CHAPTER ONE
INTRODUCTION

1.1 Background of Study

There has been rapid growth in the penetration of mobile telephony services in the last few years. But the growth has neither been exponential in the quality of service offered nor has it provided an open platform for fair competition for smaller telecommunication operators. Subscribers are not satisfied with the operators' services and their frequent derailment from meeting their service level agreements has become more challenging. Before the advent of MNP, subscribers are required to give up their mobile numbers on changing service providers. This has not only led to untold inconveniences to subscribers but also the service providers have capitalized on this lapse to either exploit the subscribers or impose unreasonable charges to subscribers. In addition, when mobile numbers have been used in multiple important correspondences, it becomes nearly impossible to give up the number for fear of missing important calls from old contacts. The picture has now changed dramatically with the introduction of mobile number portability (MNP) technology.

Mobile Number Portability gives the subscribers the privilege to easily change from networks that are not serving them well and also return when the network improves, ensuring greater flexibility and mobility across networks. The essence of this number portability is to further stiffen competition among network providers and at the same time ensure better quality of service. To adopt this new concept and remain competitive in the today's telecommunication market however, the operators require more strategic investments in new technologies, network upgrades, new business processes, and government is meant to enact laws and regulations including driving cost models(Odii and Onuoha, 2012).

In MNP terminology, the operator who loses a customer is known as the Donor Operator while the one receiving a ported number is referred to as the Recipient Operator. As an illustration, before the introduction of MNP in Nigeria, all numbers prefixed with 0805 were routed to Globacom, 0803 to MTN and 0802 to Airtel, 0809 to Etisalat. With the implementation of MNP, 0803 numbers for example, can now be ported to any network.

The history of MNP started in 1990s with Singapore implementing a limited version of this functionality in 1997, Hongkong implemented in 1999, Spain in 2000, and Australia in 2001 the

list go on and on (Maicas, Polo and Sese 2009).Though several developed countries, such as Canada, New Zealand, and Israel, did not implement MNP until 2007, but by September 2008, a total 48 countries around the world had launched MNP. The number of countries implementing MNP continued to increase rapidly that by 2011 there were 63 countries that had implemented MNP, (Muchiri, 2011). This wind of the MNP, which has been blowing in Europe and America over a decade ago has even cut across the African continent and Nigeria in order not to be left behind the wheel joined in April 22 2013 to become the 64th country of the world to embrace the MNP scheme,(Adekunle ,2013).

As the list of countries that have adopted number portability continues to grow, new technologies needed to support number portability also continue to evolve. More importantly, the increase in number portability awareness among subscribers has resulted in an increased expectation by subscribers that taking their numbers with them when changing service providers should be seamless and trouble free, (Syniverse 2006).

Atiya (2010) identified various types of number portability. These include: Service provider portability where a subscriber retains his/her number while moving to a similar service offered by a different provider; Service portability which allows a subscriber to move his/her service number between different service types; and lastly the location portability, enables subscribers to retain their numbers across geographical regions or national boundaries.

For purposes of this research, the focus will be on the service provider portability which can be fixed or mobile, and the mobile is the one currently being implemented in Nigeria.

According to Bernadi and Nuitjen (2000), MNP involves three factors: technical, operational and economical.

Technically, MNP requires additional mechanisms which enable numbers to be routed accordingly. Operationally, the process includes processes taking place between operators as well as subscribers. And economically, MNP is said to benefit consumers as well as the industry by increasing competition. MNP is not relatively a new phenomenon; it only requires that mobile telephone subscribers retain their telephone numbers when switching from one service provider of mobile telecommunications services to another. That is to say, whenever a subscriber is not satisfied with the services of any service provider, the subscriber can change the service provider while retaining the existing phone number (Atiya, 2010). This infuses competition among service providers and forces them to improve their service standards. However, subscribers are known to

be predominantly reluctant to switch their network operator if this means that they would have to change their telephone numbers. Changing one's telephone numbers can be a major inconvenience and a potential barrier preventing the general public from taking advantage of the options available in a developed competitive telecommunications market which MNP offers.

History and trend of telecommunication in Nigeria can be traced back to 1960.When Nigeria gained her independence in 1960, there were only 18,724 functional telephone lines out of an estimated population of 45 million, which was a teledensity ratio of 0.04 telephones per 100 people (Shoewu et al., 2008). And for thirty-odd years of military rule, there was very little or no investment in the Nigerian telecommunication industry.

Then, August 2001 was like a dawn of a new era in the history of Nigeria telecommunication when the first Global System for Mobile Communications (GSM) call was made under a democratic government. This era of GSM technology completely changed the face of doing business in Nigeria. However, four years after the first GSM call was made, the mobile communication industry in Nigeria had changed a lot. There are presently five GSM network and thirteen CDMA (Code Division Multi Access) based network operators in Nigeria, (Roger, 2010). The GSM operators include Airtel, MTN, MTEL, Globacom, and Etisalat while CDMA network operators include Multilinks, Starcomms, O'net, Visafone amongst others. Competition for subscribers became fierce; operators have resorted to "price wars" to win subscribers. Subscribers, on the other hand, have more choices than before as to which GSM operator to patronize. Moreover, as the competition among Mobile Service Providers continues to increase and the desire or need by the subscribers to change to other mobile networks with better services heightens each day, most subscribers still place much value on retaining their telephone numbers.

This reluctance to change to new mobile networks is due to the envisaged administrative, marketing, and goodwill costs. Thus subscribers have been forced to buy multiple handsets or subscribe to two or more service providers at same time leading to the success of "dual-SIM" handsets in Nigeria (Tiamiyu and Mejabi, 2012). This has made communication very expensive to an ordinary Nigerian subscriber. The above scenario underscored the vitality and desirability of Mobile Number Portability (MNP) in Nigeria. Which will among other things reduce the unwanted investments made by subscribers in the search for better service options and most importantly improve service provider competition and force them to improve quality of service rather than investing on deceptive promos. And to guarantee the provision of this much needed quality of

service these operators must be closely monitored or checkmated by both the government and subscribers. Now the MNP became the only way out to tame these mobile operators/service providers. MNP is the much awaited investment and a positive gateway to development in the Nigeria telecommunication industry.

Based on this realization, the proposal to implement Mobile Number Portability was first raised by the Vice Chairman of the Nigerian Communications Commissions (NCC) Ernest Ndukwe at a public lecture held at the NCC secretariat (http// www.ncc.gov.ng). During the lecture, he made the mandate for the implementation of MNP known to the various telecommunication operators in Nigeria and December 31st 2007 was first fixed for the implementation.

The initial consultation paper containing the framework for MNP implementation was released by the NCC in February 2009 and it was targeted for introduction in Nigeria in the last quarter of 2009, (Tiamiyu and Mejabi, 2012).

Following the approval of the MNP framework by the government, the Commission began plans to develop the regulatory, legal and technical structure for the implementation of MNP in Nigeria as well as the process of selecting a suitable vendor to run the Number Portability Clearing House with the publication of a "Request for Quotation (RFQ)" document for the provision of services with regards to the "Administration of Number Portability Clearing House" in Nigeria. The framework spelt out the business rules for managing the processes for porting mobile number(s) between mobile service providers. This was a revolutionary step in the development of telecommunication services in Nigeria,(http// www.ncc.gov.ng).

Hence, the Nigerian Communication Commission (NCC) finally launched MNP in Nigeria in 22 April 2013 making Nigeria the 64th country of the world to embrace the scheme. The much awaited scheme at last came to be four years after the initial target, (Adekunle, 2013).

The MNP implementation in Nigeria is in furtherance to the NCC's objectives of protecting consumer interest, through the development, monitoring and enforcement of compliance with regulations by telecom service providers in order to ensure better quality services, fair pricing and competition. And it is also in line with the provisions of section 128 of the Nigerian Communication Act (NCA) 2003 which vests the NCC with the exclusive right to regulate numbers and number portability in Nigeria. In adopting the MNP, Nigeria has joined the league with countries like the United States, the Netherlands, Singapore, Kenya and Ghana as a number porting nation. With this Nigeria has thus become the 64th country to implement mobile number

porting after South Africa pioneered other African nations in 2006, followed by Kenya and Ghana in April and July 2011 respectively, (Adekunle 2013).

So far, MNP is one of the most widely supported programmes embarked upon by both the NCC and GSM service providers in recent times. The scheme is expected to deepen competition among telecom service providers thus improving the quality of service. It challenges them to improve affordable services and compete for customer retention. Indeed MNP challenges GSM companies to sharpen their survival instincts. For the subscribers, MNP has at last conferred on them the status reflected in the popular expression: "the customer is king". This provides customers an open platform to shop around for better services.

The MNP is being implemented in Nigeria in phases beginning with GSM mobile networks. Thus, as at the time of this research, the networks involved in the present phase of implementation are Airtel, Etisalat, Glo Mobile and MTN.

However, contrary to expectations, GSM service providers have latched on to the MNP scheme just to broaden the scope of their promos and advertisements rather than improve services as earlier envisaged, (Adekunle, 2013). From observations thus far, little has changed in terms of network coverage and the volume of dropped calls and intermittent service seizures, and other quality of service concerns. Thus the expectations raised by the MNP scheme are not being fulfilled and Nigerians again are looking to the NCC to rein on the GSM operators who have merely capitalized on the scheme to indulge in a wild medley of promos without improving their services. Indeed, MNP seems not to be recording expected success in Nigeria with only a handful of subscribers that switched networks within two months of its launch (Adekunle, 2013). Subscribers' lamentations on the traffic lull in the process of porting seem to be hindering the scheme. Hence, it is pertinent to state that up till date the launch of MNP in Nigeria seemed not to have recorded expected success. The scheme is meant to compel the mobile network operators to be more accountable to subscribers and treat them as kings. It is expected to enhance billing integrity, since operators would not want to lose customers who may be willing to shift to another network if they feel short-changed by the network's billing system. In spite of these envisaged benefits of MNP, most subscribers in Nigeria have not embraced the scheme. This work therefore tries to explore some of the factors why MNP is yet to succeed in Nigeria, the impact of MNP since its inception and also develop a model that can be used to check the viability of MNP as it stands now while at same time peep into the future of MNP in Nigeria.

1.2 Statement of the Problem

Despite the fact that MNP has been introduced in the Nigerian telecommunication industry, it has neither produced the desired effect nor provided the needed impact on the sector. Subscribers are still unwilling or reluctant to embrace the MNP scheme. And as a result, subscribers are still facing switching costs associated with informing people about new number change, printing new business cards, missing valuable calls from people that do not have the new numbers, etc. Some subscribers for fear of losing contacts are forced to stay with a particular service provider irrespective of the cost, or poor service. Hence the major problems to be addressed in this research are to find out why Nigerians have not fully embraced the deployed Mobile Number portability, identify the factors responsible for the failure of MNP in Nigeria, and modify the current MNP framework in Nigeria. The research also assesses the impact of MNP since its inception on quality of service, call tariffs among other things and finally suggest what can be done to enhance MNP adoption in Nigeria.

1.3 Objectives of the Study

The aim of this research is to develop a model that predicts the future of MNP in Nigeria, and also to develop a hybrid call routing framework for the improvement of mobile number portability in Nigeria. The system will be able to achieve the following functionalities or objectives:

i) Explore and analyze the factors inhibiting the adoption of MNP in Nigeria.

ii) Develop an MNP mathematical predictive model.

iii) Use the model to monitor the MNP growth trajectory in Nigeria under three scenarios.

iv) Evaluate the performance of the model vis-a-vis the result of the analysis.

v) Compare the existing call routing frameworks and develop a hybrid framework for routing of calls to ported numbers.

1.4 Significance of the Study

The importance and the inevitability of this research are very obvious. There is a growing disillusionment by Nigerians on MNP because of the prevailing poor quality of service, network failure, increment in call tariffs etc and the inability of MNP to help resolve these issues which is affecting business transactions that are dependent on communication. And as such many

subscribers and operators have kicked against MNP in different ways. For instance some subscribers believe that instead of waiting for 48hrs to port their numbers, they would rather purchase a new SIM and start using almost immediately. They have forgotten that a new SIM implies a new identity and cost of informing friends and business associates about a new number change will at the end of the day be more than the cost of porting a number. Operators on the other hand have claimed that Mobile Number Portability is unnecessary and that it is an unwarranted expense, using assertions that the sector is already highly competitive and have suggested alternatives such as personal numbering and Universal Personal Telephony (UPT). But, these are not substitutes to MNP, but are rather expensive, value-added services. The sector may be competitive as they claim but with Mobile Number Portability in place, the remaining barriers to competition between operators would be removed thus paving way for a more dynamic and fully competitive market. Mobile Number Portability has a lot of advantages to offer. If not, why would both the developed and developing economies of the world embrace it? Embracing the MNP will position Nigeria to catch up with other developing economies like Ghana already investing in the scheme. And since other countries of the world are trying to keep pace with ever growing technological innovations, Nigeria should not be left behind.

MNP implementation in Nigeria will serve as a telecommunication gateway project for ICT in Nigeria by enabling the Ministry of Communication Technology to facilitate the installation of a consolidated national gateway monitoring system to help the sector accelerate the development of mobile telephony in Nigeria. The MNP infrastructure will as matter of necessity create the enabling environment for a competitive terrain that will enhance the delivery of affordable ICT services such as provision of universal access to telephony and services to underserved and un-served areas of the country, thereby bridging the digital divide between the urban and rural areas. The MNP framework will equally promote transparency in the communication industry and enforce the verification of the number of international telephones calls to Nigeria for the purpose of enhancing revenue generation for national development.

But implementing MNP is one thing, its workability is another. Though it has been adopted skeletally by NCC, however, it is not being embraced as expected. This is the area the predictive model of the research is very necessary. This model has clearly shown that MNP acceptability and workability are dependent on government's ability to revisit its policies or restrictions on MNP. It has been substantiated empirically in this research with the help of a field data that if government

allows the existing restrictions on current MNP to remain, subscribers may not be motivated to embrace MNP scheme. And also that, if government reduces or eliminates most of the restrictions, MNP may become feasible and viable. It equally shows that if government should further stiffen the current restrictions, MNP will totally fail in the not far distant future.

Therefore, having seen the numerous benefits of Mobile Number Portability and possible ways for its successful adoption in Nigeria and as Nigerian subscribers continue to be aware of number portability in other countries, a time will come when it will be a matter of urgency for Nigeria to fully adopt MNP for her to be able to meet up with the communication demands from other countries. It is therefore necessary to fine tune and predict the future of MNP to see if its improvement can lead to the birth of a working telephony setup and that can improve communication in Nigeria.

1.5 Scope of this Study

This research covers the development of a predictive model for evaluating the existing MNP framework in Nigeria and the development of an optimized hybrid call routing model for enhancing the Mobile number portability in Nigeria.

The focus of this dissertation includes:

a) Assess the impact of MNP on the economy since its adoption using field data collected from all the 27 local government areas in Imo State.
b) Explore why Nigerians have not fully embraced the deployed Mobile Number portability,
c) Identify the factors responsible for the non-expansion of MNP in Nigeria
d) Develop software that predicts what happens if the inhibiting factors (bottlenecks) are retained, minimized, or if the bottlenecks are stiffened.
e) Establish practical recommendations on the improvement of MNP

However, we didn't want to reinvent the wheel and thus considered it unnecessary to embark on the development of new MNP software for Nigeria.

1.6 Limitations of the Study

The researchers encountered a number of constraints in the course of this research. The major limitations include but not limited to the following:

(a) The use of only Imo state and a total of five hundred questionnaires for data collection were not sufficient enough to isolate the opinion of the larger society on MNP.

(b) Extracting information from the public either orally or by means of questionnaire proved a strenuous exercise. People were very uncooperative and reluctant to release information.

(c) The respondents returned only 356 questionnaires out of the 500 questionnaires that were distributed. Some of the questionnaires were poorly or improperly completed. Some respondents insisted on being motivated before they could answer the question.

(d) The All Call Query model already adopted by the Nigerian communications commission was a serious limitation to the development of the hybrid model. This is because the researchers did not intend to discard what was already in place but rather to improve on it.

1.7 Organization of the Dissertation

This dissertation is presented in seven chapters. The first chapter presented the general introduction to the concept of Number portability, a short historical perspective drawn from experiences across the world, the statement of the problem or what motivated the research, objectives of the study, significance, limitations or problems encountered in the course of carrying out this research, and the scope of the research were all outlined.

The second chapter reviewed hosts of literatures which have some relevance to the topic under study. The history and the motivation for the concept as well as the various approaches to Number portability scheme were reviewed. In this chapter also the researcher reviewed the works of other researchers in this area extracting their opinions, contributions, achievements, suggestions, failures, and where they stopped, and their recommendations for future work that warranted the necessity for this work. This chapter therefore has four sections namely: (a) Conceptual framework which presented the preliminary definitions and assumptions. (b)Theoretical framework which presented the body of knowledge in the Telecommunication industry. (c) Empirical research which sought to identify some work done locally on MNP. (d)The summary of literatures summarized the literature review.

Chapter three was mainly devoted for systems analysis and the methodology adopted in the research. In this chapter, an analysis of the present or existing system of porting visa vis its

weaknesses /problems were highlighted. The various MNP call routing frameworks were equally analyzed in this chapter. The researcher went further to ascertain from users the factors militating against the success of MNP adoption in Nigeria. The impact of MNP since its inception in Nigeria was also assessed. All these were made possible through the use of questionnaires that were administered to a total of five hundred respondents in all the Local Governments Areas of Imo State Nigeria out which 356 returned their questionnaires. The researchers at this juncture postulated two null hypotheses: Ho_1 which states that the failure of MNP has no relationship with the isolated factors; Ho_2 which states that MNP has no impact on quality of service, tariff reduction, employment opportunity, fierce competition etc. The Data collated were analyzed using the SPSS multiple regression and ANOVA and the results were equally presented and interpreted in this chapter. And the data analysis shows that MNP has a very close relationship with factors identified as Inhibiting factors affecting the success of MNP in Nigeria and based on this the first null hypothesis was rejected. Secondly, result from analysis also showed that MNP has failed to produce the desired impact on the quality of service, fierce competition, reduction in call tariff etc. as envisaged by the NCC and of course the second null hypothesis was accepted.

Then chapter four is where the researchers carried out the design of the predictor model and the hybrid framework. It is a schematic view of how the software will look like. It covered the objective of the new design, database structure, development tool, system flowchart, and the Input/ Output specifications and algorithm for the implementation of the hybrid model.

Chapter five is all about testing and evaluation. Here extensive testing of the software was carried out using raw data to ascertain its functionality. Also the performance of the model previously defined in this dissertation was evaluated.

Then in chapter six, the new system's documentation and implementation were presented. Program development was discussed in details, the justification for the hardware and software platforms were discussed as well as program testing and maintenance considerations.

Finally in chapter seven the researchers summarized the work, drew some conclusions, made also some recommendations and suggested other areas for future work.

