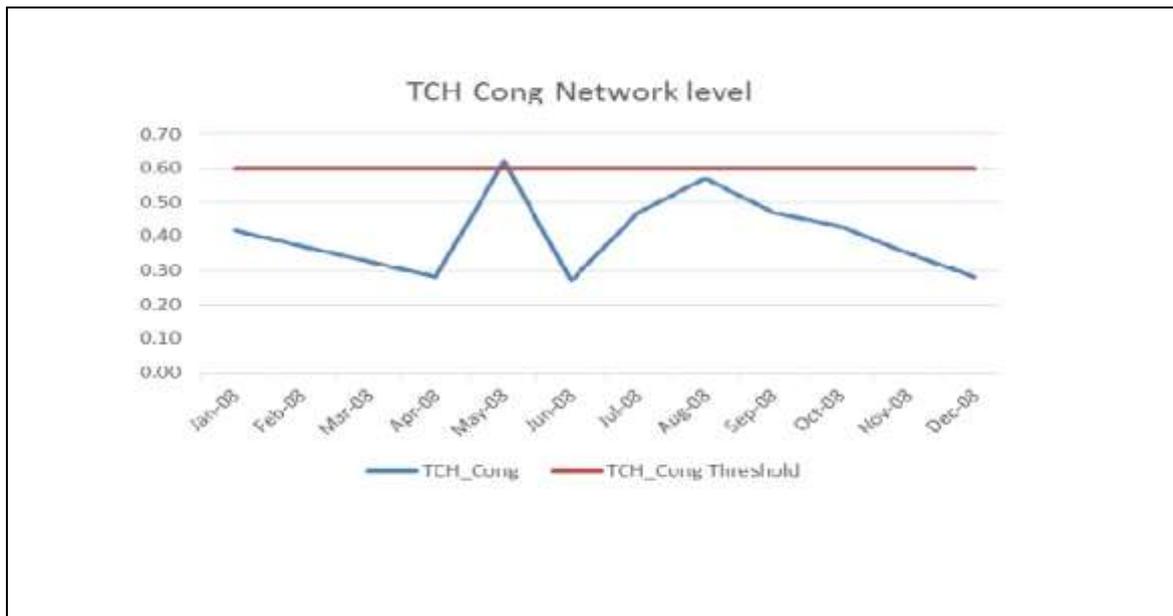
**Figure 4.6 Showing CSSR at Network Level, Airtel Zambia**

This points back to the TCH Cong, which simply means that although resource was available to setup a call, the traffic channels were not fully available at TCH assignment in order to finish this call setup, hence the low CSSR.

#### **4.2.3.3 Availability**

This is a measure of how available the network is each time access to the network is required. The radio network availability (RNA) threshold is 99.5%.

The major contributed to network unavailability have already being discussed above, mainly power and transmission. As can be seen in figure 4.10, the network was barely above the threshold most of the year, although there was a steady declination which eventually went below the threshold of 99.8%



**Figure 4.7 Showing TCH Cong at Network Level 2008, Airtel Zambia**

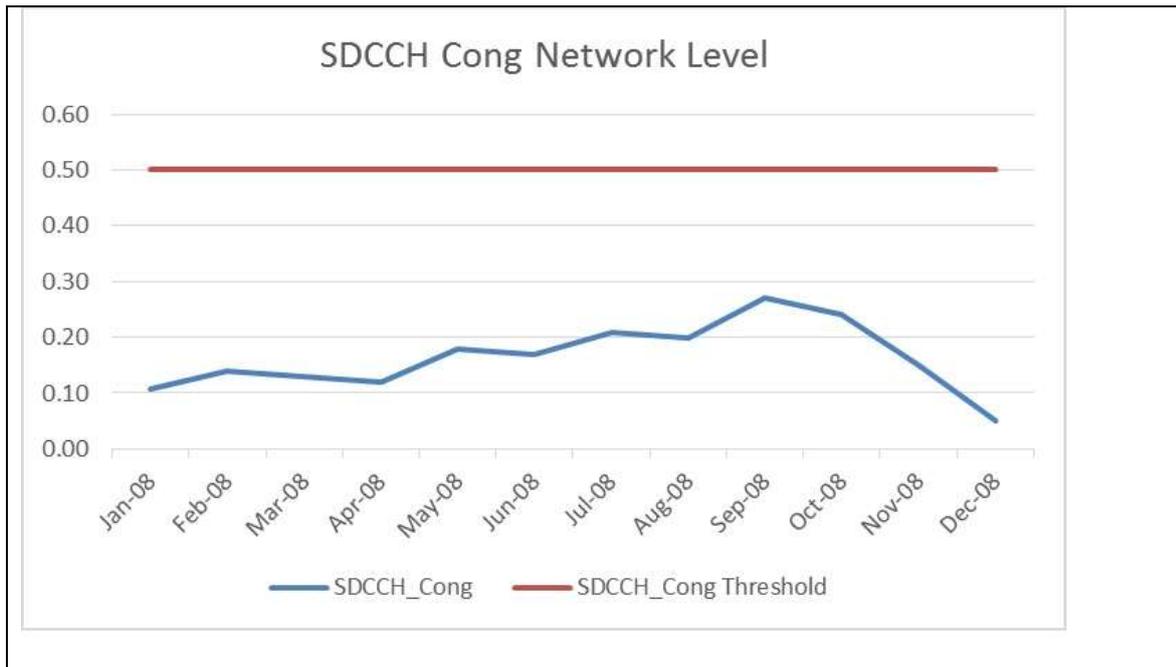
#### **4.2.4 Passive Elements -Power Outages**

To further understand the contributing factors of the power outages a deeper analysis of the power outages was done. It was noticed from figure 4.11 that lightening, generator failure, circuit breakers, Air cons and Rectifier where the major contributors to this power failure when grid supply was off. Generator failure was the major contributor with reasons such as starter battery, starter motor, and lack of fuel failure to switch over from battery to generator as being the main contributor. It has been observed that such reasons as given above where mostly in the cities, where thefts are very high, siphoning of fuel and stealing of batteries is rampant. Even in cases where security guards are involved in the theft. The poor fuel deliver could have contributed to logistical issues or even lack of visibility to some sites on the monitoring section, Network operational center, (NOC). The other contributors to these power outages where the circuit breakers which was 7% compared to 90% of the generator failures as seen from figure 4.11.

#### **4.2.5 Passive elements-Transmission Outages**

You will recall that transmission was the second highest contributor of Network outages at 33%, we therefore take a look at what the major contributors were to this particular outage. Figure 4.12 shows that the outages in transmission where more evenly distributed and not having a dominant contributor compared to the power outages. The MUX, a multiplexing node on the transmission line was at 16%, most of the MUXs are on the backbone sites and therefore this meant that part of a huge network was “cut off” each time one of those this