1.8 Definition of Terms

Donor Network:	The network to which a subscriber belonged to before porting
Recipient Network:	The network to which a subscriber ported to.
Originating Network:	A transit network that transfers calls from donor network to a recipient network.
Home Subscriber:	A subscriber belonging to the home number series.
Ported-in Subscriber	A subscriber that has been ported into a network from another network.
Ported out Subscriber:	A subscriber that has been ported out of a network and now is with another network.
NPDB:	A subscriber that has been ported out of a network
Routing Number (RN).	Routing number or Location Routing Number is unique number stored in the number portability database that is used to route the call to the recipient operator.
CH/CNPDB:	Clearing House or Centralized Number Portability Database
Operator Gateway:	The Operator Gateway connects and synchronizes the Clearing house NPDB database to the local NPDB database.
PSTN:	Public Switched Telephone Network

Abbreviations

ACQ	All call Query
CLI	Calling Line Identity
DTMF	Dual Tone Modular Frequency
GUI	Graphical User Interface
INAP	Intelligent Network Application Part
ISDN	Integrated Services Digital Network
IVR	Interactive Voice Response
IP	Intelligent Peripheral
NP	Number Portability
O&M	Operation & Maintenance
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
QoR	Query on Release
SCP	Service Control Point
SMP	Service Management Point
CDMA	Code Division Multi Access
CCBS	Call Completion to Busy Subscriber
CCNR	Call Completion in case of No Response
DN	Directory Number
GMSC	Gateway Mobile Switching Centre
GSM	Global System for Mobile communication
HLR	Home Location Register

IN	Intelligent Network
ISDN	Integrated Services Digital Network
MAP	Mobile Application Part
MNP	Mobile Number Portability
MSISDN	Mobile Station ISDN Number
MSRN	Mobile Subscriber Roaming Number
MT-SMS	Mobile-Terminated SMS
NP	Number Portability
NPA	Numbering Plan Administrator
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
SCCP	Signalling Connection Control Part
SPSS	Statistical package for social science

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Literature review is an attempt to read, identify, locate, and evaluate previous studies, observations, opinions, comments, suggestions and recommendations on the topic under study. It is intended to provide the researcher with a good up to date knowledge of the research topic. This chapter therefore reviews previous work done by other researchers to understand their challenges, propositions, achievements and potential future research areas.

2.2 Overview of Mobile Number Portability

Mobile Number Portability (MNP) can be defined as the ability of subscribers to retain their phone numbers when changing from one mobile service provider to another (Shin and Kim, 2007). It allows customers who wish to switch mobile operator to keep their mobile numbers, avoiding the costs of switching to new numbers (Khan, 2012). MNP entails a lot of processes such as porting processes, code of conduct between Donor Operator and Recipient Operator, technology used for porting, competition, and customer standards to determine the success or failure of MNP depending on how they are implemented by mobile operators.

The history of MNP started in 1990s with Singapore implementing a limited version of this functionality in 1997, Hongkong implemented in 1999, Spain in 2000, and Australia in 2001 the list go on and on(Maicas et al., 2009). Hence number portability is not a new concept and according to NCC, Nigeria is the 64th country in the world to have implemented it, South Africa and Egypt included, (Adimorah, 2013).

The main objective according to the Nigerian Communications Commission (NCC) for implementing the service is to increase the level of competition in the mobile telecommunication market and enhance consumer choice. Shin and Kim (2007) seem to agree that MNP will result to mobile service providers actively competing and providing innovative as well as improved customer service, in order to retain and expand their subscriber base. Sutherland (2007) opined that MNP although initially ignored or overlooked in creation of the telecommunication markets, is now becoming a feature that regulatory commissions or bodies should consider necessary in order to reduce switching costs; facilitate subscriber choice; and ensure effective competition in the market. In Nigeria, MNP eventually took off on April 2013 after Subscriber Identification Module (SIM) card registration which ended in September 2011. It is a common phenomenon in Nigeria to dial a number and get error messages such as 'Network busy', 'Network error', 'Your call cannot be completed at the moment', 'the number you are calling is incorrect, among many other disturbing and frustrating error messages from the operators. Many resort to carrying multiple phones to compensate for unstable interconnectivity of the operators' networks. Besides, the issue of unfriendly tariff regime has surfaced as part of the need for the revolution. It is believed that with mobile number portability, competition will drive tariffs lower than its current position. Prior to the introduction of the service, subscribers have had to use multiple Subscriber Identity Module (SIM) cards or buy two mobile handsets, thus incurring additional unnecessary costs and

inconvenience,(NCC,2012). This has inhibited subscribers from taking advantage of the growing competition in the industry. Despite the competition in the Nigeria telecommunication industry, the lock-in effects of subscribers have helped the incumbents to retain market dominance, as identified by Shin and Kim (2007). It is from this back drop that the NCC decided to implement MNP. Availability of MNP is expected to benefit consumers as competitions between the players (service providers) intensify. Some of the specific benefits that are likely to go to subscribers include: lower price, greater choice, higher quality, and greater range of services.

Mobile number portability is simply keeping mobile phone number when moving from the existing service provider to a new service provider (Bluehler et al, 2003). It means using the services and features offered by the new service provider while still retaining the old number. The issue of 0805 for Globacom, 0803 for MTN, 0809 for Etisalat and 0802 for Airtel will no longer arise. For example, if MNP is fully implemented it will be possible to move from MTN to Airtel or Glo to Etisalat or Visafone, while keeping the same phone number, provided there are no contractual obligations. Mobile number portability is not a service feature or a product; it is the removal of a barrier to choosing the provider or service that suits an individual mobile phone user. In this scenario, a mobile phone user needs only to change the existing service provider or Network provider and not the mobile number; thereby retaining the previous contacts.

2.3 Benefits of Mobile Number Portability

The primary goal of MNP is to remove the network provider's ability to exercise market power over captive subscribers. According to Kessing (2004), prior to adopting MNP, wireless service providers had been "able to restrict competition and avoid losing some consumers because of the high cost of switching networks". MNP reduces switching costs, and thereby makes wireless subscribers less captive to incumbent service providers. One of the advantages of the introduction of mobile telephony is the ease of access to communication services for both the rich and the poor, Odii and Nwokorie (2013).According to the European Commission; MNP is a key facilitator of consumer choice and effective competition. Number Portability offers immense benefits to subscribers, allowing them to easily change service providers without having to notify their friends and colleagues of a number change. With number portability, a subscriber who is unhappy with a

mobile services provider can switch to a provider of choice while retaining his existing mobile number. In short, what this means is that if a user moves to another mobile network, the new network operator would allow the individual to formally use his/her SIM card without modification to its original telephone number (including original network code). The user's number could then said to have been "ported", in MNP terminology.

In addition, Mobile number portability could reduce the complaints of poor quality of service on the network of certain operators, as subscribers would have the opportunity to change operators at will and retaining only the number which could also serve in certain quarters as users identification number. Besides quality assurance, MNP also has the tendency of engendering tariff reduction as competition gets stiffer and help in reducing crime, since it may be difficult for a single user to own multiple mobile number as it is currently applicable Another benefit to mobile phone users is the fact that even customers who do not choose to port their numbers to a new network would benefit from the new tariffs, promotions features, and quality of service improvements that are likely to roll out under the MNP environment.

Moreover, with number portability, subscribers can save money by having the best plan they like. Whereas some people hardly leave the city they live in for more features, others might travel a lot, especially to remote areas and need better signal reception. Mobile Number Portability allows both types of users to have the same number without having the additional headache. For the mobile subscribers, porting number means no more endurance for poor quality of service and a tariff regime that is not very pocket friendly for the majority of consumers. It is a form of empowerment for the consumers to demand their rights from the operators and they express this by switching to where they would be served right. And for once, many Nigerian subscribers would be eased off the burden of carrying many phones around, although many are used to it already. Number portability avails subscribers opportunity to switch to the most reliable network at any time without losing their number Again, with number portability, users of mobile CDMA can switch to GSM network using the same number and at the same time GSM user can switch to CDMA if they so desire while still using their mobile number. Indeed, it is a win-win situation for the subscribers under the new regime as all operators work assiduously to ensure they are satisfied. Number portability is essential to maximize the benefits of a competitive telecommunications market. Hence the numerous benefits of number portability can be summarized thus:

a) **Subscriber Benefits:** Number portability clearly benefits the subscribers. At the individual subscriber level, the biggest impact to changing phone numbers is not to the subscriber, but to those individuals in the subscriber's circle of friends, family and acquaintances. Updating written address books, changing programmed contacts lists, remembering the new number, are all unnecessary burdens. For a business the scope of changes forced by a change in phone number is even more considerable: business cards, stationary, print advertising, Web sites, signage, the sides of delivery vehicles, and invoices. All the changes that affect a business contribute to the reason why business men, in general, would not change service providers if it means also changing phone numbers.

b) **Market Benefits:** With the advent of Number Portability comes a more competitive market place. Without a doubt, the mobile industry is already a highly competitive industry. However, by lifting of the last remaining barrier to what some would be considered a completely free market, operators become even more focused on subscribers. Rather than continuing price wars, in countries where MNP has been implemented, operators tend to start consumer loyalty programs, improve customer service, reduce hold times, increase outbound calling programs, focus on renewal incentives, work to improve network coverage, roll-out additional differentiated services such as Wi-Fi agreements, push-to-talk service, 3G, and other customer-pleasing new functionality.

c) **Regulatory Benefits:** The infrastructure developed for Number Portability has been used to solve other problems in some countries. Where directory number resources (i.e. number ranges) were being exhausted, the infrastructure to make Number Portability possible was also used to allow numbering plan administrators to assign numbers in a more efficient manner (to assign a block of 1000 numbers to an operator rather than a block of 10,000 numbers). In another example, in countries where the mandate for NP also included fixed-to-mobile as well as mobile-to-fixed porting, the regulatory agency could encourage greater competition to incumbent fixed operators. With fixed-to-mobile portability mandated, mobile operators become a competitor to fixed service, since the subscriber can change from fixed to mobile easily, and of course, keep the same directory phone number.

d) **Operator Benefits**: On the surface, it would seem that Number Portability is a financial and implementation burden to operators; and with the increased competition comes lower prices and hence lower margins. And certainly, some operators have argued that the

implementation of number portability is cost prohibitive and would be bad for consumers since the cost of implementing NP would have to be paid for by subscribers, and could ultimately put the operator out of business. However, some operators have used the mandate for NP as an opportunity to gain market share and target high ARPU subscribers as well as multi-line business customers. As with any market where a barrier to competition is lifted, some of the free market agents will gain and some will lose. In the U.S., operators who took a proactive stance in preparing for NP were able to increase net additions in the face of increased competition. This was through a combination of customer service improvements, network improvements, targeted advertising, focus on fixed- to-mobile porting (also known as displacement), and to a lesser degree, more competitive rate plans.

2.4 Types of Number Portability

There are basically three (3) types of number portability currently being implemented around the world as identified by Atiya, 2010and they include: (a) Location portability (LP), (b) Service Portability (SP) (c) Service provider portability (SPP). They are as explained below:

a) **Location portability:** This is the ability of a subscriber to retain his/her number when changing from one physical location to another within the same calling area. Location portability enables end users to retain their telephones numbers when moving from one location to another (between areas serviced by different type numbers when they move to locations outside of the original rate for location portability in the USA. This type of portability may not be required in the existing mobile services which are offered nationwide.

b) **Service Portability:** This is the ability of the subscriber to retain his number as he changes from service provider to another, example from mobile to fixed services or from PSTN to ISDN services. This type of portability will not be implemented immediately in Nigeria because of the cost implication of upgrading the embedded fixed switches that still exist in the network.

c) **Service Provider Portability (SPP):** The most commonly deployed number portability type, service provider portability enables end users to retain their telephones numbers when changing service providers. This allows a subscriber to retain his /her number when changing from one provider to another. Service provider portability can be Introduce in

three ways: geographic, mobile and non-geographic. They relate to the numbers in the National number plan thus: Geographic Number portability or fixed number portability refers to portability involving fixed geographic numbers.

d) **Mobile Number Portability** refers to portability involving mobile numbers.

e) **Non-geographic Portability r**efers to the portability involving special services such as: Toll free services, Premium rate service (shared revenue) etc.

2.5 Forms of Number Portability

Number Portability can take one of the following forms:

a) **Fixed – to – Fixed Porting:** This is the porting of a fixed line number into another fixed line.

b) **Mobile – to – Fixed Porting**: This involves the porting of a mobile phone number to a fixed line.

c) **Fixed – to – Mobile Porting:** This porting of a fixed line number to a mobile phone.

d) **Mobile – to – Mobile Porting:** This is the process of porting a mobile phone number to another mobile phone.

2.6 Implementation of Mobile Number Portability

Implementing MNP involves three fundamental factors and these factors are: (a) the type of porting initiation (b) the type of database to be maintained, and (c) the call routing schemes.

2.6.1 Port Initiation

According to Jesu and John (2011), there are two ways to initiate a port across the globe – donor-led or recipient-led. The international and European standard is for a subscriber wishing to port his /her number to first indicate interest (initiate the porting process) by contacting the new service provider (Recipient) who will then arrange necessary process with the old service provider (Donor). This is known as 'Recipient led' porting. The second method is where a subscriber wishing to port his or her number is required to contact the donor first to obtain a Porting Authorization Code (PAC) which he/she then has to give to the recipient operator. On receiving the PAC the recipient operator continues the porting process by contacting the donor operator. This is known as donor led porting. United Kingdom is the only country that adopts this type of porting (OFCOM, 2009).This form of porting has been criticized by some industry analysts as

being inefficient. It has also been observed that it may act as a customer deterrent as well allowing the donor an opportunity of winning back the subscriber. This might lead to distortion of competition, especially in the markets with new entrants that are yet to achieve scalability of operation.

2.6.2 Number Portability Database

There are also two approaches by which the number portability database can be maintained and implemented namely Peer-to-Peer (decentralized) approach and Centralized approach.

i. Peer-Peer Approach

Decentralized approach requires that each service provider maintains its own local database. In this case, there is a bilateral agreement between the service providers. The service providers agree on the implementation of number portability based on proprietary interface. With this approach, there can be multiple commercial agreements between the service providers, which make it difficult to manage the terms of each agreement, and track the porting requests. This approach is very complex, and the complexity is further increased with increasing number of service providers.

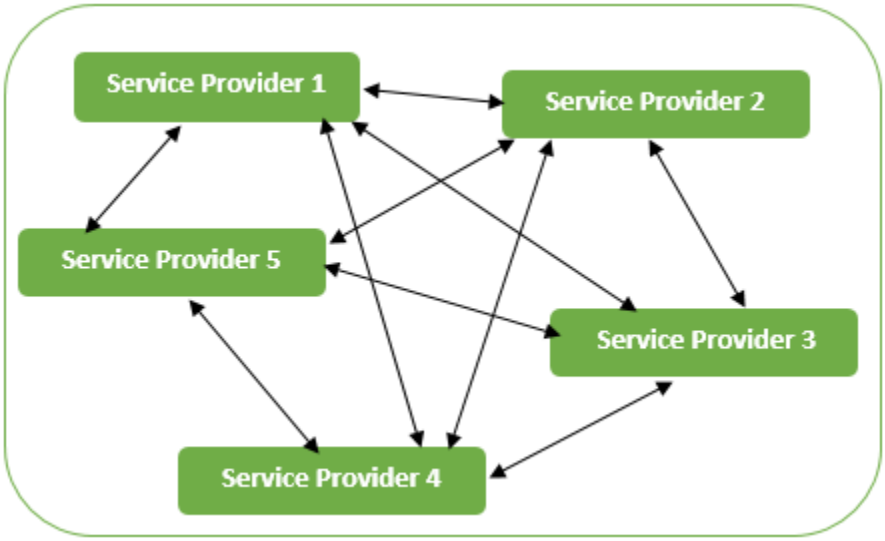


Figure 2.1 Peer-peer Approach

Source: (Atiya, 2010).

ii. Centralized Approach

In this approach, there is a central database maintained by the regulatory authority of the country that includes the guidelines, policies and processes for number porting. All the service providers in that country have a shared and well-defined interface with a centralized number portability (NP) administration center for processing the porting request of a number. This adheres to a clear set of service level agreements for each of the steps involved in the process and it is mandatory for the service providers to follow them. Any porting request from any of the service providers is sent to the NP administration centre first, to which all the service providers' number portability solutions are integrated with. A request that comes from the new Service provider to the NP administration center is sent to the present serving SP for clearance and once this is done the central NP administration center broadcasts the porting information to all the service providers in the country. As specified above, the porting request can be initiated by either of the current serving SP or the new SP (recipient). This is decided by the regulatory body of the country. The centralized approach is the most preferred solution and is widely used across the globe. This is a highly scalable implementation.

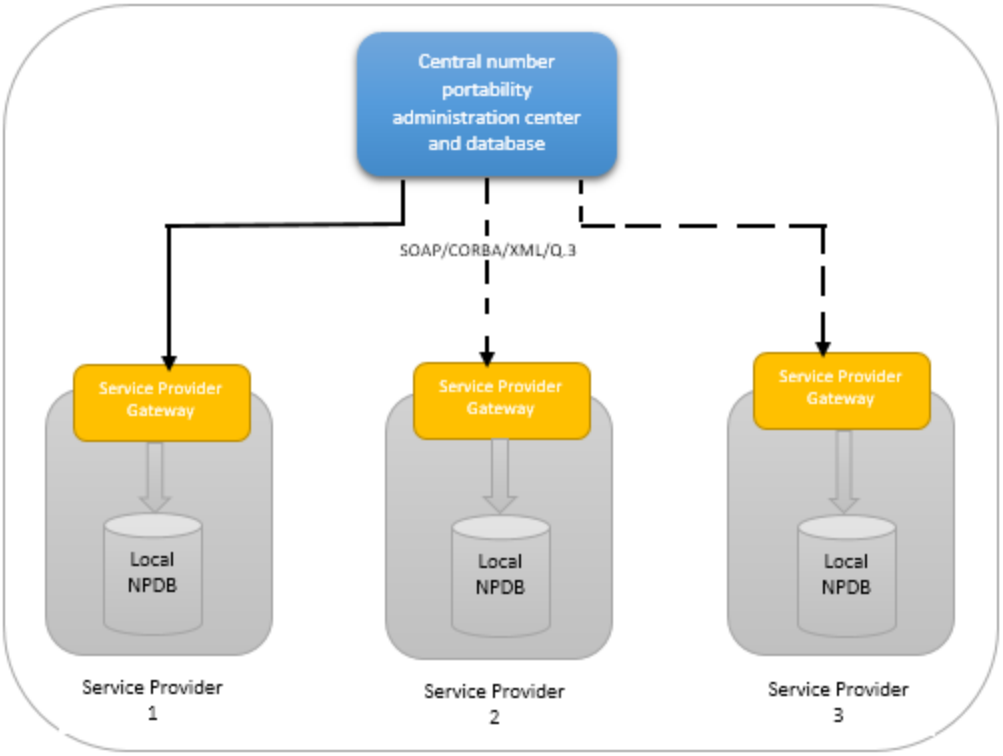


Figure 2.2 Centralized Approach

Source: (Atiya, 2010).

2.6.3 Call Routing Schemes

After the Inter Operator Communication (IOC) process has been established and the porting is in progress, calls made to the ported number must be re-routed. That is an incoming call must find its way to the NSP. The routing information used prior to the implementation of porting would route the call to where it used to go – the OSP.

Call routing scheme is a key problem to be resolved early in the preparation for mobile number portability to be efficient. Call routing is the method used for routing of calls from an originating network to the mobile network associated with a given mobile number. Although there are many variations and hybrids, routing of incoming calls in a ported environment can be categorized into four flavors or methodologies or schemes used in routing of calls and they include: Onward Routing (OR), Query on Release (QoR), Call dropback and All Call Query (ACQ) Atiya (2010).

2.6.3.1 Onward Routing (OR)

In the OR scheme, calls generated from an originating network are routed just as if there was no porting, that is, according to the path indicated by the dialed digits. The donor network checks against an internal database, notes that the number has been ported, determines to which network the call should be routed, and then routes ("trunks") the call to the new network. The internal database may be a stand-alone database, shared by all switches belonging to that donor operator, or may be switch- resident, and only contain information about numbers ported out of that switch. This method has been referred to as a "call forwarding" scheme and has some positive aspects and some drawbacks.

Most switches have some call forwarding capability, therefore this method is a very quick and relatively simple to implement. It does not involve a centralized database, as does the other methods, and therefore does not require close cooperation among competitive operators. This scheme does require the setup of multiple call segments; this scheme can become very inefficient with regard to transmission facilities (i.e. circuits and trunks) and switch resources (i.e. cards, racks, and memory) – all expensive components in an operators network. Furthermore, a donor network that loses subscribers may incur costs for additional transmission facilities and switch resources to handle the routing for subscribers that it has lost – not a good position to be in.

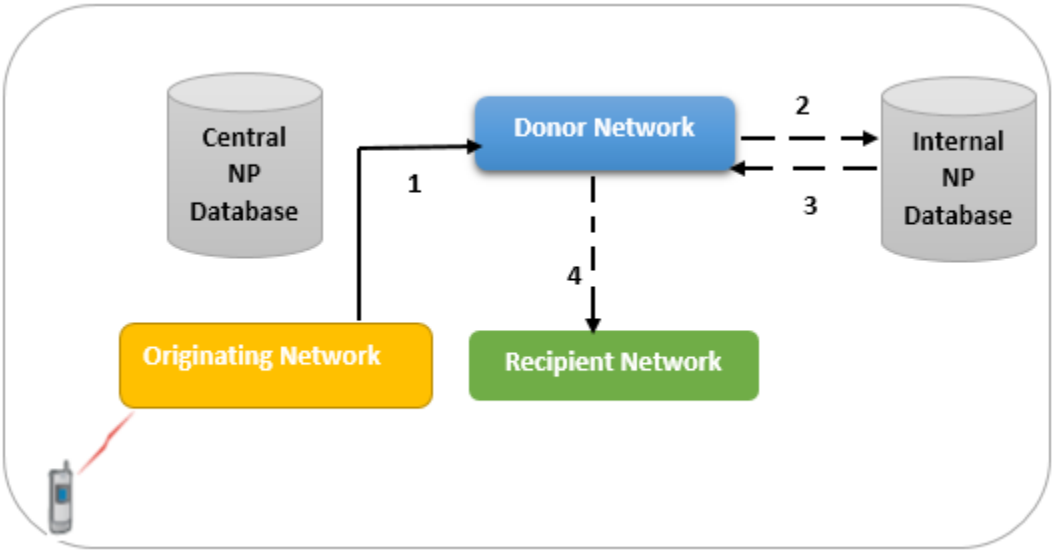


Figure 2.3 Onward Routing Scheme

Source: Atiya (2010)

2.6.3.2 Query on Release (QoR)

In the QoR scheme, the originating network first routes the call as if porting had not happened. The donor network checks if the number was ported, and if so, the call is released back to the originating network. Note that the donor network does not keep track of where the subscriber has ported, just that the number is not resident on the switch. The originating network queries a centralized database, determines the revised routing to the new network, and re-routes the call correctly. With QoR, circuits are allocated to the donor network but are released immediately rather than remain tied up for the length of the call, as in OR. And although the donor network is still involved in each call, its involvement is minimized. This method therefore is more efficient in terms of circuit and transmission facilities. But a new network element is needed – a centralized database. This requires that all operators agree on a process by which the centralized database is updated and maintained – typically by agreeing on a third party to own and operate the database. Also, the costs to own and operate the centralized database must be borne by all the operators.

In summary, the Originating Network receives a call from the caller and routes the call to the donor network. The donor network releases the call and indicates that the dialed number has been ported out of that network. The Originating Network sends a query to its copy of the centrally administered NPDB. The NPDB returns the routing information of the dialed number. The Originating Network uses the routing information to route the call to the new serving network.

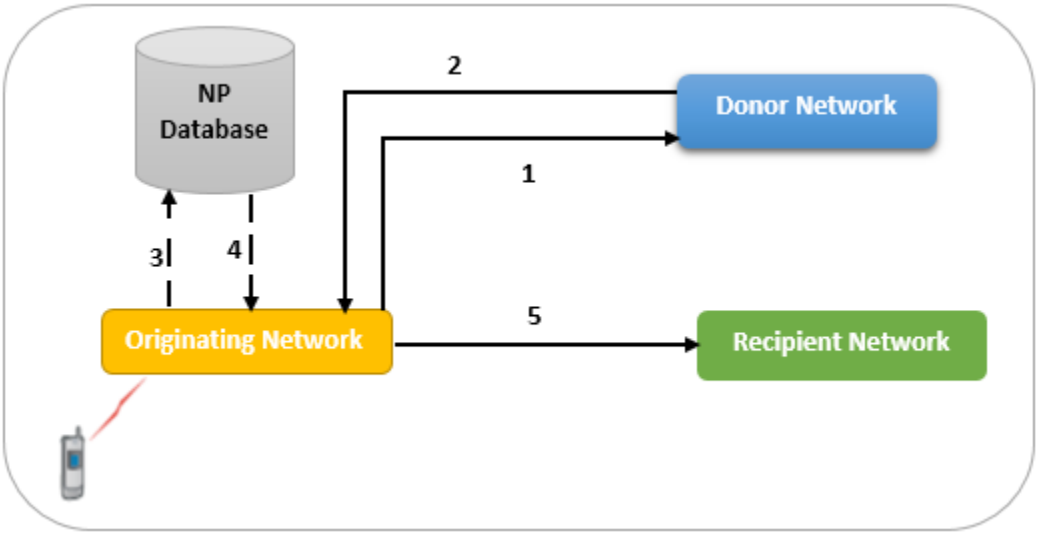


Figure 2.4: Query on Release

Source: Atiya, (2010)

2.6.3.3 All Call Query (ACQ)

In the ACQ scheme, the originating network does not route calls to the donor network; in fact, once a number has been ported, the donor network is not involved at all. The originating network queries a centralized database and the call is re-routed to the recipient network. There are two forms of ACQ – in one, literally all calls are queried, in the other, the line range in which the number belongs is checked to see if that line range is eligible for porting prior to the database query. In reality, where ACQ is used, most operators query all calls to simplify administration. As in QoR, there is a process to update and maintain the database and a third party to own and operate the database.

All the operators must agree upon this. And as in QoR, the costs to own and operate the database must be borne fairly by all the operators. As porting volumes increase, QoR becomes the most efficient scheme for call routing. In some cases, countries have started with ACQ when porting volumes were low, and have migrated to QoR as volumes have increased. In some countries, QoR and ACQ coexist, and the choice of implementation is left to each operator.

The operator that originates the call always checks a centralized database and obtains the route to the call. The Originating Network receives a call from the caller and sends a query to a centrally administered Number Portability Database (NPDB) also called central database (CDB). Network operators generally keep local copies of the CDB, which is hosted on either a network element within their network or a third party network element. The NPDB returns the routing information of the dialed number. The Originating Network uses the routing information to route the call to the recipient network.

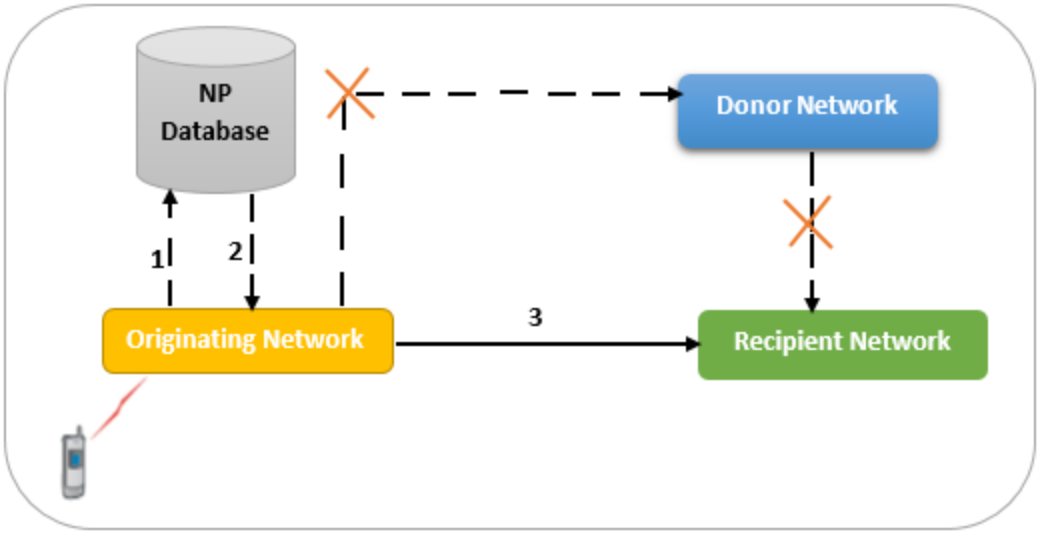


Figure 2.5 ***All Call Query***
Source: ***Atiya (2010)***

2.6.3.4 Call Dropback

As in Query on Release, in Call Dropback, the donor operator maintains an internal database, which is used to look-up new routing information. The call is released back to the originating operator along with the new routing information that is also passed back to the originating operator. The originating operator in turn uses the routing information provided by the donor network to reroute the call. Therefore a centralized database is not needed, and a circuit from the donor operator to the new operator is not required. However, major changes to the signaling protocol are necessary to make this scheme happen, which is the major reason it has not been widely adopted. QR is efficient when a limited number of ported numbers exist, by comparison, QoR becomes more cost effective as porting becomes more common. But as porting becomes even more prevalent in a country; QoR is less efficient than All Call Query.

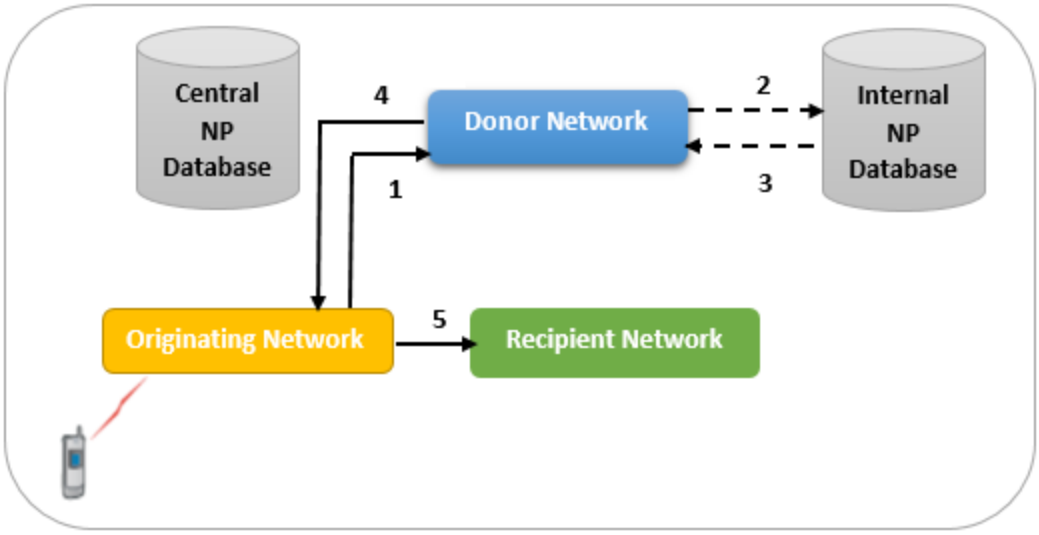


Figure 2.6: Call DropBack

Source: Atiya (2010)

In summary, onward routing is often regarded as the simplest routing method to implement and the All Call Query method as the most complex, with the other methods lying between these two extremes. This is also reflected in the costs of establishment, with onward routing regarded as cheaper to establish than the All Call Query method. By contrast, the ongoing costs associated with the All Call Query method are usually regarded as less than those of the Onward Routing method. Again, the costs associated with the other two methods lie between those of All Call Query and Onward Routing.

2.7 Number Portability Steps

Different countries have implemented Number portability differently. These differences are primarily because of the disparities among regulatory agency's philosophies, existing infrastructure and methods employed by operators to meet the mandate. Although there is a variety of ways to implement these steps, in all cases, there are three basic steps to porting a number from the "old" service provider (OSP) to the New Service Provider (NSP):

a) **Port Initiation:** The subscriber has to initiate the port by letting an operator know of his/her intent.

b) **Exchange of Porting Information**: The OSP and NSP must communicate with each other about the port, including the subscriber information, exact date and time, and of course, the phone number.

c) **Network Routing Schemes:** Once the number has been ported, calls made to that phone number must be "re-routed" to the NSP.

Step One- Port Initiation: To start the porting process, a subscriber needs to contact an operator to request the port. There are two basic approaches for this process used around the world which includes, Donor Initiated in which the subscriber goes to his/her current operator or OSP to request to port "out" and Recipient Initiated in which the subscriber goes to the NSP to request to port "in" his/her number.

Donor Initiated: In this model the donor operator or OSP starts the porting process. The subscriber contacts his/her current service provider and indicates their desire to change service providers and port their number. The OSP then initiates the administrative process with the NSP. In some places, the subscriber is given an authorization code or document showing they are eligible for porting (note: eligibility is determined by fulfillment of the contract or ability to break the contract). The subscriber has a set period of time (for example, up to 30 days in the U.K.) to determine a desired service provider and present the written authorization. The NSP then coordinates the port with the OSP, using contact information provided in the written authorization form. In other cases, the OSP contacts the NSP directly upon initiation by the subscriber. This assumes that the subscriber has already selected a new service provider. In both of these cases, the net result is that the subscriber must initiate the porting process through the current service provider.

Recipient Operator Initiated: In this model the porting process starts when the subscriber contacts a desired new service provider (NSP) (recipient operator) to initiate the porting process. The subscriber contacts a retail point of sale (a kiosk, a Web site, a retail center, an authorized agent, etc.) and provides information regarding his/her current operator (OSP), such as account number. The NSP then begins the administrative process and must validate the subscriber-provided-information with the OSP. At this point, the OSP still has the ability to reject the port, based upon agreed valid reasons, such as incorrect subscriber information.

Step Two: Exchange of Porting Information: Regardless of the method chosen for port initiation, the OSP and NSP must exchange information for validation and port coordination. This

information exchange is commonly referred to as inter-carrier communications or inter-operator communications (IOC).

In the case of fixed-to-fixed porting, the amount of information in the IOC can be several pages, including circuit and trunk information, physical locations of various network elements, as well as subscriber information. In the case of mobile-to-mobile porting, the data in this exchange can be as simple as: subscriber name and billing address, account number, the phone number to be ported and the date and time of port. There are several different methodologies used around the world to accomplish IOC. One such example is a fully automated exchange through a single central clearinghouse.

This method uses a pre-determined format for the data and can be completed in minutes. This fully automated exchange is kicked-off by one operator's back-office system (e.g. a billing system or a customized gateway) and is responded to automatically by the other operator's back-office system. Another automated approach involves entering the porting information into a GUI. The information is then exchanged through a centralized clearinghouse with the other operator. In both of these cases, software systems play a major role in validating the port, expediting the changeover in service providers, and tracking the porting process end-to-end.

In some countries, a manual approach is used, often using facsimile or e-mail to exchange information. There are trade-offs to both approaches. The automated solution results in fewer errors. The automated solution results in less errors and a much faster overall porting experience for the subscriber.

This automation comes at a cost – software systems need to be developed, and modifications to operators' existing back-office systems need to be made to exchange the information. The manual approach can be troublesome – faxes can be lost, e-mails can be deleted, and in both cases, humans need to interpret and input the information into various systems. And of course, a manual approach results in a much longer port process.

Port Timing: The time it takes to complete a port varies as widely as the differences in the implementation of the process – from as little as two and a half hours to as lengthy as 30 days, with extreme examples of four months. How long should the process take? There is no right or wrong answer; but generally from a subscriber's perspective, a shorter timeframe is better. The

answer to this question, in part, needs to be determined by the regulatory agency and in part, by the operators.

Cooperation between Operators: Typically competitors do not cooperate or never mind to cooperate. But in the case of number portability, competitors need to cooperate to accomplish the porting process. The degree to which the operators cooperate has a direct correlation to the reliability and overall porting speeds. And although two operators may be competitors, there is incentive to cooperate – the OSP assisting the NSP in porting a subscriber will benefit next time the roles are reversed. Furthermore, two cooperating competitors can decrease the cost of porting for both operators.

This cooperation includes agreement on the forms to be exchanged, the method and protocol to be used for the exchange, timeframes for acknowledgement of the requests and responses, information to be used to validate the port request, valid reasons for rejection, hours / days of the week and holiday schedule to be observed in the porting processed, etc. The need for cooperation is obvious – the degree to which competing operators agree to cooperate varies greatly by country, and even among operators within a single country. However, we have observed that those operators most willing to cooperate find that their ports go through quickly and reliably, resulting in a better porting experience for the subscriber.

2.8 History of Mobile Number Portability

MNP started in 1990s with Singapore implementing a limited version of this functionality in 1997. Hongkong implemented in 1999, Spain in 2000, Australia in 2001, the list goes on and on (Maicas et'al, 2009). Singapore was therefore the world`s first country to implement mobile number portability. The rationale being that mobile number portability was expected to bring about considerable benefits to users of mobile telephony services (Buehler and Hancap 2004).

Buehler and Hancap, 2004 noted that Spain is the only country in the European Union where more customers have ported cell phone providers, with more than 9million porting completed as of April 2007. As for the fixed line market, number portability is also available since year 2000, but weaker competition meant that actual adoption of the fixed number portability process was quite sluggish. As of August 2004, 1,041,246 fixed line switched were completed. In the year 2001, Sweden, Denmark, Norway and Australia introduced mobile number portability. In Denmark, portability of fixed line numbers and ISDN was implemented on January 1, 2001. Mobile number portability

was implemented on July 1, 2001. In 2006, 238,293 fixed lines were ported, along with 456,159 mobile lines. Considering that the number of fixed by the end of 2006 was 2,974,000 and the number of mobile lines was 5,828,000, roughly 7.9% of lines were ported in 2006. Fixed number portability was introduced in Norway in 2000, one year before the introduction of mobile number portability. The administrative solution for fixed and mobile number portability in Norway, the National Reference Database (NRDB), was put into service in 2000. The NRDB is owned and managed by the 8 largest network operators in Norway. The reference database was developed, installed and is presently managed by Systor Troudheim A/S.