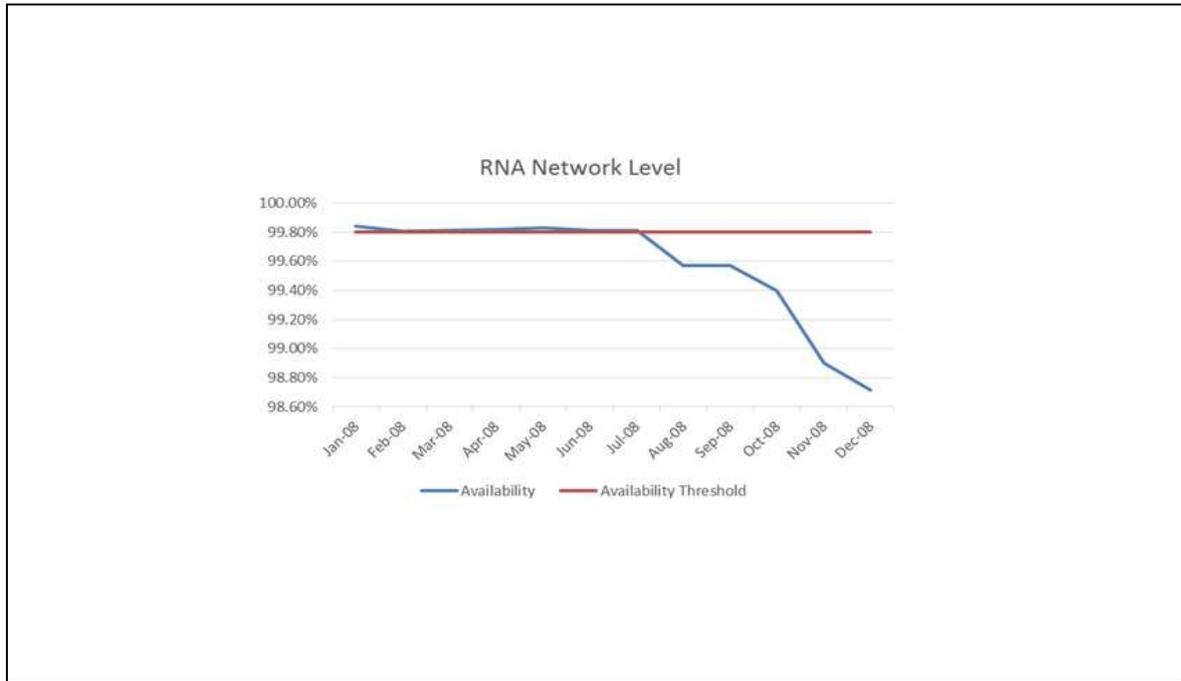
MUX went down. It was always critical that this node be the last one to fail in order to avoid a huge network outage and serious monitoring of these nodes is required with a good response by the transmission teams expected. The poor RX signal level is always a common failure in any network which uses Microwave transmission and this usually happens in the rain season when there is high fading. The transmission failures can also be contributed to long hops or the misalignment of dishes on a particular hop. Lightening was also a contributor as well as high BER (Bitrate error) on faulty E1.



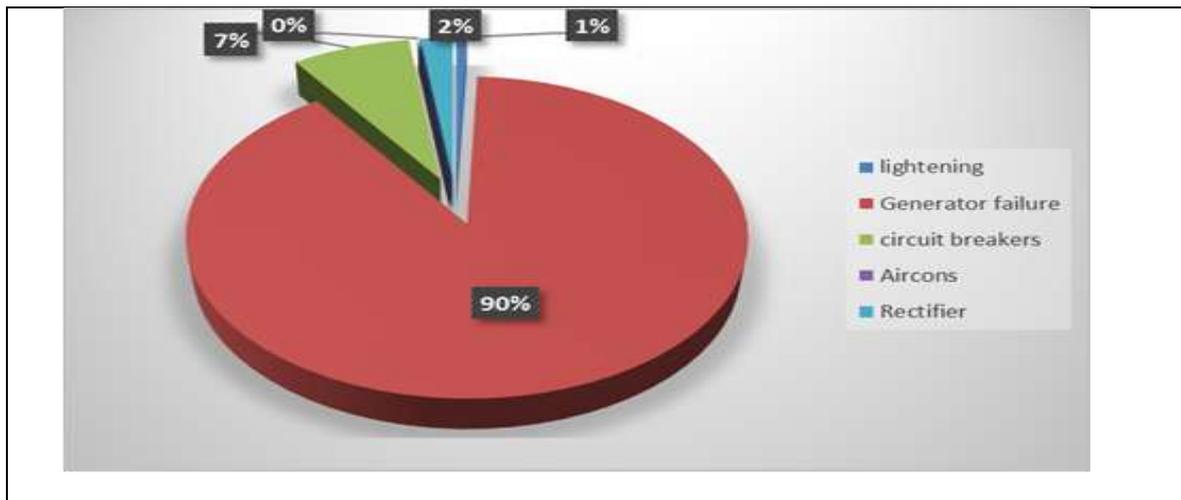
**Figure 4.8 Showing SDCCH Cong at Network Level 2008, Airtel Zambia**

### 4.3 Network Outages Active and Passive elements 2012-2013

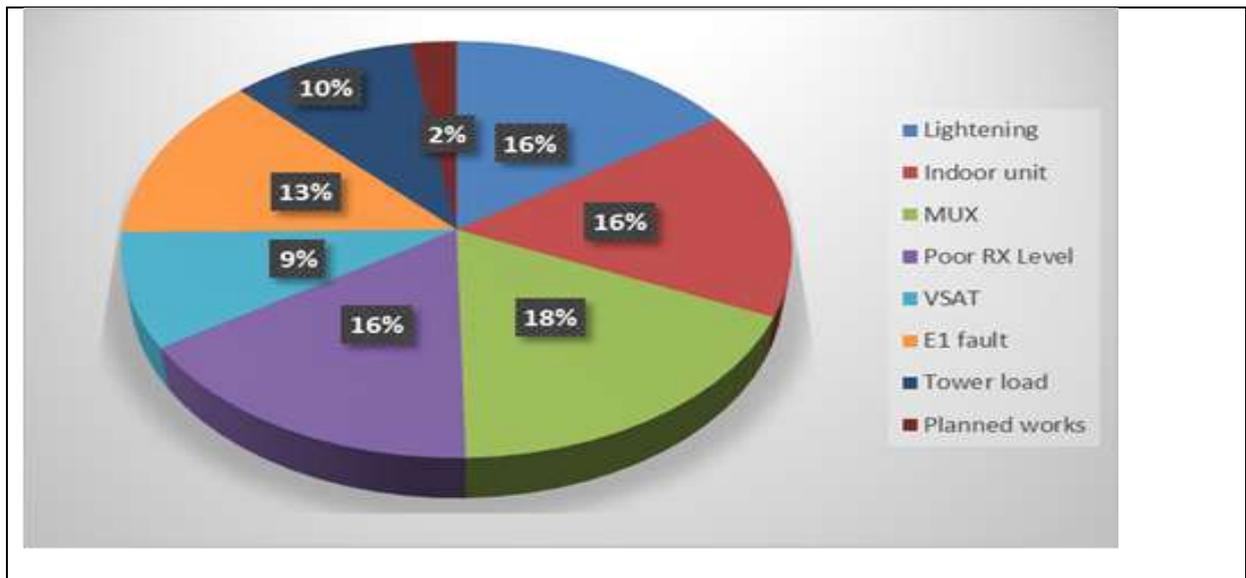
Table 4.4 shows the outage numbers of the network in 2013. Again we see that major contributors are similar to the data of 2008, power and transmission. The counts in the data of figure 4.13 are much high than 2008, mainly because of the increased number of sites. As can be seen from the above data, the highest count of power outages at site level was in February. As can be seen from figure 4.14, 84% of the outages on the network were due to power related issues with transmission at 16%.



**Figure 4.9 Showing RNA at Network Level 2008, Airtel Zambia**



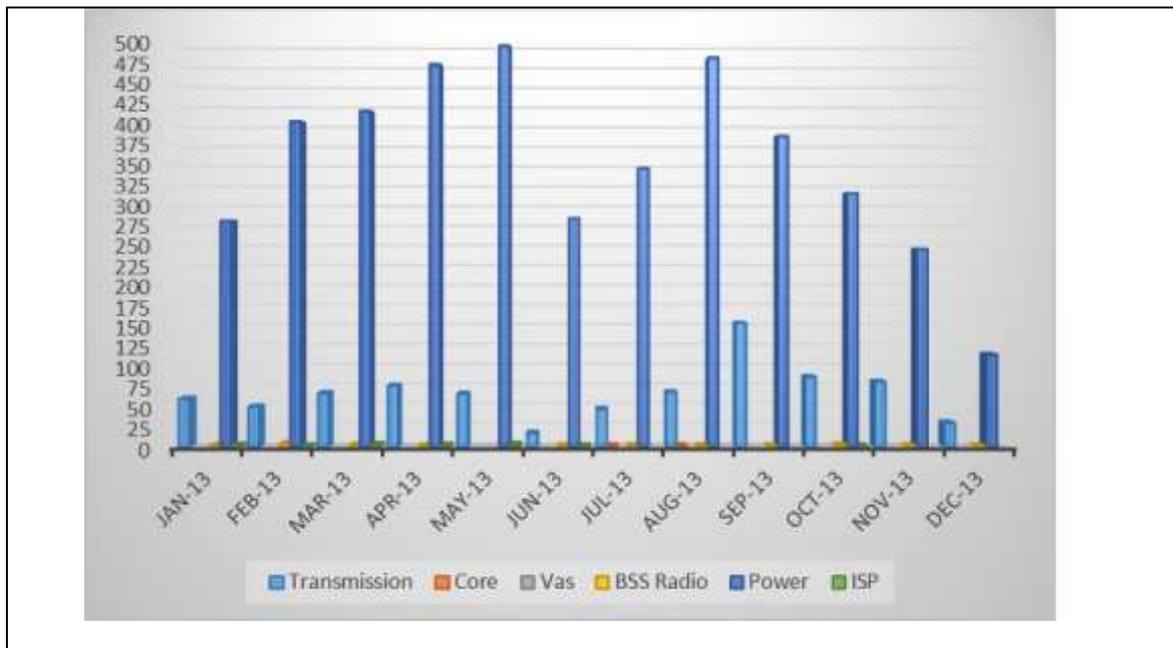
**Figure 4.10 Generator Failure major contributor of power outages 2008-2009, Airtel**



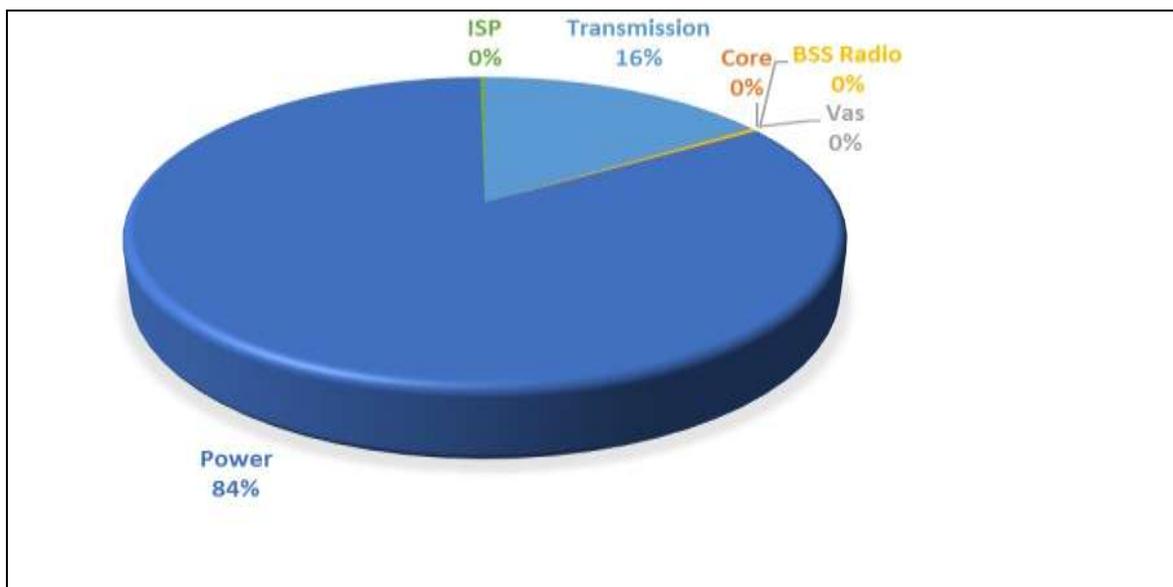
**Figure 4.11 Generator Failure major contributor of power outages 2008-2009, Airtel Zambia**

**Table 4.4 Network outage tracker 2013, Airtel Network**

Date	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sept-09	Oct-09	Nov-09	Dec-09
Transmission	60	50	67	76	66	17	47	68	154	87	81	30
Core						1	1					
Vas												
BSS Radio	2	4	2	1			1	1	1	2	1	1
Power	281	404	417	475	498	284	346	483	386	315	246	115
ISP	2	1	3	2	3	1					1	



**Figure 4.12 Distribution of month Network Outages 2009, Airtel Zambia**



**Figure 4.13 Power was the Major contributor of Network outages in 2013, Airtel Zambia**

### 4.3.1 Active Key Performance Indicators (KPIs)

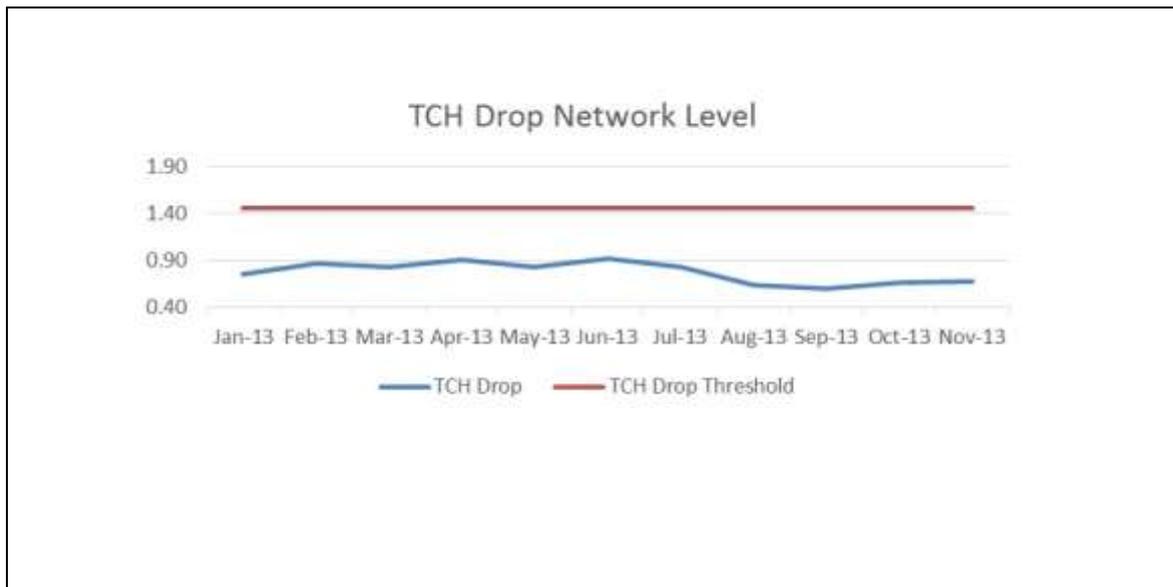
#### 4.3.1.1 Retainability

There are mainly two major key performances indicator under this subheading, Call drop late and Handover success rate. The raw data collected mostly looked at Call drop rate and was measured against the agreed grade of service (G.O.S) of the network which is 2% in this case. Retainability is when an originating call is adequately able to access the Network such that it