In Sweden, fixed line portability was implemented in 1999 and mobile number portability was implemented on September 1, 2001. At the introduction of mobile number portability, the Swedish operators joined forces and procured a central solution SNPAC CRDB, which is a central reference database containing both fixed and mobile numbers. Also in Australia, local telephone numbers have been portable since 1999. The porting process is based on a peer to peer file exchange between fixed line operators. For service providers who require knowledge of porting activity to enable them to deliver voice calls directly to the current network owner, they can either form agreements with all of the fixed line operator, or use a third party local number portability provider. Mobile number portability has been available as of September 25, 2001.

In summary, the table below summarizes the list of countries by name and successful dates of Number Portability implementation.

Table 2.1: History of MNP Implementation in America

American Countries	**Implementation Date**	**Time To Port (Days)**
United States	November 24, 2003	3
Mexico	July 5, 2008	4
Dominican Republic	September 30, 2009	3 - 10
Brazil	October 1, 2008	5

Source:(Jesu and John 2011)

Table 2.2: History of MNP Implementation in Asia Pacific

Asia Pacific Country	**Implementation Date**	**Time to Port (Days)**
Australia	October 25, 2001	1
Hong Kong	March 1, 1999	2
Pakistan	March 23, 2007	4
Singapore	June 13, 2008	3 - 5
New Zealand	April 1, 2007	2
Thailand	September 1, 2009	4
India	March 2, 2011	7

Source: Jesu and John (2011)

Table 2.3: History of MNP Implementation in Europe

European Country	**Implementation Date**	**Time To Port (Days)**
France	June 1, 2003	10
Italy	January 15, 2002	3
Germany	November 1, 2002	2
Finland	July 25, 2003	5
Denmark	January 1, 2001	30 - 60
Sweden	September 1, 2001	21

Source: Jesu and John (2011)

Table 2.4: History of MNP Implementation in Middle East and Africa

Middle East and Africa	**Implementation Date**	**Time to Port (Days)**
Israel	December 3, 2073	3 – 4 hrs
Jordan	June 1, 2010	7
South Africa	November 10, 2006	2
Oman	August 28, 2006	6
Egypt	April 1, 2008	5

Source: Jesu and John (2011)

2.9 Issues Related to Number Portability

In number portability there are some issues that are of great concern and they are:

2.9.1 Porting Time

According to (Suman and Anita, 2014), Porting time is the time needed to port a number from one subscriber to another. It should be as minimum as possible because if the porting time increases there is a tendency to refrain from porting.

2.9.2 Number Portability Cost

Setup cost: It leads to increase in cost for the service providers which includes the cost of additional infrastructure, both hardware and software, required to enable appropriate rerouting of calls made to subscribers who have switched networks.

Operational cost: The operators also need to invest in the setting up of Number Portability database either centrally administered or operator specific. This includes the initial cost of development and an ongoing cost of operation and maintenance.

Administrative cost: The administrative process of porting a number involves cost for the recipient network operator, donor network operator and the operator of a number database. All these can pass on the administrative cost to the user requesting the port. The switching of identity also causes significant costs to users as mobile number is used as an identifier for many applications on mobile. These prices should be regulated to ensure that the subscribers are not overcharged.

2.9.3 Data transmission

For ported number, the data transmission in case of SMS and MMS poses greater challenge as both the sender and the receiver may be unaware of the loss of data. Therefore, messaging requires urgent attention when the number has been ported to a new service provider.

Also (Balston and Macario, 2001) added that complexity of number portability can come from many sources. Historically, numbers were assigned to various operators in blocks. The operators, who are also called service providers, then provided these numbers to the subscribers of telephone services. Numbers were also recycled in blocks. With number portability, it is envisioned that the size of these blocks may grow smaller or even to single numbers. Once this occurs the granularity

of such operations will represent a greater workload for the telecommunications provider. In number portability the "donor network" provides the number and the "recipient network" accepts the number. The operation of donating a number requires that a number is "snapped out" from a network and "snapped into" the receiving network. If the subscriber ceases to need the number then it is normal that the original donor receives the number back and "snaps back" the number to its network. The situation is slightly more complex if the user leaves the first operator for a second and then subsequently decides to use a third operator. In this case the second operator will return the number to the first and then it is assigned to the third.

In cellular communications the concept of a location registry exists to tie a "mobile station" (such as a cellular phone) to the number. If a number is dialed it is necessary to be able to determine where in the network the mobile station exists. Some mechanism for such forwarding must exist.

2.10 Role and Involvement of a Regulator

From a regulator's perspective, mobile number portability is intended to produce certain effects on the mobile market. Fundamentally, it should prevent network operators from gaining market power by charging an extra price margin that corresponds to the cost of switching networks (Aoki and Small, 1999). Consequently, mobile number portability should:

a) Enhance competition among network operators, especially in relation to the installed subscriber base;
b) Create downward pressure on prices; and
c) Make it easier for newer entrants to gain market.

The essence and the need for the involvement of a regulator in determining the approach to implementation of mobile number portability to be adopted in each country is that:

a) Without the involvement of a regulator, industry players will lack the initiative, or the means of reaching agreement, to settle on a particular method of implementation;
b) The most cost-effective solution to a network operations problem such as implementation of mobile number portability should be most efficiently worked out by the country's telecommunication regulator.

Many countries vary regarding the extent of regulator involvement in determining how mobile number portability is implemented. Arguably the most important decision (other than apportionment of costs) to be made in preparation for implementation of mobile

number portability is selecting the method to be used for routing calls made to a mobile number to the correct terminating mobile operator.

In many countries, network operators and other relevant parties have established a forum or procedure for making decisions collectively about mobile number portability implementation. In the absence of involvement of a regulator, such a forum or procedure becomes handicapped and the effectiveness of reaching decisions quickly becomes critical. Even in those countries where the most critical decisions are taken by the regulator, however, it is clear that the involvement of industry in developing the detailed specifications for how mobile number portability will be introduced or will operate is vital (Rogerson et al, 2005).

2.11 Conditions for Successful MNP

The success of number portability depends on the following factors:

Subscriber Awareness: Subscribers need to be aware of Number Portability (NP), its advantages, and how to go about it**.**

Simplicity: NP success mainly depends on the simplicity of the process. There could be many rules that the regulator may impose. For example, a number can't be ported in the first 6 months of the subscription. Such forced conditions hamper the success of NP**.**

Porting Cost: Number portability success also depends on the cost of porting a number. The lower the cost, the higher will be the rate of porting. The cost here refers to the amount that the subscribers need to pay to port their number to some other service provider's network. High porting costs is an obstacle in adoption of this service while low costs (lower than 20 % of operator's monthly revenue) can be effective in increasing the rate of porting. Owing to the special effect of this factor in the churn rate in the MNP market, the European unions' universal service directive has obliged the member states to provide the service with cost oriented prices. In Finland for instance, MNP service is provided free due to the high competitive situation of the market. In Nigeria too porting is free of charge. But in countries such as Ireland and Spain operators are allowed to set charges for this service and it is an obstacle in developing porting numbers service.

It all depends on the regulatory authority that decides who bears the cost of porting. For better success and market competition, it is sometimes recommended that the new service provider, who is getting the subscriber, bears the cost of porting.

Handset subsidies and fixed-term agreements: NP has been a great success in the countries like Finland where there are no subsidies on mobile handsets. Subsidies given by the service providers lead to fixed term agreements and hence limit the option for the subscriber to switch to a different service provider. There can be other agreements, which can hinder the success of NP.

Speed of porting (the time-to-port): If the time to port is too long, consumers will put-off using the service. For consumers 2 days time-to-port is too long. In fact, for some consumers, porting the number within an hour or two is very important, although there isn't any evidence from international experience to show that reducing a time-to-port will improve MNP take-up. Yet, on the one hand by reducing porting time, the cost of MNP implementation would increase. For instance, the cost of porting a number in Irish system (that has the shortest porting time) is far more than other implementations and almost five times more expensive than porting cost in Hong Kong. (Wright, 2002); NERA and Smith, 1998).

Speeds of porting and porting time depend on two factors: technical porting systems and the willingness of networks to speed up the porting process. As a matter of fact, none of the donor or receiver network tends to resolve technical problems of porting systems quickly and try to neglect to find adequate cost solution for this service. One of the other obstacles to rapid porting is the notice period that has been mentioned in the contract with the donor operator; in this period the donor operator must be notified before porting a number.

Hence subscriber should wait to end this period for releasing the number by the donor operator. Although, many countries have utilized manually operated porting process in the beginning of MNP implementation, nowadays most countries have been using automatic porting systems. While the speed of porting has been reduced considerably, there are still some problems in the way of rapid porting. Hence speed is one of the major factors that affect the success of NP. Service level agreements should be stringent enough to minimize the time taken to port the number to other network. This increases the level of customer satisfaction.

2.12 Telecommunication in Nigeria

When Nigeria gained her independence in 1960, there were only 18,724 functional telephone lines for an estimated population of 45 million, which was a "teledensity"• ratio of 0.04 telephones per 100 people (Shoewu et al., 2008).Teledensity is the percentage of the number of phone users per population at a given period of time and its growth is proportional to the growth in the subscriber

base (Chindo, 2013). During the thirty-odd years of military rule, there was very little by way of investment in telecommunications, and other sectors did not fare any better.

Then by 1996 according to the International Telecommunication Union, Nigeria's teledensity ratio became 0.36. And in 1999 the Nigeria' teledensity was still a far cry as it slightly rose from 0.36 to 0.4. In short, African as a whole then had an average teledensity of 1.67 (Shoewu et al., 2008). Nigeria then had a very limited telephone network for many years, and the waiting list was estimated at over 10 million people, who applied to NITEL which was established since 1985 for services. However, with the liberalization of the telecommunication industry in 2001 coupled with the introduction of first GSM in August the same 2001, the story changed dramatically. Within just one year of GSM operation, the teledensity ratio of Nigeria tripled.

August 2001 will ever remain indelible in the history of Nigeria as it heralded the dawn of a new era " the era of GSM technology", which completely revitalized lives of citizens and the manner of doing business in Nigeria (Ajala, 2005).However, four years after the first GSM call was made, the GSM industry in Nigeria changed a lot. Competition for subscribers got fierce. Operators resorted to "price wars" to win subscribers. Subscribers on the other hand, had more choices than ever regarding which network operator to use. By May 2005, Nigeria with an estimated population of 128,771,988 had more than 9 million GSM subscribers. In 2011 the teledensity of Nigeria rose to 64.7% and Nigeria was recorded as one of the fastest growing GSM market in the world (Juwah, 2011).As at September 2013 to be precise the Nigeria teledensity is 86.62% with a total of 171,961,525 connected lines and a total of 121,271,218 active lines including mobile, mobile CDMA and fixed wired /wireless, (NCC, 2014). It is expected to reach 98 percent by 2015.

Meanwhile, amidst this growing figure and telecommunications industry boom is the challenge for quality and efficient service from the network operators. These challenges range from inter-network connectivity problems, network congestion and dropped calls. It is a common knowledge that Cell phone users in Nigeria today carry two to three phones as a way of escaping from poor service from either of the operators. This has also fuelled the rush for dual SIM handsets in the country.

Just four years after the start of the GSM era in Nigeria, the focus gradually shifted from providing coverage to providing quality service. The euphoria of owning a phone set is gradually giving way to complaints of dropped calls and congestion.

The operators are fast realizing that they are in a highly competitive environment where subscribers can make or break them. Dissatisfaction by subscribers gives rise to a high rate of subscriber churn and low revenue for the operator. The performance of the network has a direct impact on the revenues. The NCC mounts pressure on the operators to step up the quality of service offered Nigerians and had even gone a step further to award contracts to private companies to conduct comparative analyses of the quality of service offered by each of the operators. The NCC further threatened to sanction any operator that fails to pay attention to quality of service, network congestion and dropped calls.

2.13 Loopholes Inherent in Nigeria Telecommunication Market

During the course of the research a lot of loopholes were identified in the Nigerian telecommunication market and these loop holes are partly affecting the workability of MNP in Nigeria. They are as listed below:

a) **Access to SIM Cards is very easy**: Unlike in other countries like South Africa where you have to fill out a form and sign a contract before getting a SIM card, Nigerians pick up SIMs easily without any form of documentation for just N100. The result is multiple SIM ownership. Only teenagers and the elderly have only one SIM. Most adults have two SIMS and some have two SIMs from the same service provider (1 for call/SMS, another for data).
b) **Dual-SIM mobile phones are a huge success in Nigeria**: Dual-SIM mobile phones further facilitated the need for multiple SIM card ownership. For instance Techno Trinity is a Tri SIM phone, and it sold like pure water when it came out some years ago. Also MTN came out with 2-in-1 and 4-in-1 SIMs for N100 further flooding the market with more SIMs.
c) **Illiteracy**: The level of illiteracy is still high in Nigeria. Illiteracy in this context does not just mean the inability to read or write, but also technological illiteracy. When someone is ignorant of the technological advancement, he/she would like to stick to the little ones already known and would be resistant to any form of change.

d) **Nigerians are not patient and don't like stress**: The fact that the process involves going to the service provider's office or outlet is a big stress to many of Nigerians. Some keep procrastinating till eventually the idea to Port is given up.

e) All service providers have different service/geographical strengths and weaknesses. For instance MTN's network may be strong inside Owerri town and weak in some other areas around Owerri. For example, Etisalat's modem has strong network for internet or browsing in FUTO but dead in Owerri town, so for each location in Owerri there is a particular network that works well.

2.14 Mobile Number Portability in Nigeria

The Nigeria Communications Commission (NCC) on April, 22nd 2013 launched Mobile Number Portability (MNP) scheme (Adekunle, 2013). MNP is, to date, the most collaborative programme embarked upon by both the NCC and GSM service providers. The scheme is meant to deepen competition among telecoms companies and challenge them to offer improved and affordable services. The policy took off three years after the initial target set in 2009 in furtherance of NCC's objectives of protecting consumers' interest through the development, monitoring and enforcement of compliance with regulations by telecommunication service providers, in order to ensure better quality services, fair pricing, etc. and in line with the provisions of Section 128 of the Nigerian Communication Act (NCA) 2003 which vests the NCC with the exclusive right to regulate numbers and number portability in Nigeria.

Considered a revolutionary step in the development of telecommunications services in Nigeria, the policy in a nutshell, enables phone subscribers in a multi-network environment to change from one network to the other without changing their telephone numbers, following the granting of a porting request. It was meant to make GSM companies sit up and raise their standards, failure of which they risk losing their customers. So far, however, the porting game is yet to spiral into a full-scale competitive storm. This can be largely attributed to the fact that none of the service providers has provided that competitive edge – that special incentive that would serve as a bait for 'disgruntled' subscribers of other networks. There is yet no exceptional thing to instigate the much-needed competition and start off a porting war. On their part, most subscribers have remained circumspect, opting to remain with 'the devil they know,' rather than dare uncharted waters. By adopting MNP,

Nigeria is now in league with countries like the United States, the Netherlands, Singapore, Kenya and Ghana as a number porting nation. With it, the NCC has consolidated on its drive to make.

However, Nigerian subscribers still receive the shabby treatment and malpractices they suffered in the hands of GSM companies prior to the commencement of porting. The excitement and expectation which trailed the launch of the scheme has all but died out. Perhaps, it is high time we all ported silently by staging a mass boycott of all the GSM services even if only for one day.

On their part, GSM service providers have merely broadened the scope of their promos and advertisements, rather than improve services as earlier envisaged. From observations thus far, little has changed in terms network coverage and the volume of dropped calls and intermittent service seizures, and other quality of service concerns.

The much-awaited value-laden services promised by the operators of the various networks remain a mirage. There is as yet little accountability (to the customer), billing integrity, as well as any significant difference in the quality of services offered. Subscribers continue to be disturbed by unsolicited SMS wired to their phones for unsubscribed services and promos run by GSM operators.

While Nigerians may not carry placards to compel GSM operators to render services that would encourage porting, they continue to rely on the NCC to protect them from the obvious complacency and lack of initiative of the service providers. Many more people really want to port and are waiting to be encouraged.

In another development, Adimorah (2013) in his report on "Appraising Number Portability" added that adopting the MNP, confirmed that Nigeria has joined the league with countries like the United States, the Netherlands, Singapore, Kenya and Ghana as a number porting nation. With it, the NCC has consolidated on its drive to make Nigeria's telecom sector a global competitor through quality assurance. Nigeria has thus become the 64th country to implement mobile number porting after South Africa pioneered other African nations in 2006, followed by Kenya and Ghana in April and July 2011 respectively.

2.15 MNP Post Launch Report in Nigeria

One of the biggest ironies of the 'porting game' is that the biggest GSM company (MTN) with a subscriber base of about 50 million, which presumably saw in the policy an opportunity to make a

deeper penetration and further cut into the market share of its competitors, has become the biggest loser.

According to the NCC's Director of Public Affairs, Tony Ojobo, about 4000 Nigerians switched networks within the first 48hours following the launch of MNP in the country (NCC, 2013).

Statistics released by the NCC in June 2013 indicated that 49 per cent of the total porting applications received from subscribers within the first month of the commencement of MNP dumped MTN. Figures released by Technology Times, an online ICT publication, showed that etisalat recorded the biggest gain of 44 per cent new migrants within the same period. Globacom followed MTN by recording losses of 23 per cent; Airtel Nigeria was number three with overall losses of 17 per cent, while etisalat Nigeria came last on the losers table with 11 per cent "portees" for May 2013figures.

Additional reports made available by Nigeria Communication Commission (2013) monthly subscriber data report indicates that a total of 13 923 subscribers ported from one network to another between May and June 2013. While 7, 164 subscribers ported in May 2013, the number dropped to 5 759 subscribers in June 2013.

2.16 Effects of MNP on Telecom Network Providers in Nigeria

According to (Chris, 2014),Mobile Number Portability has to some extent some effects on the telecommunication network providers in that it has motivated them to increase the efficiency of their services in order to retain customers and attract new ones from other networks. But most interestingly instead of these network providers to focus on their efficiency they only distinguish themselves in the market through continuous introduction new attractive products and service packages.

2.17 Effects of MNP on Subscribers in Nigeria

While the NCC is enthusiastic about the MNP service, most Nigerians are not. The evidence is from the statistics of porting as released by NCC as at June 2013 only less than 15,000 subscribers switched network out of about 121 million active phone users in Nigeria, (NCC,2013). Also in another report published by (Chris,2014), the lack of interest can be attributed to the following: (a) the service came too late when most Nigerian are already use to dual SIM phones; (b) the unfriendly conditions that accompany the porting process; (c) subscribers are unable to predict the

perfect network since the upside of one network may be the downside of another network. He then noted that though the MNP has mounted pressure on the providers for better service delivery in the country but the acceptance is still very low.

Consequently there are indications that the NCC has dumped MNP. An article published by Chika (2014) explains that MNP which was introduced to checkmate the unwholesome practices and poor quality of service from Nigerian network providers has been another wasted project. And investigation has it that since June 2013 the NCC refused (remained silent) to publish figures on MNP. According to Emmanuel (2014), the Executive Vice chairman of NCC disclosed that a total of 197,000 subscribers have so far ported since the introduction of MNP. It was also established that despite calls by the contractor that NCC and the Network providers should meet to amend the guidelines for porting which is too stringent, NCC has refused to respond to their requests.

In conclusion, it can be seen from the available literatures that both the NCC and Nigerians are disillusioned with MNP introduction in Nigeria. This research therefore becomes imperative as it is set to prove empirically the reasons for non workability or acceptability of MNP in Nigeria and at the same time show state of MNP as it is currently and predict the growth trend that will if not for any other thing guide the NCC on the way forward towards the realization of a workable and acceptable MNP in Nigeria.

2.18 MNP in Some Selected Countries

2.18.1 Mobile Number Portability in India

A consultation paper published by the Telecommunication Regulatory Authority of India (TRAI) in 2007 laid down the standards, frameworks, technical issues that would facilitate the implementation of mobile Number portability in India. Mobile number portability started in as a pilot project in India in 2010 and has been implemented across the nation in January 2011,(Rajiv, 2012). For porting, customers have to send an SMS to 1900, unique porting code will be sent to their cell number. It charges customers maximum `19. This unique porting code is to be mentioned in the form submitted to Recipient Operator. There must be a gap of 90 days between every porting requested by the subscribers. In India the All Call Query (ACQ) model is used together the centralised database model.

2.18.2 Mobile Number Portability in United Kingdom

In UK, there are four mobile operators namely: Cellnet, Vodafone, Orange and One2one, (OFCOM,2007). The office Telecommunication (OFTEL) which is now Office of Communications (OFCOM) is the regulator of telecommunications in the UK. Before the introduction of MNP in UK, a feasibility study was carried out to determine the readiness of the country in respect to the introduction of MNP. The mobile operators were expected to put operational systems in place, and were further obligated to educate consumers about MNP and the technology used for porting. There are two types of ports which take place in the UK: consumer ports and Bulk ports. Consumer ports involve porting by individuals from one service provider to the other, and bulk porting involves business. In the UK, the porting process is Donor led, where a consumer wishing to port informs the Donor service provider in order to get the Port Authorization Code (PAC). This process is different from other European countries where consumer port is Recipient led, (OFCOM, 2009). In UK also, the routing scheme implemented is Onward Routing. An ex-post study in the UK was commissioned by OFCOM in order to identify and analyse the porting processes which were not working well for consumers. OFCOM (2009) found out that there were difficulties experienced by a few consumers who wanted to port and they included:

a) Unwanted or excessive save activity imposed on consumers by the donor network at the point of PAC request. Several respondents commented on the "hard sell" approach adopted by operators when they made the PAC request. Respondents described experiences of having to go through "negotiation battles" with the operator in order to get them to release the PAC.

b) Refusal or failure to issue PACs to consumers, despite receipt of a valid request. This led to most consumers indicating a preference for recipient led process.

c) Delays that extended the length of the end-to-end porting process.

d) Consumers also indicated that the two day porting time frame was long (Ofcom, 2009).

2.18.3 Mobile Number Portability in Hong Kong

According to the report by Lawrence (1999), MNP was implemented in Hong Kong in 1999 as mandated by the Office of the Telecommunication Regulator (OFTA). The Office of the Telecommunications Authority (OFTA) ceased to function on 31 March 2012. Its powers and duties were transferred to the Office of the Communications Authority (OFCA), the executive arm and secretariat of the Communications Authority of HongKong. MNP was implemented after much resistance by operators. Seemingly, MNP was well received by consumers because during its first month, more than 102,000 applications were made for switching (OFTA, 1999). At the start, OFTA commissioned a feasibility study which was conducted by NERA in respect to the cost- benefit analysis of MNP. The objectives of the study were firstly to identify the technical options for the implementation of MNP on all mobile networks. Secondly assess the costs, availability and risks of each technical options, and finally looked at demand for, estimates of MNP options to recover the costs of portability. The research results indicated that MNP would promote fair competition and increase a net profit. In the study, three types of consumer benefits were captured and are: quality of service, lower prices and consumer choice. These developments with regard to the introduction of MNP in Hong Kong came at the time when the market was very competitive with four fixed line operators and seven mobile operators. In the consultation paper on MNP, OFTA stated that: "With such a fast growing mobile customer base in Hong Kong and the choice of mobile networks available to customers, the OFTA believes that there would be some genuine demands and requirements from customers for mobile number portability". As stated before, the existence and the success of MNP depended on the technical feasibility. Hong Kong adopted the call forwarding facility which was a common technology in many countries. Caller Line Identification (CLI) was also introduced. Short Message Service (SMS) was seen as a value added service over voice telephony. However, it could not be included as part of services. This limitation could pose challenges to consumers in need of this service. Another technical challenge was the international calls on ported numbers, which could not be traced by the recipient operator at least during the early stages of porting (NERA, 1998).

2.18.4 Mobile Number Portability in Sweden

Sweden was the first Nordic country to implement MNP, (Buehler and Haucap, 2004). At the time, there were 16 mobile operators. According to the Telecommunications Act of 1996 as amended, number portability was supposed to be implemented in 1999, but was delayed and finally introduced in 2001. The Act further stipulated that any costs incurred during the implementation of MNP within the operators would be borne by them (operators) and costs related to the transfer of the subscriber could be charged to the recipient operator by the donor operator (Levin, 2006). Despite the introduction of MNP, consumers were not motivated to port. Instead, it is reported that there was a high percentage of churn rate. Churn rate occurs when subscribers change network operators without fear of losing their numbers. Two types of churn were recorded: Voluntary – the customer stops using the service due to one or other reasons, such as pricing, poor network quality or inadequate customer service to name a few. Involuntary – the service provider bars the customer from utilizing the service for no-payment or another reason. In Sweden, the call routing model adopted is Onward Routing and All Call Query with centralized database model.

2.18.5 Mobile Number Portability in Australia

During the course of a study conducted in Australia on the telecommunications market, it was established that prices were fairly competitive, and there was a high churn rate in the market for mobile services which indicated that there would be increase the level of porting should MNP be introduced. It was on this awareness that the then Minister of Communications and Technology in Australia made a pronouncement that the costs of changing numbers outweighed the benefits for consumers, and therefore it was imperative that the Australian regulator introduced MNP (ACA, 1999). Hence in 2001, mobile operators in Australia implemented MNP through the Australian Communication Authority (ACA) directives and are seen as the world leader in implementing MNP. In Australia, according to a report by Network Strategies (2007), five million successful ports took place with an average of 85,000 ports per month. The success was attributed to the fact that it is quick, seamless and low-cost. Like in the UK, the regulator remained technology neutral and allowed mobile operators to determine the type of technology suitable for MNP.

2.18.6 Mobile Number Portability in Italy

MNP was launched in Italy in 2001. According to Levin (2006), two years after the introduction of MNP, only 68% of consumers had ported their numbers. The percentage was higher than those of their European countries such as Portugal, Spain and Germany. According to the study, MNP did not make any impact despite 95% mobile usage, of which 93% are prepaid. Porting took 5 working days to complete in a market of 3 mobile operators (Levin, 2006).

2.18.7 Mobile Number Portability in Ireland

According to the consultation paper developed by Ovum for the Office of the Director Telecommunication Regulation in 2001, discussions initially began on the Numbering Plan and subsequently MNP was implemented. Ovum conducted a study regarding the MNP implementation processes and made the following recommendations: first, the process of porting should not be dependent on the retail sales process. Essentially, a customer wishing to port was required to first open a new account as per procedure, including the allocation of a new number from a number block of the new operator. Thereafter, they had to make a request to the new operator to have the old number ported and the new number withdrawn, without any involvement of the retailers. According to Ovum (2001), this two-stage process has positive effects to consumers because it avoided the costs, complexities and delays that result from involving the retailer in the process. Second, the right to port a number should be established primarily by checking that the user has possession of an existing mobile phone which uses that number (Ovum, 2001). According to the report by the Office of Director of Telecommunications (2007), it was proposed that validation be made with regard to the compatibility of the customer's current handset, in relation to the number intended for porting. They proposed that such validation could be achieved in a number of ways: a call from the mobile, where the CLI shows the number to be ported; a call to the number to be ported, establishing that the user has possession of a mobile using the number; a recent bill showing the number to be ported. Lastly, the donor operator should accept a number portability order from the recipient operator for the purposes of both porting the number and closing the account with the customer. This study further indicates that this requirement is essential to ensure that the porting process takes place speedily and reliably. The donor operator should not refuse porting on the grounds of: the customer having an outstanding debt; the customer

not having completed the minimum contract period; the customer's handset being Subscriber Identity Module (SIM) locked so that it can only work on the donor operator's network.

2.18.8 Mobile Number Portability in Germany

In 2002, the German telecommunication regulator, the 'Bundesnetzagentur' implemented MNP in Germany, (Jesu & John, 2011). Like other countries, the operators were required to establish a central database system administered all porting activities. Porting in Germany took 31 days. Consumers were required to terminate their contract with the existing service provider before joining a new one. Consumers who wished to port their numbers were requested to pay fees to the donor operator. Porting at the time was low due to the fact that it was not mandatory for mobile operators to conduct awareness programmes. Another contributory factor for low porting was because consumers had to wait for a period of two years before porting.

2.18.9 Mobile Number Portability in Finland

In Finland, MNP was implemented in 2003. According to the Communications Market Act, "a telecommunications operator shall not charge a user for the transfer of a telephone number to another telecommunications operator." This was in contrast to countries such as Germany, which charged fees porting. The donor operator may, however, receive a one-off payment equivalent to the one-off costs of transferring the telephone number. Over 1000 000 ported numbers were reported during its first year (Smura, 2004).

2.18.10 Mobile Number Portability in United States

The Telecommunication Act of 1996 in the United States (US) gave a directive for MNP to be introduced. At the start, the regulatory directive was met by resistance from mobile operators who indicated that the market was already competitive with six mobile operators. However, they were obliged to comply with the regulations. Further obstacles to introducing MNP were exacerbated by lengthy postponements resulting from technological challenges, but MNP was finally implemented in US in June 2003 (Jesu & John, 2011). A quantitative study was conducted in the US about the effects of mobile number portability and it focused on consumer perception and behaviour. In terms of the sample size, 684 mobile subscribers were interviewed. Data was collected from the Cellular Telecommunications Industry Association from 2003 to 2005. A

telephone survey was done with 422 subscribers and survey questionnaires were attached to 138 subscribers' emails. The questionnaires asked respondents about reasons for porting, quality of service, customer satisfaction, switching costs, lock-in and prices. The research results were that the then implementation of MNP did not satisfy the regulator's intention to reduce switching barriers and that subscribers have been locked in. The Federal Communications Commission (FCC) recommended that future work had to determine if the implementation of MNP was done in an effective way.

2.19 Related Researches on Mobile Number Portability

Since the inception of Mobile Number Portability in 1997, there have been several threads of researches revolving round its adoption and enhancement. This section therefore embodies the ideas drawn from the previous researchers' intuitions about the workability of Mobile Number Portability.

As far back as 2001 a survey carried out by Gans and king, (2001) on Mobile Network Competition in the European Countries showed that porting charges and pricing are the most impressive factors among the others that affect the workability of MNP. Based on their findings they concluded that the followings are the conditions that will facilitate effective mobile number portability: (i) Stakeholder are adequately informed of the benefits of MNP (ii) Porting period is short and the process is painless to consumers (iii) Subscribers are not charged for porting their numbers to network of their choice, and that any fee that may be charged to the subscribers should be so minimal not to impair their decision making process. (iv)The process of porting should be simplified, example one stop point of contact for the subscriber.

Also, a work on Mobile Number Portability by Buehler and Haucap (2004) examined the consequences of introducing mobile number portability (MNP). They argued that if the sole effect of introducing MNP is the abolishment of switching costs, MNP unambiguously would benefit mobile customers. However, if MNP also causes consumer ignorance as telephone numbers no longer identify networks, mobile operators will increase termination charges with ambiguous net effect on the surplus of mobile customers. The paper also examined how extensions such as MNP based on call-forwarding, termination fee regulation, and alternative means of carrier identification affect these findings and concluded as follows: For success of MNP the termination charges have

to be regulated and also the set up costs for MNP must not be so high that they exceed the various consumer benefits.

Mengze and Jeongwen (2006) examined Price Competition with Reduced Consumer Switching Costs: The Case of Wireless Number Portability in the Cellular Phone Industry and advised that in Hong Kong, most networks decreased their prices significantly around the time of MNP implementation. And despite this, "Orange", the largest network in Hong Kong steadily gained market share following the implementation of MNP. They quickly concluded that it was not always true that the big players lose because of MNP.

Sutherland (2006) in his paper titled Mobile Number Portability states that; once consumers have access to cheap, timely and effective MNP, they are in a significantly stronger position to negotiate deals with their existing operators or with a rival and operators with strong brands can use MNP to attract customers from rivals. He concluded that it is not that MNP causes customer to churn, but that MNP rather frees customers to express their latent dissatisfaction current provider. He then concluded that churn is good to an extent but that MNP benefits business customers.

Another research on Fostering Competition in Thailand's Telecommunications Sector by Xavier (2008) equally x-rayed the importance of MNP in development of effective competition in telecommunication sector. He stressed that the importance of MNP is very paramount, if any country's telecommunication must grow.

Also, Xavier and Ypsilanti (2008) together worked on Switching Costs and Consumer Behaviour: Implications for Telecommunications Regulation, noticed that lengthy and cumbersome switching procedures made it inconvenient for consumers to switch and this outweighed any potential benefits. They thus suggested as follows:

a). Early exit charges, imposed by an existing provider, can reduce the benefits of switching.

b).Technical incompatibility of equipment can make it uneconomical for consumers to switch (for example, if they cannot use a blocked mobile phone with their new provider)

c). Long-term deals can lock consumers into lengthy relationships with their providers (as may occur with mobile telephony and Internet contracts) and increase the risk of them being overcharged. Hence, Xavier & Ypsilanti (2008) concluded that switching patterns provide an important indicator that the demand-side of a market is well developed and that consumers are sufficiently empowered to participate actively. Xavier and Ypsilanti also opined that the ability and willingness of consumers to switch is critically important and

that where switching is impeded or discouraged this could impact not only on the demand-side but also potentially raise supply side barriers-new entrants. They further stressed that the motivation to switch (port) is generally a function of consumers' estimate of the performance of their existing provider; and whether or not they believe there are better alternatives available from other providers on the aspects of service that matter to them.

Lyons (2009) worked on the Effects of Mobile Number Portability on Service Prices and concluded that Prices fell in countries with a five-day porting period or with better MNP delivery standard after a lag of roughly one year. Secondly, that no significant effect of MNP was found on average prices for countries that applied a less stringent target for maximum porting time. And finally that MNP was not then a huge success in Singapore because the penetration was less when it was initially implemented.

In the year 2009 also, Iqbal (2009) who worked on "Mobile Number Portability in South Asia" concluded as follows - Existing market structures in South Asia may not be as suited for MNP because of the large number of prepaid or low-end users. And that their phone use patterns and requirements are rather distinctive, compared to high-end postpaid subscribers, commonly found in the developed western markets. He further emphasized that the importance of MNP might be declining, due to falling of switching costs. He equally noticed that number changes are getting easier and the use of email and other technologies made it easier for subscribers to notify their friends about their new numbers. And in the case of business, many used word processor templates for their invoices and letterheads, which can be edited within seconds, in case of a change in phone numbers. Additionally, the cost of having multiple SIMs, and running parallel accounts, is so cheap that subscribers would miss MNP facility.

Joseph and Joachim (2009) together worked on Switching Cost and Customer Loyalty in the Mobile Phone Market: The Nigerian Experience and are of the opinion that Switching barriers affect significantly the level of customer retention, and also affect the relationship between customer satisfaction and customer retention. They felt that switching costs could be used to predict consumer's behavior in the mobile telecommunication sector.

Polo and Sese (2009) in their work on how to Make Switching Costly; The role of Marketing and Relationship argued that, whether MNP increases competition in mobile markets or not, that the

more underpinning question may be whether subscribers are able to port freely without significant switching barriers.

Atiya (2010)is a Journal paper on Mobile Number Portability: Challenges and solutions, discussed the types of number portability, various call routing schemes for service provider number portability, comparisons among various routing schemes, challenges of implementing number portability, best solution in terms of complexity of implementation, use of network resources, and scalability and concluded that: To implement number portability, the best solution is to implement the centralized system, maintain a common number porting database, and use the All Call Query (ACQ) call routing scheme to route the calls to a ported number. A trusted third party, who typically reports to the telecom regulatory authority, can maintain the centralized number porting database.

Rohan (2011) in his work on End of MNP in Pakistan noticed that Multiple SIM ownership among those at Pakistan's Bottom of Pyramid (BPO) increased from 13% to 23% from 2006 to 2008, despite MNP being introduced. And that, -BOP users placed great weight on affinity group calling plans (such as "friends & family"). He noted that subscribers were very comfortable with changing SIMs to take advantage of coverage and price differentials. He concluded that they were unlikely to use MNP.

Tiamiyu and Mejabi (2012) worked on Evaluation of Subscriber Attitude to Mobile Number Portability Implementation in Nigeria. They assessed the attitude of mobile telephone subscribers to the implementation of mobile number portability (MNP) in Nigeria. The study also identified the demographic variables that should be considered when targeting marketing or sensitization campaigns. They analyzed their data using frequency distributions and cross-tabulations with the Chi-square statistic at the 0.01 level of significance. Findings revealed that while most subscribers supported the implementation of MNP in Nigeria, a significant proportion believed that tariffs would not drop as long as the power problem continued. Furthermore, it was found that of the demographic variables, age had the strongest influence on subscriber attitudes and this was identified as a strategic focus for network operators and the regulatory authority. Based on the above findings and conclusions, they recommended that future work should determine empirically the knowledge of MNP of the subscribers in Nigeria and capture the respondents' intention to port**.**

Nnochiri and Okafor (2014) developed a conceptual framework on user perspective on factors of quality of service (QoS) for Mobile SIM networks using 3D fuzzy logic approach as a means of enhancing the MNP scheme in Nigeria. They presented a chronological procedure for the implementation for both the network integration and the customer perspective on quality of service. The work was designed as an initial exploration to demonstrate the feasibility of a flexible trusted platform. However, the study did not explore or empirically determine extent of improvement. Another limitation is that the study did not capture the Key Performance Indices (KPIs) of the network regulators for switching as a result of NP availability. And as such they suggested that these shortcomings could be examined in further studies.

Suman and Anita (2014) carried a comparative analysis of number portability routing schemes on various parameters such as cost, complexity, search time etc, and concluded that ACQ is best suited in terms of cost Whereas Onward routing is the simplest routing method to implement. The costs and complexity associated with the other two methods lie between those of all call query and onward routing. The paper however failed to consider a possible better performance when there is a hybrid between any two of the schemes as implemented in some countries like Sweden (ACQ and Onward Routing), Portugal (ACQ and Query on Release), Hungary (ACQ and Query on Release), France (ACQ and Onward Routing), and Belgium(ACQ and Query on Release).