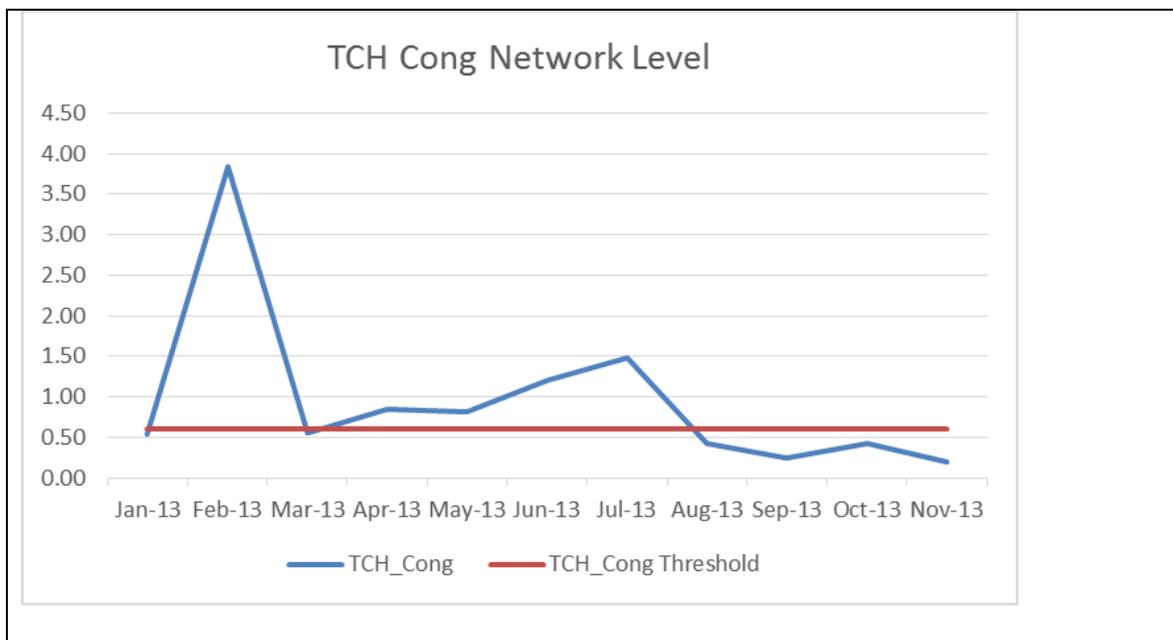
is processed through to the terminating call and such a process is sustained without being abruptly terminated until such a time as the originating call has normal termination. The major measure of this key performance of retainability is TCH Call drop rate. The acceptable threshold of TCH CDR is 1.45% with a grade of service of 2%. The TCH drop performance of figure 4.15 indicates that generally the subscribers were able to make calls without abruptly being “cut off” from the network since the percentage of dropped calls was well below the threshold of 1.45%. This means that most of the calls were not only setup successfully but also that the termination of the calls was normal and successful.

#### **4.3.1.2 Accessibility**

In accessibility the major key performance indicators are the call setup success rate (CSSR) and TCH blocking rate or TCH congestion. The CSSR simply states the measure of the number of calls that are successfully established and radio resourced allowed when the subscriber makes a call from their devices. Blocking rate is a measure of the number calls that can't have access to the network due to a lack of radio resources. The threshold for CSSR is 98% under the g.o.s of 2% and the blocking rate is 0.6% under the same grade of service. Figure 4.16 shows the performance of TCH cong in 2013. According to the figure 4.16, it shows a mixture of performances in the sense that the performance of this particular KPI poor in quarter 1 and quarter 2 of the year and improved in the last two quarters. There was high congestion in February mainly due to the faulty card on MSS in pool, this meant that subscribers had difficulties in accessing the network in the first two quarters due to lack of availability of radio resources on the network. The figure 4.17 shows the performance of the CSSR. It can be noticed that the performance of this KPI was very poor the second quarter. Subscribers were unable to setup calls as it was below the threshold. This performance of accessibility can be attributed to the unavailability of the network due to the power and transmission outages.



**Figure 4.14 Showing TCH Drop at Network Level 2013, Airtel Zambia**



**Figure 4.15 Showing TCH Cong at Network Level 2013, Airtel Zambia**

The calls could not be setup because the network was not available and hence the very poor call set up rate. Another KPI that can help understand the CSSR is the SDDCH Cong rate. This is a channel resource needed in order to setup a call. If this control channel is not available, it is not possible to make a call. As can be seen from figure 4.18, the other contributor to the poor CSSR was the SD cong as mentioned above if this KPI has a poor performance then the overall CSSR is expected to be poor as well since this radio resource is part of the call set up rate. It was also noticed that the particular KPI was following the same

trend of TCH Cong, which was indicating that there was congestion on the network due to mostly a faulty card on MSS which lead to lack of resources, mainly sddch resource.

#### 4.3.1.3 Availability

This is a measure of how available the network is each time access to the network is required. The Radio Network availability (RNA) threshold is 99.5%. Again the major contributor to this unavailability is the power outages as already indicated in the outages. It can be seen from figure 4.19 that the Radio network was below the threshold of 99.5% meaning that most subscribers were not able to make calls on the network

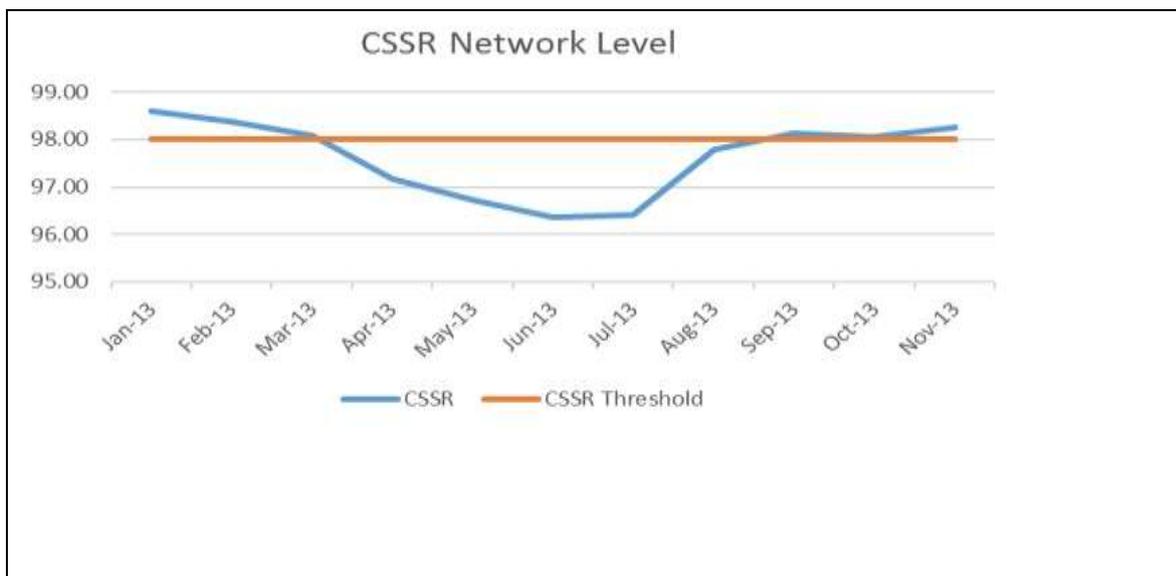
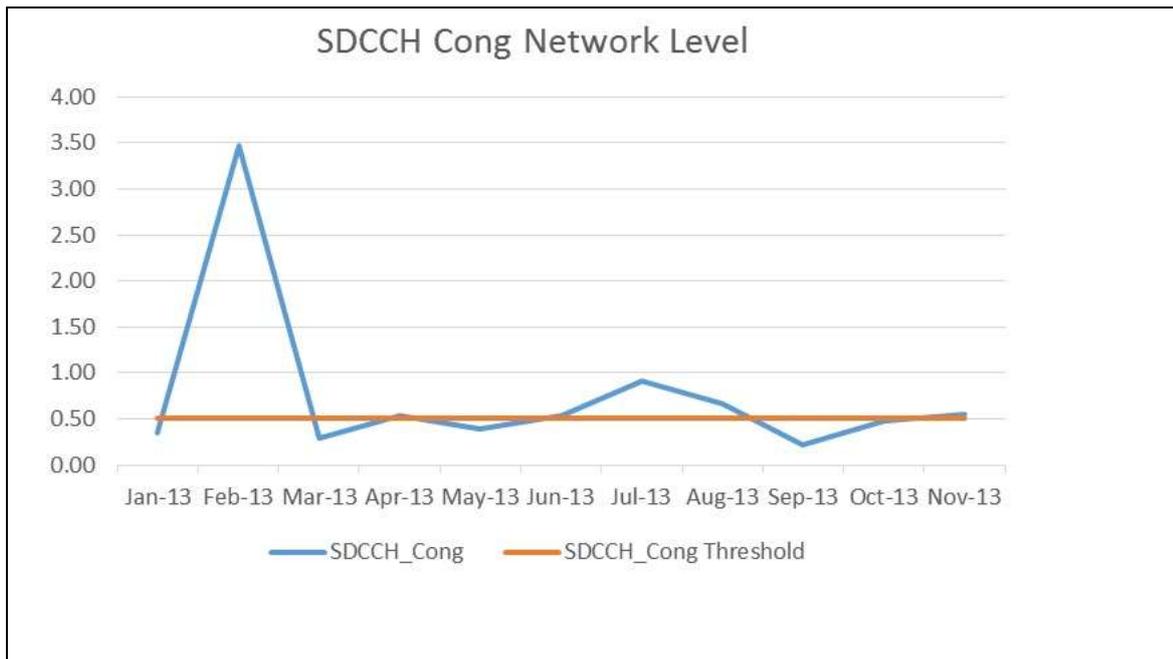