From the above available literatures they researchers can draw the following conclusions*:*

1. Customers experiencing a high level of satisfaction are likely to remain with their existing providers and maintain their subscription according to (Kagwathi et al., 2013; Kim et al., 2004).
2. Also the finding that service quality is not a significant factor as switching cost suggests that subscribers are likely to remain with their current carriers even when they experience only a low level of service satisfaction is opined by (Habib et al., 2011; Shin, 2006).
3. Sometimes it is found that customers still stay with the service providers despite not satisfied or obtaining low level of satisfaction , (Buehler et al., 2006; Barnhoorn, 2006).

2. Older customers have a lower probability of adopting MNP (Maicas et al., 2009; Shin, 2006; Tiamiyu and Mejabi, 2012).
3. That Number portability has no relevant impact in the prepaid segment, where subscribers place little weight on keeping their mobile phone number. And customers tend to have prepaid services with multiple operators with resultant low churn rates (Oliver, 2009).

4. MNP usage has been found to be higher among post-paid than among prepaid customers (Levin, 2006).

5. That MNP usage will be higher among contract customers than among prepaid customers. On average, contract customers will hold on to their mobile phone for a longer time, and therefore will be more attached to it. Normally, business customers are contract customers. Those are more inclined to utilize MNP services, due to number switching costs. Contract customers are able to get phone subsidies. Customers choose to upgrade their phones with other service providers, (Levin, 2006).

6. That education level is positively linked to switching: subscribers with higher levels of education are relatively more prone to switching mobile 22carriers. However, it is found that gender may not affect subscribers' decisions on switching (Shin, 2006).

7. That dominant GSM operator will lose the most subscribers (Buehler et al., 2006; Smura, 2004; Levin, 2006).

However none of the researches has carried an empirical impact analysis of Mobile Number Portability in Nigeria nor captured the Nigerian's intention to port nor developed a model that can be used to assess the MNP as it is now and predict the future of MNP in Nigeria. And also, hybrid model between ACQ and Call Dropback has not been considered and this is where this research is focusing so as to close a research gap.

CHAPTER THREE
SYSTEMS ANALYSIS AND METHODOLOGY

3.1 Introduction

Systems analysis is the process of gathering and interpreting facts, identifying problems and using the information obtained to recommend improvements to the existing system. It is the whole process of analyzing an existing system with the potential goal of improving or modifying it. Whereas methodology is the way something is done, that is the strategies, steps, or actions taken in order to realize the set objectives. A software development methodology is therefore a series of processes that leads to the development of an application.

Hence this chapter analyzes the current system of porting in Nigeria with the objective of identifying its mode of operations, challenges and weaknesses. A new system is proposed and also analyzed, showcasing its features, expectations and justifying the need for its implementation. The choice methodologies used in developing the proposed system including other tools used in achieving the new system are described in detail. It finally ends with the high level model of the proposed system.

3.2 Analysis of the Existing System

This is a thorough and in- depth study of the existing system so as to understand it and at the same time identify some loopholes that may need to be addressed. In this work the current method of porting was painstakingly studied and examined including the framework and all its weaknesses and strengths are exposed so that the need for a new or improved one becomes obvious.

Mobile number portability which had been the trends in mobile telephoning across the world was made possible for Nigerians by the Nigeria Communication Commission on Monday, April 22, 2013.After the approval of the Mobile Number Portability (MNP) framework by the government, the Commission started making plans to develop the regulatory, legal and technical structure for the implementation of MNP in Nigeria. It also went further and selected a suitable vendor to run the Number Portability Clearing House. The framework spelt out the policies/rules for porting mobile numbers between mobile service providers and subscribers in the country. Porting in Nigeria starts when any subscriber that wants to port a number, first indicates interest and makes

that interest known to his/her network of choice (now the recipient operator). This is done by physically visiting the recipient network with a valid identity card. This method is called recipient-led porting. The subscriber is made to fill a form, giving full personal details, and will be instructed to send the message '**PORT**' to a short code **3232**, to Number portability Clearing House. Immediately this is done, the Clearing House immediately sends a message to the donor network, informing it of the plan by a subscriber to port out of its network. Once this is approved by both networks, the recipient operator (or new network provider) provides a new SIM to the subscriber, and the subscriber is expected to replace the old SIM with the new SIM, to commence making and receiving calls after 48hours. This is summarized in the following steps and in figure 3.1 below for clarity.

(a) Subscriber visits any of the outlets of the service provider he/she intends to switch to.

(b) The subscriber completes the necessary forms.

(c) The new operator verifies and forwards request to Number portability clearing house

(d) If the request is approved, the subscriber is directed to send an SMS;"PORT" to 3232

(e) After processing, the donor operator is informed that this particular subscriber has ported out of its network and a new SIM card will be issued to the subscriber still bearing the old number.

(f) The Number Portability clearing House Admin makes this information available to both the donor and the recipient network and the number is disconnected from the donor network and provisioned in the recipient operator's network.

(g) The location routing number of the recipient operator is defined against the ported –in subscriber.

(h) New location routing number is relayed and updated by all operators

(i) The subscriber is expected to wait for some time (between 24 – 48hrs) within which he/she gets an SMS to commence using the ported number.

(j) A subscriber is also expected by regulation to stay for a minimum of 90days on the new network before any other migration.

These steps are as shown in figure 3.1 below.

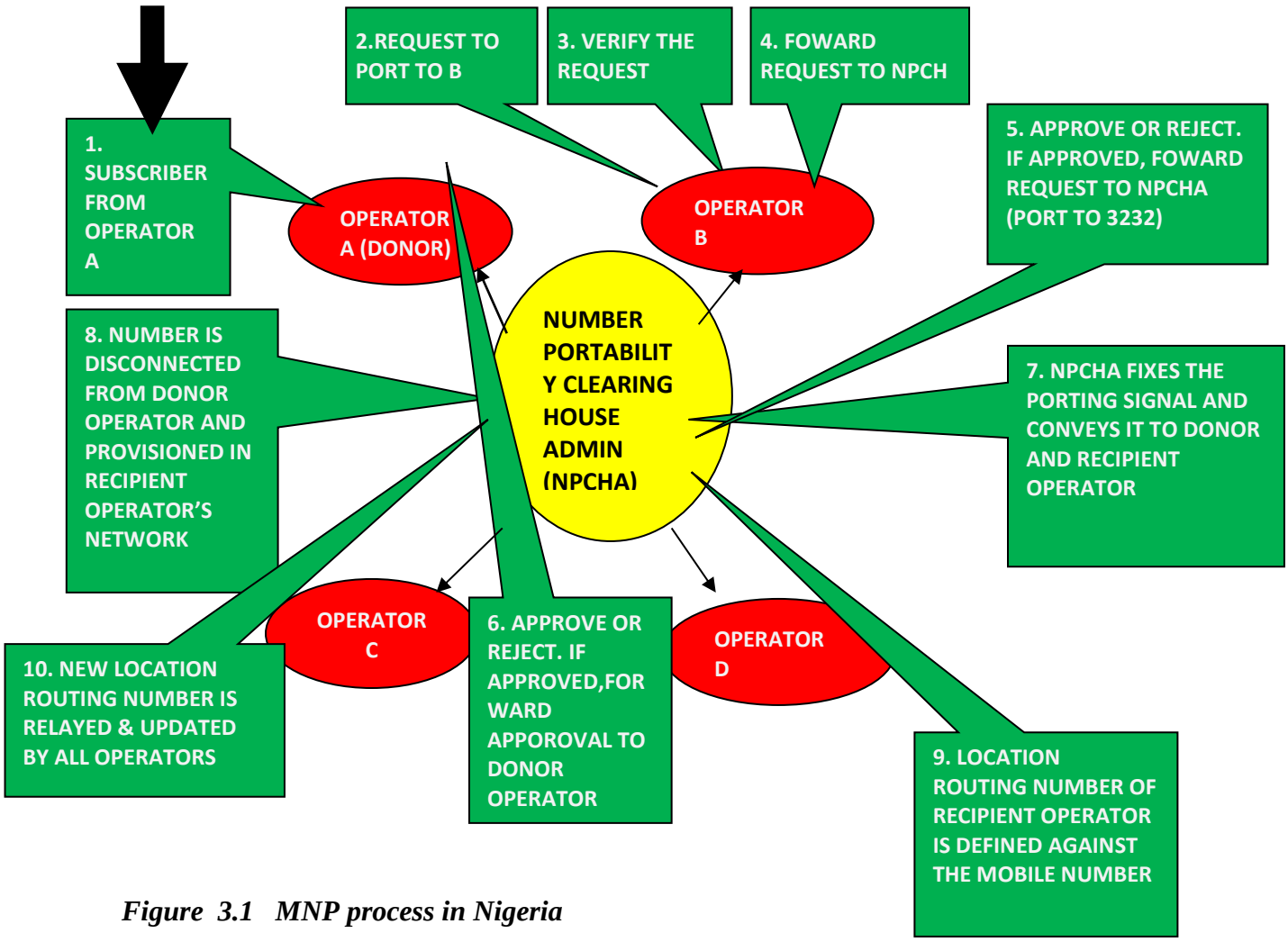


Figure 3.1 MNP process in Nigeria

Having implemented the MNP, Nigeria has joined the league of other countries as a number porting nation. The scheme is expected to deepen competition among mobile network service providers, improve quality of service, and discourage the use of dual SIM phones among other expectations. Indeed, it challenges GSM service providers to sharpen their survival instincts. For the subscribers MNP has at last conferred on them the status reflected in the popular expression: "the customer is king". They are expected to encounter less and less of the shabby treatments and malpractices they have been suffering in the hands of GSM service providers because the scope of

their choice of service provider has been expanded. According to NCC the policy is being implemented in phases beginning with GSM mobile networks. Thus, the networks involved in the present phase of implementation are Airtel, Etisalat, Glo Mobile and MTN.

3.2.1 Existing MNP Call Routing Frameworks

From available literatures it has been established that for porting to be efficient and successful, there are two technical issues that must be streamlined. These issues are (a) the type of database maintained which can be either centralized or distributed; (b) the calls made to the ported number must be re-routed. In the Nigerian context, NCC has already approved Central database system to enable them oversee the operations of the different operators. Then the second technical issue of re-routing of calls which is the actual porting process. This re-routing implies that an incoming call must find its way to the new service provider. Ordinarily the routing information used in routing the call prior to porting would route the call to the old service provider. Call routing is the method used for routing of calls from an originating network to the mobile network associated with a given mobile number whenever a call is made. There are many variations to routing of incoming calls in a ported environment and they are categorized into four and they include: Onward Routing (OR), Query on Release (QoR),Call dropback and All Call Query (ACQ).These call routing frameworks are analyzed as follows:

I. The All Call Query Framework

In this framework responsibility is placed on the originating network to detect any calls to ported mobile numbers, so as to retrieve routing information for those calls, and to reroute them. The donor GSM network is not involved in call handling, and therefore has no responsibilities in this respect. The recipient GSM network has the responsibility to detect that calls are addressed to ported numbers (the recipient network would otherwise route those calls to the donor GSM network). The recipient GSM network shall also complete the calls, which involves retrieval of information from the location register of the central number portability database. In summary, in the ACQ model the originating network upon receiving a call, the originating network sends a query to a centrally administered NPDB which returns a Routing Number (RN) associated with the dialed number. The RN number is used by the originating network to route the call to the

recipient network. This is also called direct routing. Examples of countries that adopt this framework are Nigeria, India, Italy, Poland, Austria, Germany etc. The names of other countries that adopt ACQ are shown in appendix F of this thesis. The framework is shown in figure 3.2 below.

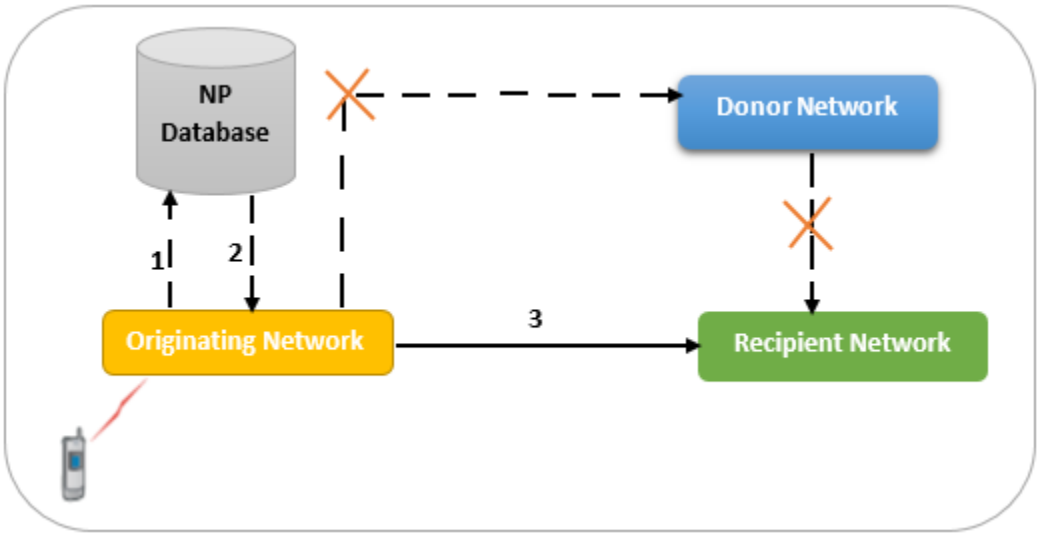


Figure 3.2 All Call Query Framework.

The framework is further explained using the procedural flow diagram figure 3.3 below.

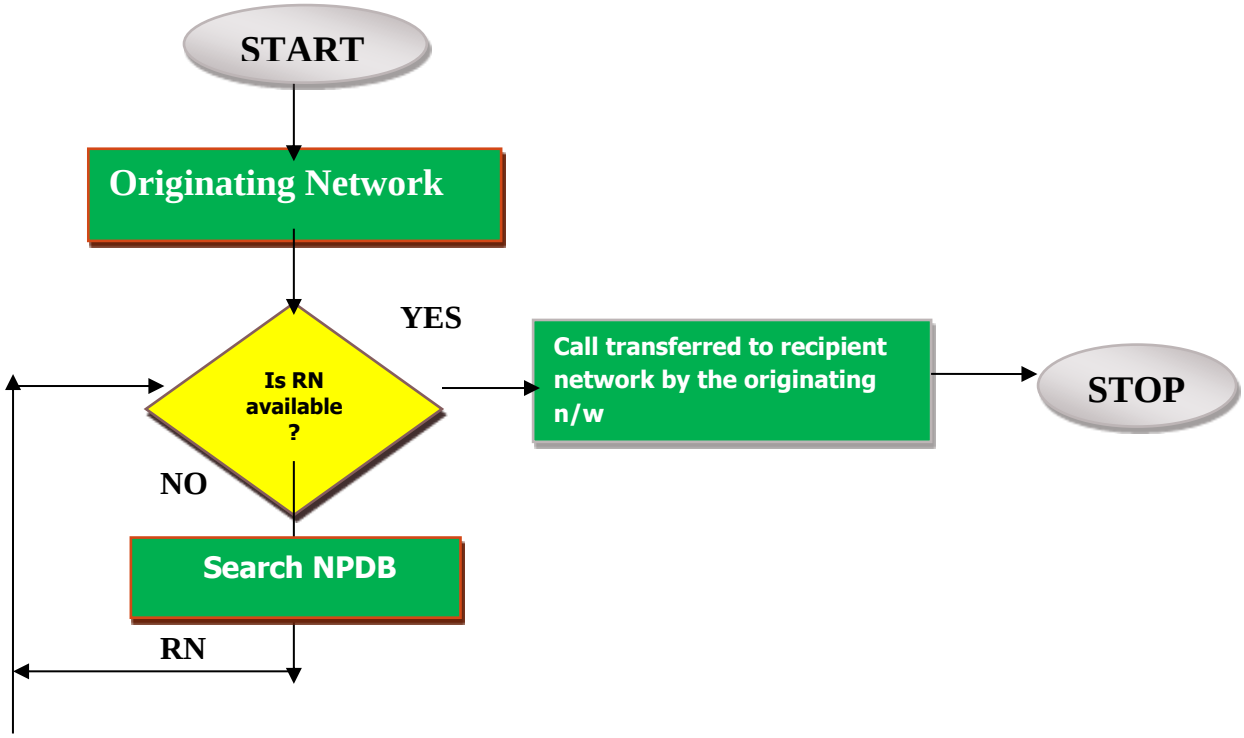


Figure 3.3 Flow diagram of All Call Query Routing Framework.

II. Call Dropback Framework

In this Framework, the originating network first routes the call to the donor GSM network. The donor GSM network detects that number portability has been applied, consults the NP database, and retrieves routing information for the call. The donor GSM network then releases the call back to the originating network with the routing information. On reception of the release message with the routing information the originating network reroutes the call to the recipient GSM network. In a nutshell the call drop back implies that the originating network sends the call to the donor network. The donor network checks its internal database. And if the routing number is not available in its local database, the donor network makes a query to NPDB and finds the routing number associated with the dialed number. After which it returns the routing number to the originating network. The originating network then routes the call to the new servicing network using the routing number. This framework has the advantage that both the donor network and recipient networks are involved in the re-routing of calls. It is illustrated in figure 3.4 below

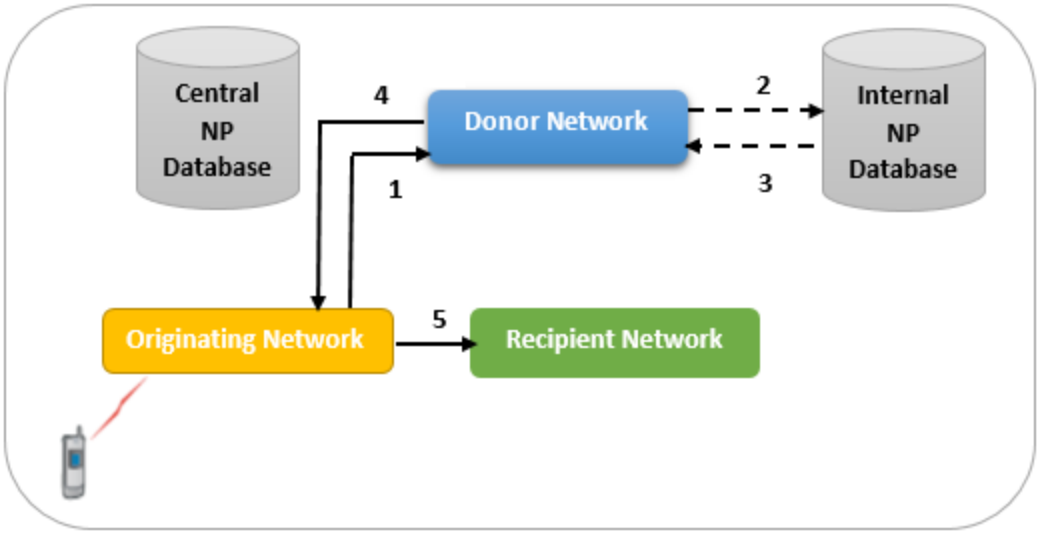


Figure 3.4 ***Call Dropback Routing Framework***

The framework is also further explained using the flow diagram figure 3.5 below.