Figure 4.16 Showing CSSR at Network Level 2013, Airtel Zambia

#### 4.3.2 Passive Element-Power Outages

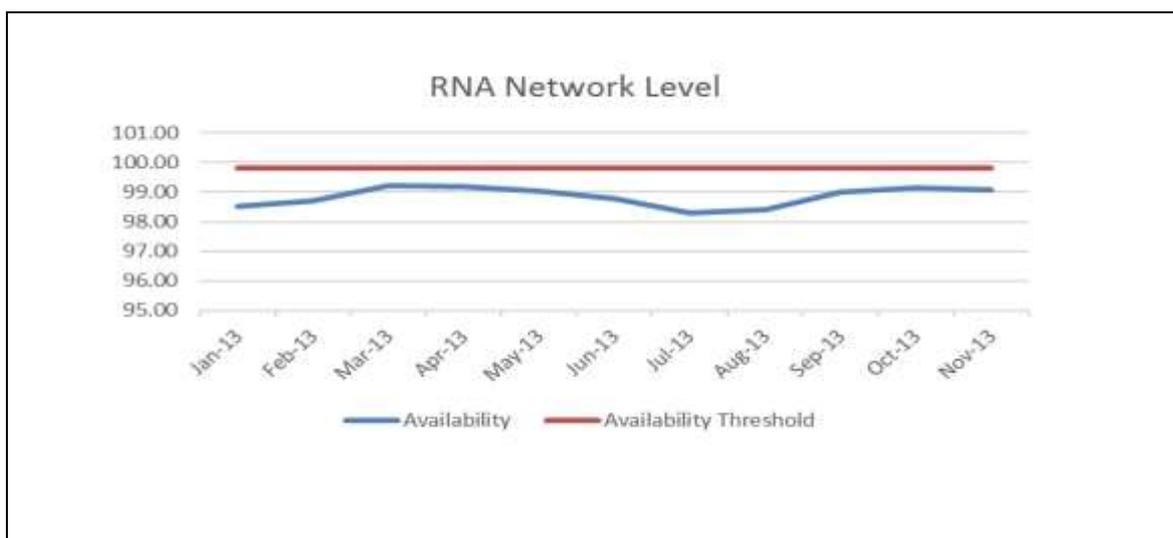
The was an increase in power outages from 50% in 2008 to 84% in 2013, the main reasons being that the number of sites had increased and secondly there was a new generator engine which was brought in to reduce the D.G failures experienced earlier of which in this case proved to be retrogressive. The generator is still the major contributor of now 95% of the outages in the network as can be seen from figure 4.20. The new engine of the generator did not have the expected improvement which was hoped for since this particular outage increase from 90% to 95%. Transmission on the other hand had greatly improved from 33% down to 16% as highlighted in figure 4.21



**Figure 4.17 Showing SDDCH Cong at Network Level 2013, Airtel Zambia**

### 4.3.3 Passive Elements-Transmission outages

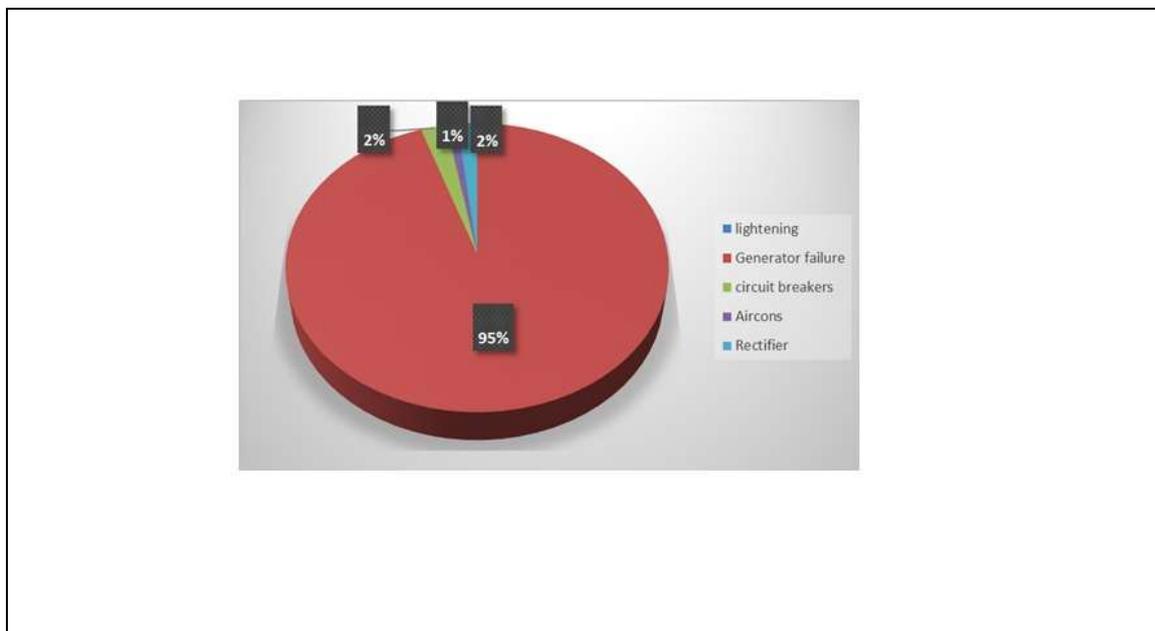
The major contributors where the radio transmission unit, again a different radio was used hoping that the greatly need improved would be given by this new radio but again that improvement was not achieved. There was great stability achieved with the MUX performances, this guaranteed less backbone outages since MUX nodes are mostly on the backhaul of the network. There were no outages on VAS and BSS radio outages was quite negligible in comparison to the network outage of 2008.



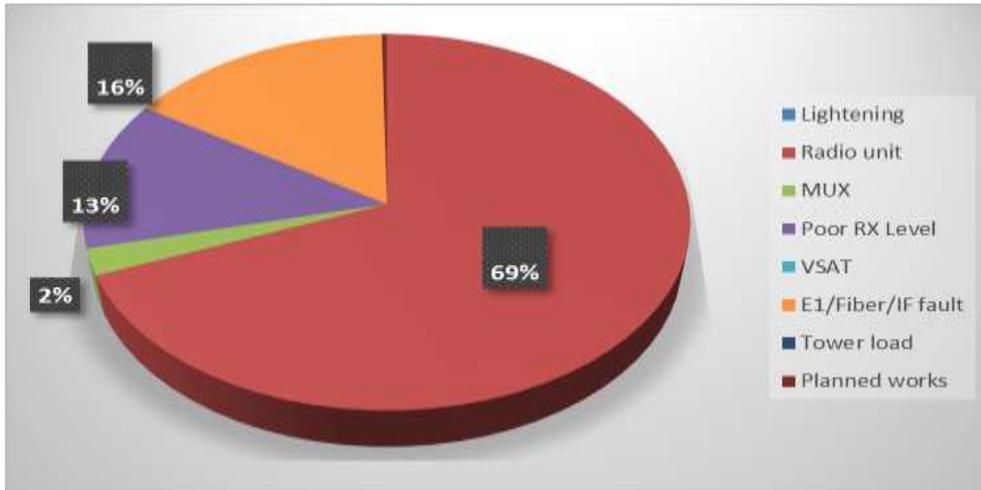
**Figure 4.18 Showing RNA at Network Level 2013, Airtel Zambia**

#### **4.4 Further a comparative analysis was done on the performance of the above KPIs Before and After Outsourcing.**

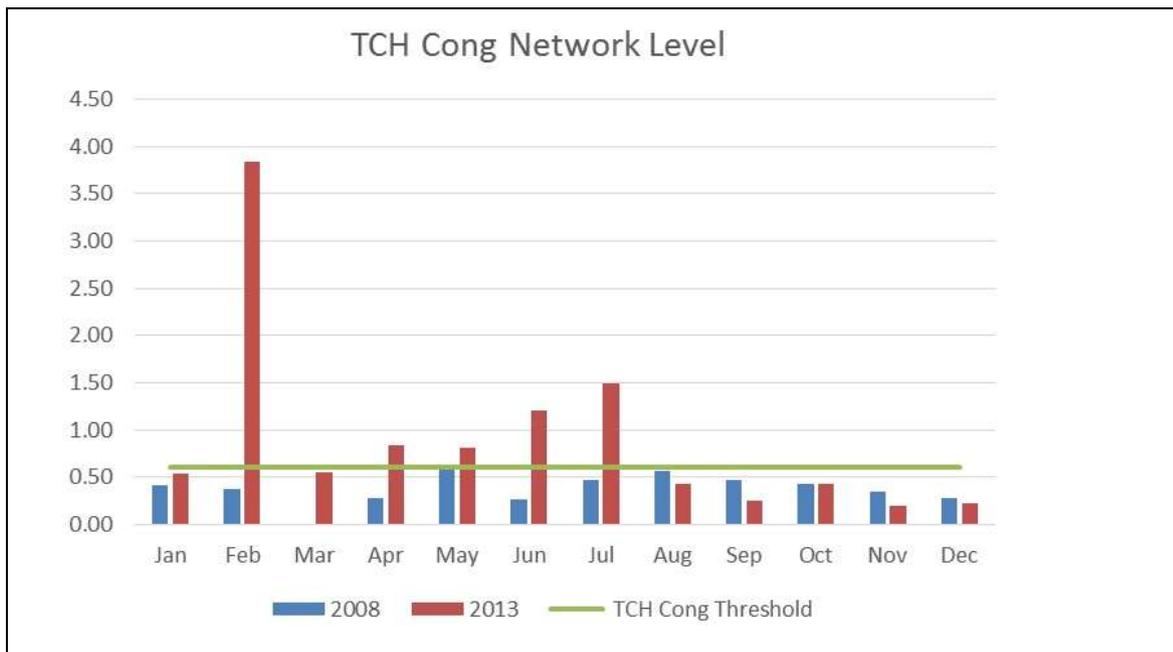
Comparatively, looking at accessibility and in particular TCH congestion, the performance of this KPI was much better before compared to after outsourcing as can be seen in figure 4.21. TCH Cong was high mainly due to the lack of Sddch resource as already mentioned above. This was due to the beginning of a new promotion from marketing which saw a high demand in radio resource. Although it was later properly dimensioned as can be seen in the following month of March, it meant that the subscribers in 2013 had a few months when they struggled to make calls since most were being denied access to the network compared to 2008. It also be noted that that the site count had increased in 2013 and therefore more subscribers hence the congestion levels a bit higher. For TCH drop the performance of post outsourcing was much better compared to the performances of pre outsourcing as shown in figure 4.22 despite the fact that there were more sites in 2013 hence more subscribers and the likely would of dropping a call much high than 2008. This means that the subscribers in 2013 where able to sustain calls without being abruptly terminated in comparison to 2008 in all the months of the year. This was a great improvement for this particular KPI. It should also be noted the TCH drops experienced on the network was well below the agreed threshold.



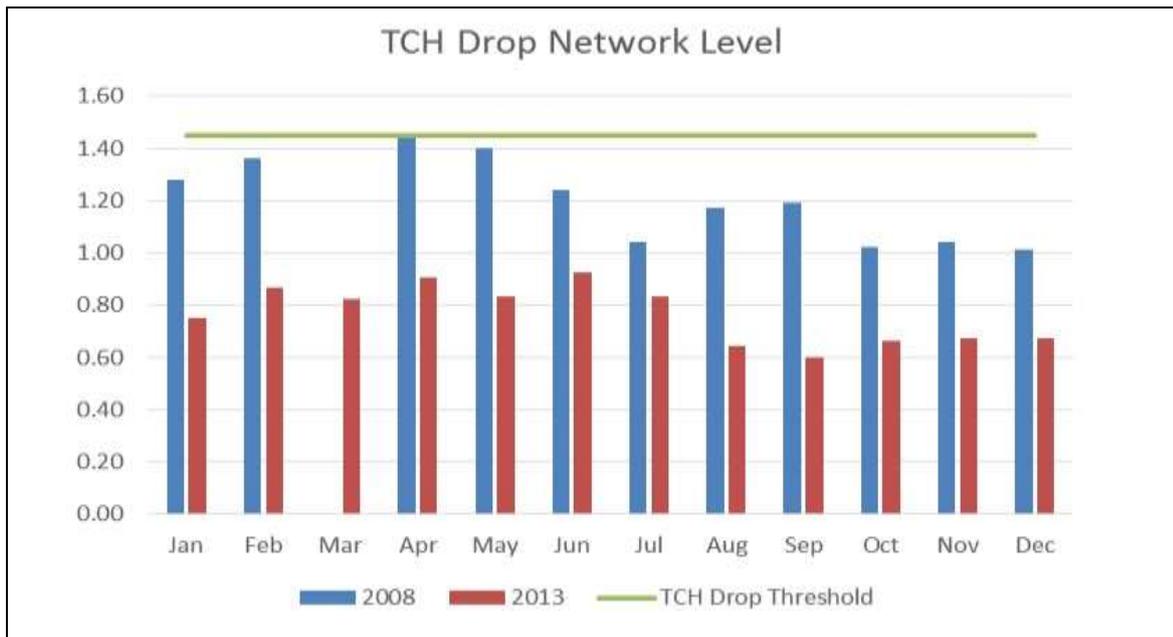
**Figure 4.19 Generator Failure major contributor of power outages 2009, Airtel Zambia**