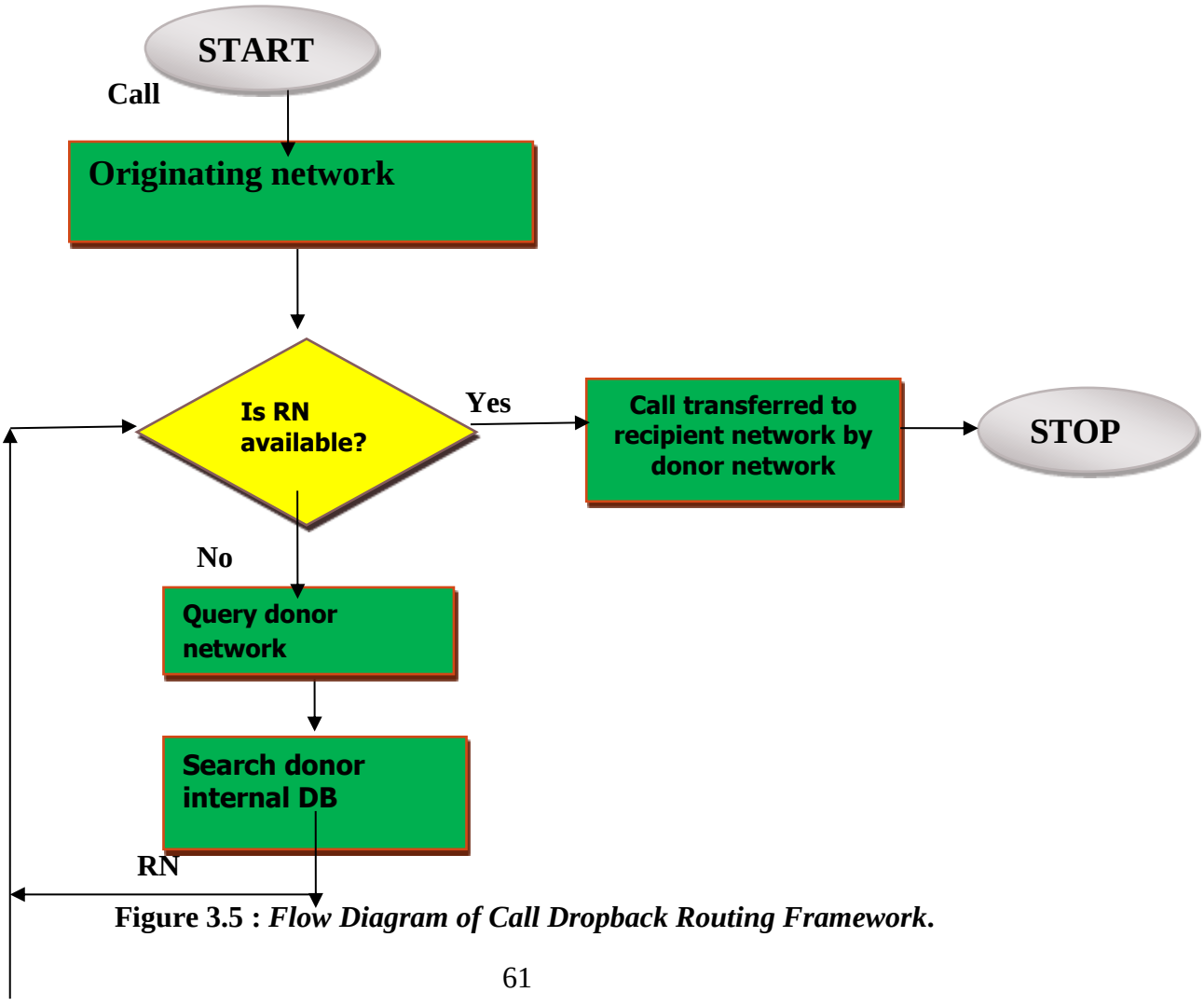


Figure 3.5 : ***Flow Diagram of Call Dropback Routing Framework.***

III. Onward Routing Model

In this framework, the originating network sends the call to the donor network. The donor network checks the Number Portability Database (NPDB) and finds that the number has moved out of donor switch. The donor network makes a query to NPDB. NPDB returns the routing number associated with the dialed number. The donor network uses the routing number to forward the call to new network. The routing of the call via the donor GSM network and require a corresponding high-level network models. Some of the countries that adopt this framework are United Kingdom, Switzerland, Spain etc. This framework is also called call forwarding and is as shown in figure 3.6below.

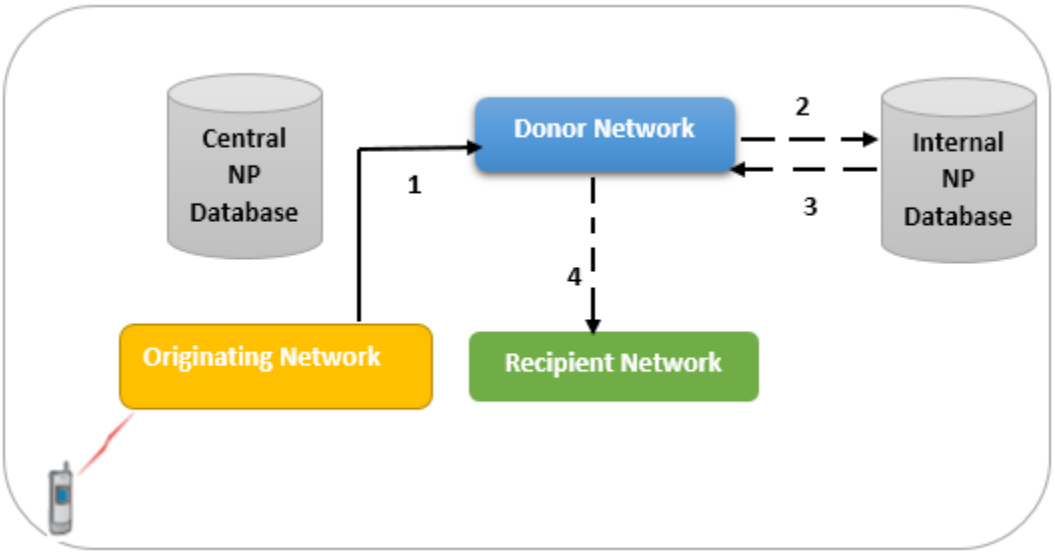


Figure 3.6 Onward Routing Framework.

Onward routing framework is further illustrated using a flow diagram, figure 3.7 below.

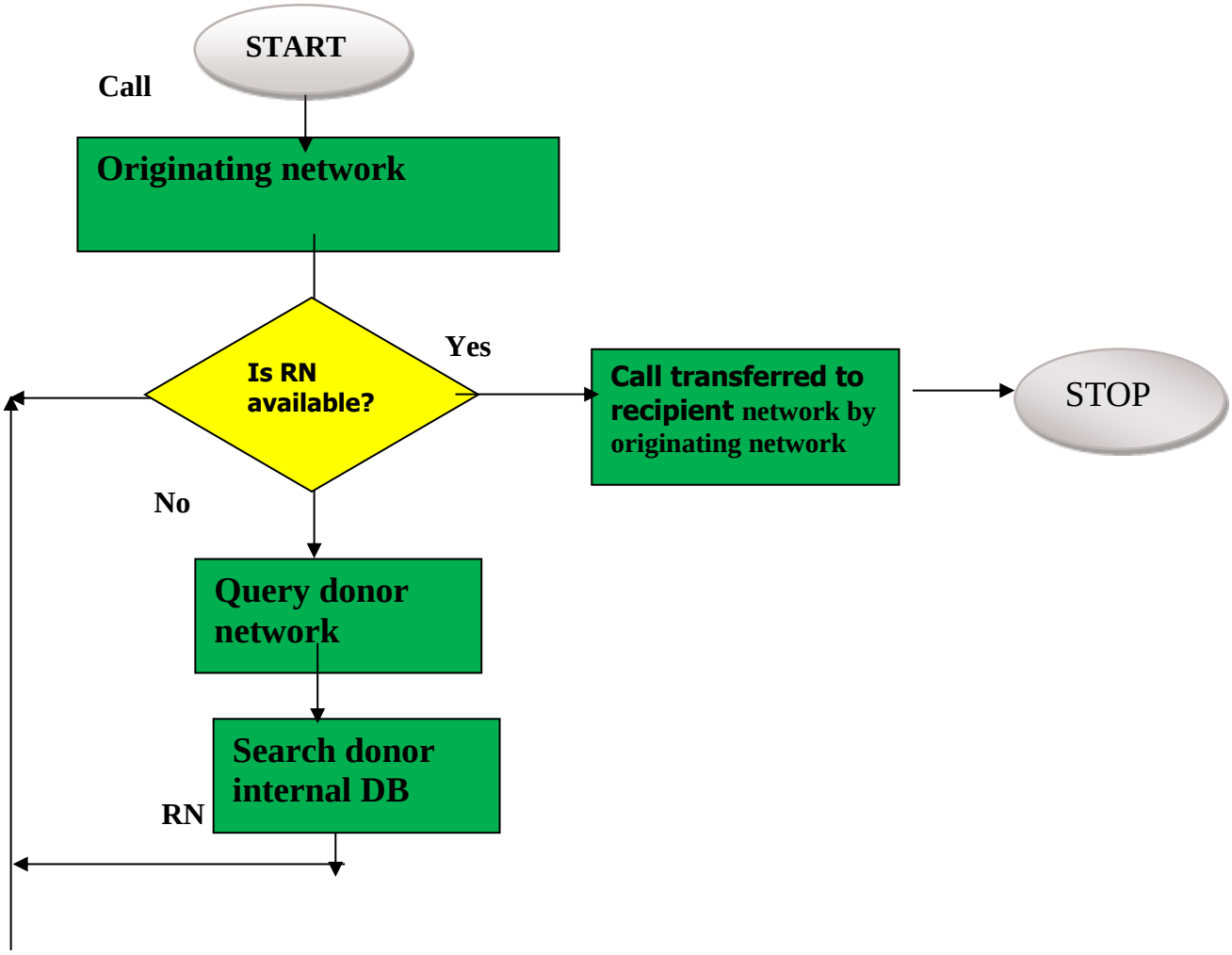


Figure 3.7 Flow diagram for Onward Routing Framework.

IV. Query on Release Routing Model

The originating network in this framework sends the call to the donor network. It then detects that the called number has been ported out to another network. It thereafter releases the call with a special indication telling that called number is ported out. The originating network then sends a query to its own Number Portability Database (NPDB). The NPDB returns the routing number (RN) associated with the dialed number. The originating number then routes the call to the new servicing network. The framework is as shown in figure 3.8 below.

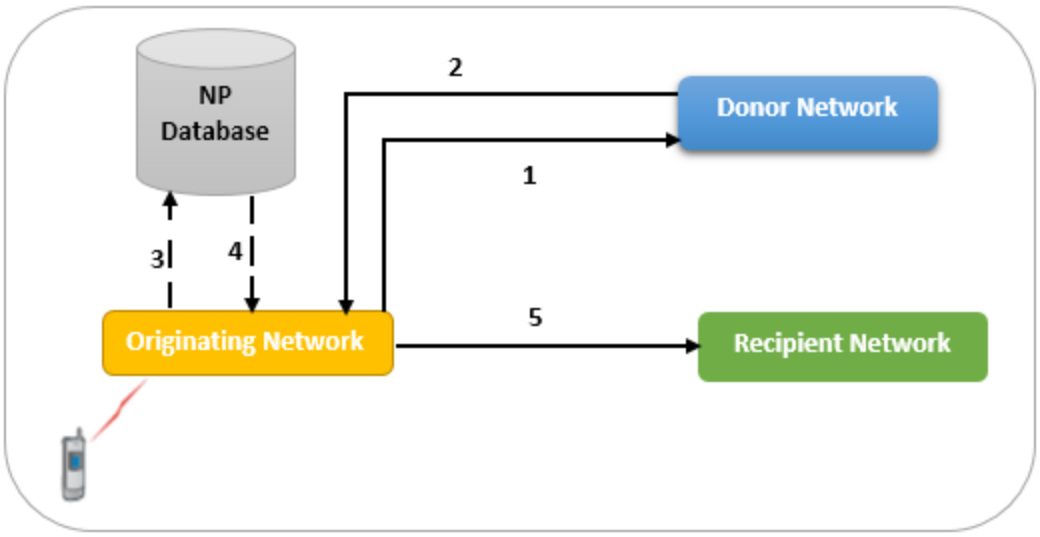


Figure 3.8 Query on Release Framework

This Query on Release framework is also explained using the flow diagram, figure 3.9 below.

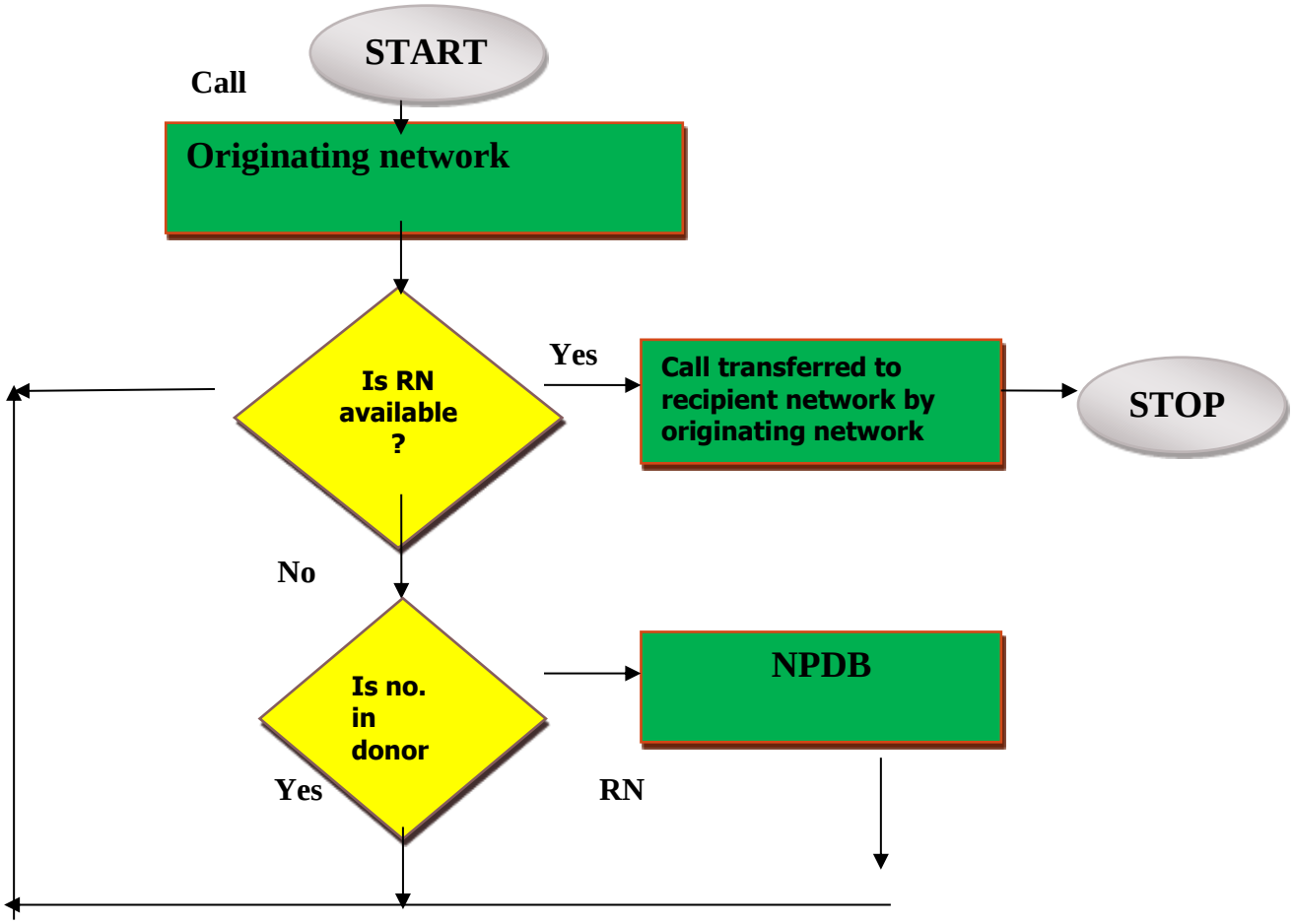


Figure 3.9 Flow diagram for Query on Release Framework.

3.2.2Comparing the Existing Call Routing Frameworks.

The four routing frameworks have their different strengths and weaknesses and these strengths and weaknesses can be compared using the following parameters:

i) Call routing cost
ii) Type of database accepted
iii) Number portability database searched.
iv) Network congestion.
v) Efficiency in searching of routing number.
vi) Efficiency in terms of network resources used.
vii) Need for a dedicated circuit between the originating network and donor network.
viii) Maintenance of Local NPDB by the donor networks.

The table below summarizes the comparison of different call routing frameworks.

Table 3.1: Comparisons of Existing Call Routing Frameworks.

PARAMETERS	**ACQ framework**	**Call dropback framework**	**Onward routing framework**	**Query on Release framework**	**Remarks**
CALL ROUTING COST	**High routing cost**	**Moderate routing cost**	**Low cost**	**Moderate routing cost**	**High routing cost is due to maintaining only a centralized DB for all the operators. .**
TYPE OF DB ACCEPTED	**Centralized DB**	**Distributed DB**	**Distributed**	**Centralized**	**For efficient porting both centralized & distributed DB can be maintained.**
NPDB SEARCHED	**Searches centralized NPDB**	**Searches donor network local NPDB**	**Searches donor network local NPDB**	**Searches centralized NPDB**	**Searching of donor network local DB can reduced time during porting**

EFFICIENCY IN SEARCHING	**Less complex, direct search to NPDB**	**Very efficient since donor n/w only queries its internal DB**	**Efficient also & less complex only donor n/w DB is searched**	**Not efficient because searches donor n/w before NPDB for RN**	**With efficient RN retrieval, porting will be very efficient.**
NETWORK CONGESTION	**Moderate n/w congestion per call**	**Less n/w congestion per call because of involvement of donor n/w**	**Moderate congestion per call.**	**High n/w congest per call**	**Improved quality of service can only be achieved with less n/w congestion**
EFFICIENCY IN TERMS OF N/W RESOURCES USED	**Very efficient. Does not involve donor n/w to route the call**	**Efficient. Donor n/w send RN to originating n/which then routes the call to recipient n/w**	**Efficient. Donor network routes the call to the recipient n/w**	**Not efficient involves the donor n/w &use of NPDB**	**Efficiency in terms of network resources is seen in routing of calls.**
NEED FOR DEDICATED CIRCIUT	**No circuit needed between originating and donor n/w**	**Dedicated circuit is needed for the donor network to communicate with the originating n/w**	**No circuit is needed**	**Dedicated circuit is needed between the originating n/w and the donor n/w**	**The need for dedicated circuit is very important for efficient porting (routing of calls)**
MAINTENANCE OF LOCAL NPDB BY THE DONOR N/W	**Does not need donor n/w local DB**	**Donor local NPDB is maintained**	**Donor local DB is maintained**	**Does not require donor n/w to maintain local DB**	**Maintenance of both centralized NPDB and local NPDB by the network is still advisable**

In summary, from table 3.1 above it is seen that originating network derives the Routing Number (RN) from the Number Portability Database (NPDB) and then routes the call directly to the recipient network in ACQ framework, whereas all other routing frameworks require the donor network to supply the routing number. Therefore, there is the involvement of donor network in

QoR, Call Dropback and Onward routing. A dedicated signaled circuit is equally required between originating network and donor network in QoR and Call Dropback as call is made. The movement of Routing number to and fro the network increases network traffic per call in case of QoR and Call Dropback.