**Figure 4 20 Showing major Transmission contributors of outages, Airtel Zambia**

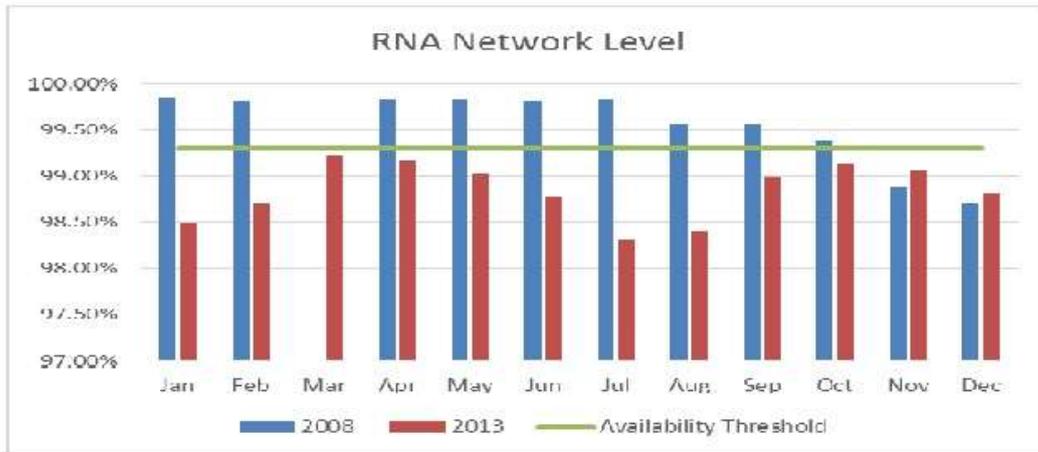


**Figure 4.20 Showing comparative performance of TCH Cong, Airtel Zambia**

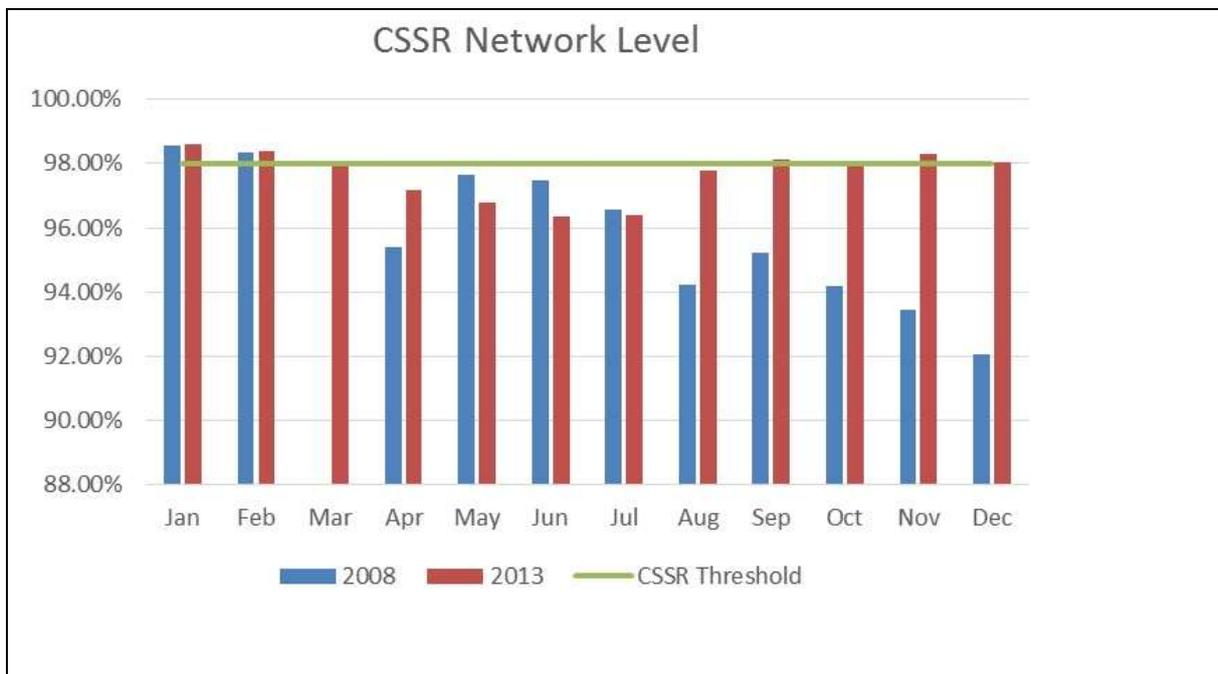


**Figure 4.21 Showing comparative performance of TCH Drop, Airtel Zambia**

Figure 4.23 show the comparative analysis of radio network availability. It can be seen that the pre outsourcing (2008) ere performances were much better compared to the post outsourcing period over the same period. This shows that the network was more accessible and available to subscribers in 2008 compared to 2013. In 2013 the sites count affected by the power problems already highlighted had indeed increased and hence the low access to the network since it was not ready available compared to 2008. According to figure 4.24, the performance of CSSR in 2013 were much better compared to the performances of 2008, this shows that more subscribers were able to make call in 2013 compared to 2008. Looking at this performance, 98% in the minimum acceptable performance of CSSR, it can been seen that in 2013 more calls were able to reach this threshold and able to complete calls compared to 2008. Figure 4.25 shows the months of February, July, and August and to a certain extent December of 2013, the resource channels were not readily available in order to completely set up calls, hence the poor performance as already stated in the previous sections.



**Figure 4.22 Showing comparative performance of RNA, Airtel Zambia**



**Figure 4.23 Showing comparative performance of CSSR, Airtel Zambia**

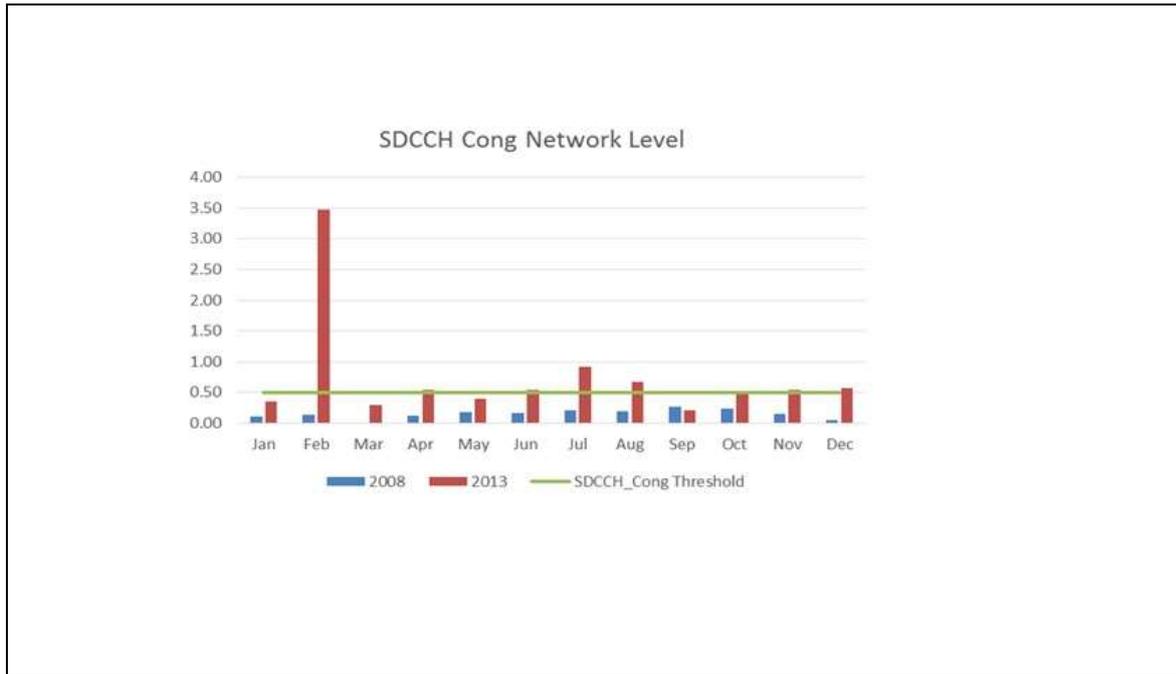


Figure 4.24 Showing comparative performance of CSSR, Airtel Zambia

#### 4.5 Summary of results show before and after performances

Table 4.5 Summary of results showing performances before and after

RESULTS OF FINDINGS BEFORE AND AFTER OUTSOURCING						
CATEGORY	KPI	BEFORE	THRESHOLD	AFTER	THRESHOLD	observation
<b>PASSIVE</b>						
	Power	84.00%		95.00%		
	Transmission	33.00%		16.00%		
	RNA	99.74%		98.50%		
<b>ACTIVE</b>						
	TCH drop	1.25%	below	0.70%	below	
	TCH cong	0.45%	below	1.33%	above	This was due to faulty card
	CSSR	98.25%	above	98.54%	above	
	SD cong	0.06%	below	2.00%	above	This was due to faulty card

The summary table above shows the performances of the active and passive elements before and after outsourcing. It is a summary of the description of results that has been discussed in this chapter.

## **CHAPTER 5: CONCLUSION AND RECOMMENDATION**

### **5.1 Introduction**

The last chapter brought out the various discussions of the results of the research. The performances of the active elements and their KPIs were discussed and explained. The performances of the various passive elements which contributed to the availability of the network were equally explained and particular results tabulated.

The overall aim of this research was to ascertain the impact of outsourcing on the quality of service in cellular mobile service network provider. The objectives set within the boundaries of mobile telecommunications and in the context of Outsourcing:

- iv. To understand the outsourcing model and how it differs with conventional model
- v. Analyse the performance of the major KPI for passive elements before and after outsourcing.
- vi. Analyse the performance of the major KPIs of the active elements before and after outsourcing.
- vii. Formulate recommendations on the overall performance of the Network.

This section will look back at these set objectives, summarize the findings and offer conclusions and recommendations based on the research findings. The preceding chapter, findings and discussions had a lot to show and assimilate, hence the need of this summary. Recommendation on the impact of outsourcing on the quality of the performance of the network and how to better improve the performance of the network will be made.

### **5.2 Conclusions**

The conclusions of the objectives under this research will now be discussed.

#### **5.2.1 The outsourcing model and how it differs from the conventional model**

It was observed that with the conventional model, operations are done by the staff of MNP and none of the infrastructure is shared. The MNP invests in acquisition of all the infrastructure and the revenue gains are solely for the MNP. The MNP has to maintain the network and therefore bears the operational and maintenance costs. Whereas in the outsourced model, the investment in infrastructure is a shared costs between the manufactures

or vendors of the equipment and the MNP and the revenue is shared over a period of time. It therefore does provide some relief to the MNP in the operational and maintenance costs and in the procurement of spares. This is an added advantage over the conventional model and hence one of the reasons that the outsourced model is being preferred to the conventional model as described and noticed under the drivers of outsourcing. It is therefore, in this sense, a good business decision that Airtel was outsourced.

### **5.2.2 Analysis of the major key Performance indicators of the Quality of Service of the Network before and after outsourcing.**

The particular KPIs of the active elements will now be summarized as shown by the results and findings.

#### **5.2.2.1 Retainability**

The KPI of Call drop was the main focus in retainability. It was observed that on a comparative basis, the performances were after outsourcing compared to before outsourcing. It should be also noted that the TCH drop was below the KPI threshold both pre and post outsourcing. The performances in both cases are within the acceptable limits and therefore outsourcing did not affect the performances of this KPI.

#### **5.2.2.2 Accessibility**

There are three KPI under focus in accessibility, call setup success rate (CSSR), stand-alone dedicated channel congestion (SDCCH) and traffic Channel Congestion (TCH CONG). Looking at the CSSR results comparatively speaking, the performances of after outsourcing were much better before outsourcing, meaning that most subscribers were able to setup a call more easily in after than before outsourcing. It should be noticed however, that in both cases, the subscribers were mostly either below or on the threshold of CSSR. On the other hand, there was more SD congestion after outsourcing than before outsourcing, meaning that the radio resources needed to set up a call were readily available comparatively before outsourcing than the post period of outsourcing. Again it should be noted that even though this was the case, the levels of congestion were below the expected or just about threshold of 0.5%. This is still acceptable and that is why there was serious degradation in the overall performances of CSSR. The performances of TCH cong show that it was better comparatively before than after outsourcing. It can therefore be concluded that with such a mixer of results, there is really no warrant to say that the quality of network was affected by

outsourcing. These results do show overly that it was within the thresholds and therefore there was negative impact on this KPIs after outsourcing.

### **5.2.3 Analysis of major KPI of the passive elements of the Network before and after outsourcing.**

The findings and results showed that the major contributors to most of the outages and network unavailability were from the passive elements, mainly power outages and transmission outages which has been grouped under passive elements for convenience. The major contributors on the power outages were the D.G. The project of D.G swap out which was initiated on the network as a result of end of life cycle of the D.G did not achieve the expected good performance. The poor performance of various parts of the D.G as highlighted in the findings largely contributed to the poor performance of the D.G. Before outsourcing the percentage of power outages was at 50% as compared to the percentage outages of 84% after outsourcing. The major contributor in this upswing in power outages was the generator failure, this invariably affected the RNA KPI of availability.

#### **5.2.3.1 Availability**

The KPI of availability is mostly connected to the power and transmission outages as already highlighted before and after outsourcing. The conclusion is that outsourcing did have an effect on the availability of the network. The results do show a striking degradation that assumes a negative trend in the overall performances of this KPI. The failures of the generators could have been due to theft of stator battery, fuel or starter motor. The switch over failure of the generator could also have been an issue. The performance of the transmission showed an improvement in before of 33% to 16% after outsourcing. It showed great improvement in the stability of the various transmission links particularly on the main hubs, the MUX which are mostly on the backbone.

What can conclude from this objective is that the unavailability of the network before and after outsourcing was mostly contributed by power outages. Comparatively speaking, there was an increase in outage minutes as noticed in chapter on findings and discussions from the pre to post outsourcing periods, which increased the unavailability hence the increase in revenue loss. This therefore shows that outsourcing could have done better, if the contract was to maintain and improve the performance of the network.

### **5.3 Recommendations**

The conclusion and lesson that was drawn from the second objective was that power planning is vital in the life cycle of passive elements. There is so much that can be done differently and included at various stages of a network growth if a full-fledged power planning section was to be included in various MNOs. Due to the challenges that fuel cell energy present and the lack of “appetite” for solar energy in most MNOs, the traditional way of power grid supply will still dominate the passive elements with the supply of D.G where grid supply is not available. Although the challenges and limitations of grid power were highlighted, the current trends still show that it’s still the preferred means of power supply during site roll out and in infrastructure sharing.

The recommendation from this conclusion is that Airtel Zambia needs to include a full-fledged Power planning section in order to improve the roll out of new passive network element nodes and guarantee some level of stability. Furthermore, the unavailability of the network before and after outsourcing was mostly contributed by power outages. Comparatively speaking, there was an increase in outage minutes as noticed in chapter on findings and discussions, which increased the unavailability hence the increase in revenue loss. The recommendation is therefore that, firstly in order to guarantee a more stable power supply, it is observed that better performing D.G and long lasting battery bank will need to be implemented on the network. This implementation will improve the availability of the network as a whole. Secondly, that a D.G swap out should be carried out, quality D.G from reputable experienced companies should be bought and replace all D.G that have reached end of life. Thirdly, since the battery bank have also reached end of life, there should be a complete swap out with new and longer lasting batteries brought into the network. The transmission design will need to be changed to a heterogeneous nature of the transmission network and improve stability and spare stock since only one vendor equipment will be installed in the network. Generally for key performance indicators, the performances pre and post outsourcing were not adversely affected by outsourcing. The results don’t show a striking degradation that assume a negative trend in the overall performances of these indicators. The fact that most of the KPIs were within the same range of performances either just above or just below the desired threshold does not show a magnified differences in performances. The recommendation is that since these KPIs are all within the acceptable standards of performances, The planning and optimization section should Optimize the access

to network by checking CSSR, SD Cong using parameters such as Rxlevmin, adaptive SD configuration, reversion of old channel and TCH Assignment in order to improve the Accessibility KPI, also a review of the current set parameters that deal with retainability should be checked in order to provide little or acceptable congestion. Availability KPI is closely connected to the performances of the passive elements, nevertheless the security in the sites should be improved in order to reduce thefts of fuel starter batterers` and other D.G accessories that might improve the stability of the sites.

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