Onward routing is often regarded as the simplest routing method to implement and the all call query method as the most complex, with the other methods lying between these two extremes. This is also reflected in the costs of establishment, with onward routing regarded as cheaper to establish than the all call query method.

However, a country must adopt any of these routing frameworks or a combination of them for efficient porting experience. For example, Nigeria opted for All Call Query, India, All Call Query, UK , Onward routing and so on. Some countries also have adopted a combination of the frameworks ,example Belgium is adopting a combination of All Call Query and Query on Release while Sweden is adopting Onward Routing and All Call Query. The summary of the list of countries and their implemented call routing frameworks is attached as appendix F of this dissertation.

3.2.3Advantages/Strengths of the Existing System

The existing system of porting in Nigeria has few advantages to its credit and they are outlined below:

a) It shows that Mobile Number Portability can work in Nigeria, and this is a sign of growth in the Nigeria`s telecommunication market.

b) MNP implementation has compelled the various service providers in the country to upgrade their technologies to prevent stagnation and to do network maintenance activities to ensure proper operation of the number portability service.

a) It stirred up a healthy competition among the providers .And for the first time in Nigeria the service providers were afraid of losing subscribers to their rivals through porting.

b) There are numerous flavors and bouquet of value-added services offered by the operators since the implementation of MNP.

c) To some extent there has been a competitive tariff package offered by all service providers.

d) Number portability has given freedom to subscribers to choose any service provider of their choice and at will.

e) The All call Query framework being used also has less search complexity.

3.2.4 Weaknesses in the Existing System

Some weaknesses have also been identified in the existing system of porting and call routing in Nigeria and they are as outlined below.

a. A subscriber that intends to port his/her number must be physically present in any of the network provider's outlets in order to declare his/her intention.

b. The intending porting subscriber is meant to manually fill some forms and tender ID cards for proper identification

c. Many subscribers are not motivated to port because of the clumsy administrative procedure in the system.

d. The minimum of 48-hours duration. This is a serious weakness because subscribers would instead prefer to pick up a new SIM and start using almost immediately rather than waiting for 48hours just to port a line.

e. Once a subscriber has been successfully ported to new network, it is mandatory by regulation for the subscriber to stay on that particular network for at least 90days before any other migration. This lock-in period is a major weakness in the existing system because it is possible that the new network provider which the subscriber must have ported-in to is not even better than the old one and as such the subscriber may wish to go back to the donor network almost immediately and that is not possible. The fear of this lock-in period still makes subscribers believe that it is better they stay with the devil they know than to go to the angel they never knew.

c) The Setup cost needed by the network providers to upgrade their technologies and to do network maintenance activities to prevent stagnation and ensure proper operation of the number portability service is very high.

f. Network providers spend more time and money on customer retention programs rather than improving quality of service.

g. The set up cost for the adopted of All Call Query routing framework is high.

h. The adoption of ACQ alone in re-routing of calls to ported numbers in the existing system makes the whole process sluggish. This is mainly because the ACQ is the most complex to

implement as it supports only centralized database which in turn requires considerable national co-ordination.

i. Subscribers don't get benefit of balance / facilities provided by old service provider.
j. There is loss of some specific identity as a result of porting.
k. Involves a number of technical feasibilities as well clerical formalities.
l. Operators not providing up to 3G may not fit in.
m. The centralized database solution adopted in Nigeria though perceived as a long-term target solution for number portability that supports optimal call routing. But it is technically much more complicated to implement and more so involves significant investment.

3.3 Proposed Models

In this dissertation we propose two models, namely:

(a) An MNP predictive model.
(b) A hybrid call routing model.

3.3.1 The Proposed Predictive Model

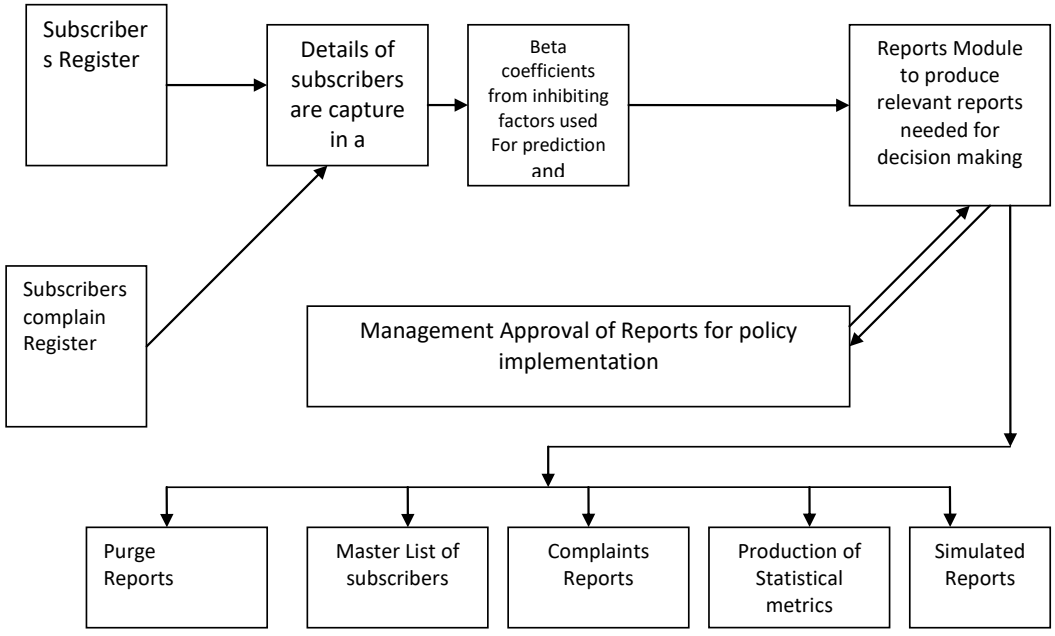


Figure 3.10 High Level Model of the Proposed Predictive Model

3.4. Proposed Hybrid Call routing Framework

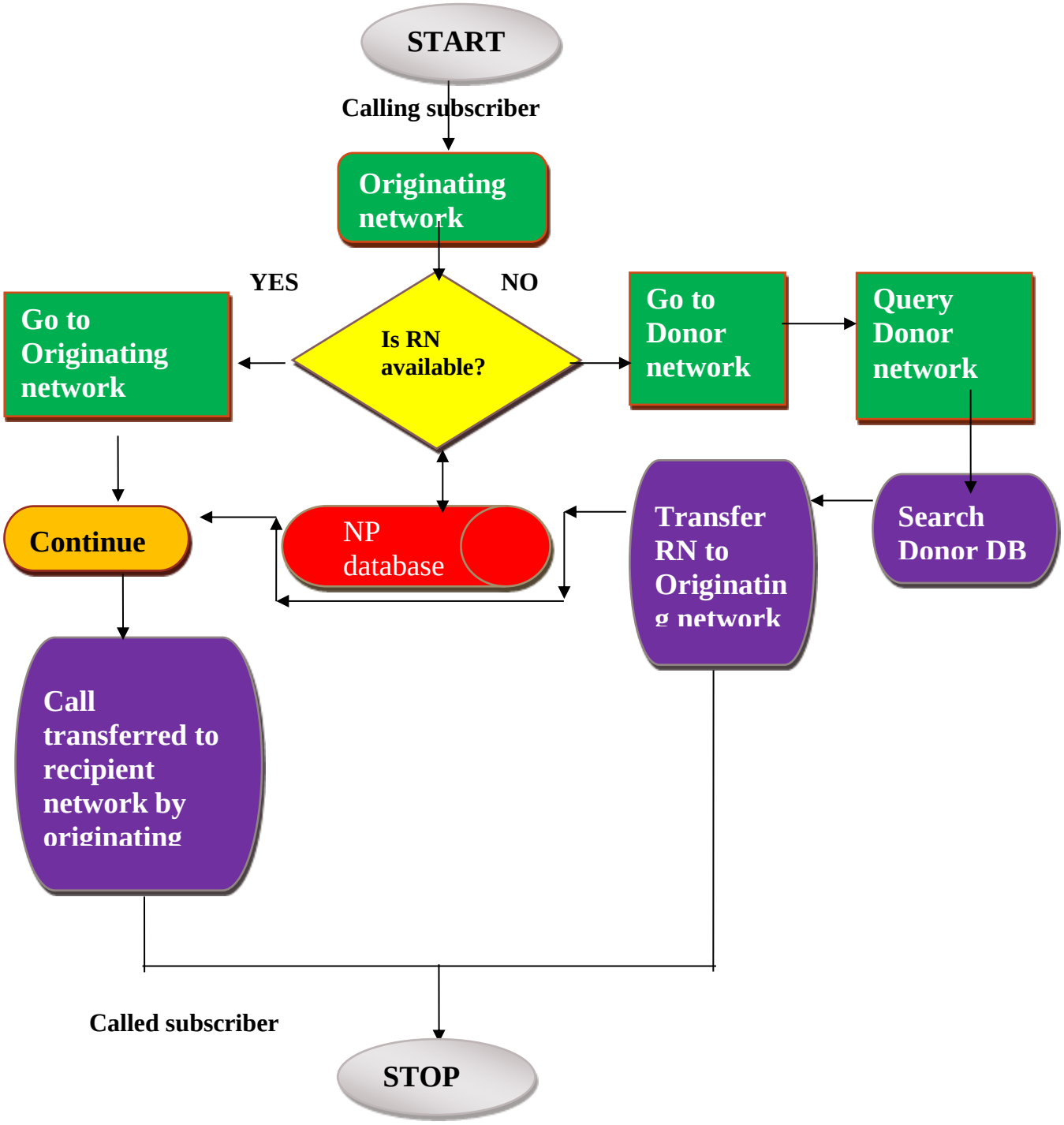


Figure 3.11: The hybrid Call Routing Framework.

3.5 Analysis of the Proposed System

The proposed system is the predictive model for evaluating Mobile Number Portability in Nigeria. In realizing this model, field data were collected using questionnaires distributed to five hundred respondents (500) in all the twenty seven (27) Local Government Areas in Imo State out of which three hundred and fifty six (356) questionnaires were returned. Using the questionnaires the factors inhibiting the non adoption or expansion of the deployed mobile number portability in Nigeria were identified, isolated and subjected to SPSS analysis to extract their beta coefficients. These beta coefficients were plugged into a software developed using the mathematical Model: $Y = a+B_1X_1+B_2X_2+\ldots B_nX_n$ to forecast the future of MNP in Nigeria under three scenarios:

a) If the inhibiting factors (prevailing conditions) that are identified during field work are left as they are.
b) If government removes the prevailing conditions that are discouraging MNP patronage in Nigeria.
c) If government further stiffens the prevailing conditions on MNP.

The proposed predictive model is a combination of a model architecture that captures the impact of MNP since its inception in Nigeria and a complementary software that is bound to sharpen the strategy to improving the MNP adoption so that it can become a huge success in Nigeria.

In addition to the predictive model proposed above, the dissertation also proposes a hybrid call routing model as part of its contribution to ensure that mobile number portability becomes a success in Nigeria. Given the loopholes in the existing call routing frameworks, it becomes paramount to introduce a model that can combine the advantages of two frameworks to produce an enhanced call routing framework for Nigeria. Hence in this research, a hybrid model architecture between All Call Query and Call Drop Back frameworks has been developed. In the hybrid framework, each network operator keeps and maintains its own local number portability database alongside the central number portability database. When a call is made to a number, the originating network now has the option to either query the central database or liaise with the donor network to query its local database in order to retrieve the routing number with which to route the call. The hybrid model combines the functionality of ACQ and Call Dropback models. This hybrid routing model ensures less search complexity which in turn ensures faster porting, less network seizures and less volume of dropped calls which are being experienced today even with the MNP in place.

3.6 Merits of the Proposed System

The merits of the proposed models are discussed below.

a) The predictive model can assist policy makers in telecommunication to assess the performance of MNP under the three key scenarios and also help in shaping policy trust on MNP.

b)The predictive model also assesses the impact of MNP on the Nigerian economy since its adoption.

c) With this model, it is possible to find out why Nigerians have not fully embraced the deployed Mobile Number portability.

d) The predictive model is also able to identify the factors responsible for the non expansion of MNP in Nigeria

e)The model is able to predict what happens if the existing factors (bottlenecks) are removed or minimized or stiffened.

f) It can also make meaningful recommendations on the improvement of MNP.

g)The utilization of the two databases in proposed hybrid model makes the model more efficient by reducing the time required to retrieve the routing number with which to route a call to a number.

h) This routing model combines the efficiencies of the All Call Query and Call Dropback models and offers less search complexity, moderate cost of implementation, flexibility of network resources and reduced network traffic.

i) The hybrid model becomes more cost effective as porting becomes more common or prevalent.

3.7 Demerits of the Proposed System

The demerits of the proposed system are outlined below:

a) The predictive model proposed above may predict the future of MNP in Nigeria but it is not full proof. In fact, no predictive model is full proof, but can at best be an extraction of the future.

b)Also no real life event is linear. There is always a variation from the prediction to reality. Hence this prediction model is only an estimation of what the future of MNP in Nigeria would be. And as such would not be expected to be perfect.

c) In the hybrid model, major changes to the signaling protocol are necessary to make it work.

3.8 Justification of the Proposed System

Mobile number portability is one of the revolutionary steps in the development of telecommunication services in Nigeria. But in Nigeria today, it is very obvious that the porting game is yet to spiral into a full-scale competitive storm. This can largely be attributed to the fact most subscribers have remained circumspect, opting to remain with their old service providers rather than dare uncharted waters. The excitement and expectation which trailed the launch of the scheme has all but died out. It is also clear that little has changed in terms of network coverage and the volume of dropped calls and intermittent service seizures, and other quality of service concerns. The much-awaited value-laden services promised by the operators of the various networks remain a mirage. There is as yet little accountability (to the customer), billing integrity, as well as any significant difference in the quality of services offered. Subscribers continue to be disturbed by unsolicited SMS wired to their phones for unsubscribed services and promos run by service providers.

But since Nigerians would not carry placards to compel these operators to render services that would encourage porting, they are anxiously relying on the NCC/ government to protect them from the obvious complacency and lack of initiative of the service providers. The truth is that many more people really want to port and are waiting to be encouraged.

The implementation of this work therefore becomes inevitable since the research did not only assess the impact of MNP in Nigeria, it also identified the inhibiting factors affecting the non expansion or acceptability of MNP in Nigeria, the model developed can be used to predict the growth or decline of MNP in Nigeria with respect to the identified impediments or inhibiting factors and as such will be of immense assistance should government/ NCC decide to revisit the mobile number portability as earlier on promised from the available literatures.

Also the hybrid call routing model above combines the following features of the ACQ and Call Dropback models:

a) cost effectiveness of the ACQ model
b) Less search complexity feature of both the ACQ and call dropback models.
c) Efficiency of Call dropback model interms of the network resources used.

d) In the hybrid model there a low network traffic per call and is therefore cheaper, faster and records a low number of dropped calls which are the ingredients of good quality of services that porting is meant to offer.

3.9 Methodology

A system development methodology is a framework that is used to structure, plan, and control the process of developing an information system. Common methodologies include waterfall, prototyping, iterative and incremental development, spiral development, rapid application development, and extreme programming. A methodology can also include aspects of the development environment (i.e. IDEs), model-based development, computer aided software development, and the utilization of particular frameworks (i.e. programming libraries or other tools).

Due to the nature of this research, this dissertation deploys the following methodologies:

a. Mathematical/Statistical methodology used to extract field data for analysis and interpretation.
b. Hypothetical - deductive methodology: This is an example of mathematical/statistical methodology using questionnaire approach in which source data are subjected to analysis after being collated.
b. The standard procedure called "The Structured Systems Analysis and Design Methodology (SSADM)" a thorough fact-finding technique will be adopted in investigating and analyzing the existing system, its modes of operation and the challenges inherent in it.
c. While the object oriented paradigm (VB.net) will be used to write the codes.
d. Finally prototyping will be used in packaging the model.

3.10 Justification of Choice Methodology

Each of the methodologies above is chosen for one purpose or the other in this dissertation. Some of the areas of applications are as discussed in the subsections below.

3.10.1 Mathematical and Statistical Models

These types of models are obviously related, but there are also real differences between them. The following mathematical models are employed in this work:

a) **Mathematical Models:** Mathematical models grow out of equations that determine how a system changes from one state to the next (differential equations) and/or how one variable depends on the value or state of other variables (state equations) These can also be divided into either numerical models or analytical models. For example in the course of this research a mathematical model was formulated thus: $Y = a+B_1X_1+B_2X_2 + \ldots B_nX_n, B_o \equiv a =$ constant ,where $\hat{Y}$ is the predicted or expected value of the dependent variable, X_1 through X_p are p distinct independent or predictor variables, b_0 is the value of Y when all of the independent variables (X_1 through X_p) are equal to zero, and b_1 through b_p are the estimated regression coefficients. Each regression coefficient represents the change in Y relative to a one unit change in the respective independent variable.

b) **Statistical Model:** A statistical model is a formalization of relationships between variables in the form of mathematical equations. A statistical model describes how one or more random variables are related to one or more other variables. The model is statistical when the variables are not deterministically but stochastically related. In mathematical terms, a statistical methodology is frequently thought of as a pair of set of possible observations and the set of possible probability distributions. It is assumed that there is a distinct element of which generates the observed data. Statistical inference enables us to make statements about which element(s) of the set are likely to be the true one. Some other statistical models are the general linear model (restricted to continuous dependent variables), the generalized linear model (for example, logistic regression), the multilevel model (for example multiple regression), and the structural equation model. In this dissertation the multiple regressions were utilized in analyzing the data since the variables are stochastically related.

3.10.2 Hypothetic-Deductive Models

A hypothetic-deductive model or method is a proposed description of scientific method. According to it, scientific inquiry proceeds by formulating a hypothesis in a form that could conceivably be falsified by a test on observable data. A test that could and does run contrary to predictions of the hypothesis is taken as a falsification of the hypothesis. A test that could but does not run contrary

to the hypothesis corroborates the theory. It is then proposed to compare the explanatory value of competing hypotheses by testing how stringently they are corroborated by their predictions.

One example of an algorithmic statement of the hypothetic-deductive method is as follows:

a) Use your experience: Consider the problem and try to make sense of it. Gather data and look for previous explanations. If this is a new problem to you, then move to step b.

b) Form a conjecture (hypothesis): When nothing else is yet known, try to state an explanation, to someone else, or to your notebook.

c) Deduce predictions from the hypothesis. For instance, if you assume b is true, what consequences follow?

d) Test (or experiment). Look for evidence (observations) that conflict with the predictions in order to disprove b. It is a logical error to seek c directly as proof of b. This formal fallacy is called affirming the consequent.

One possible sequence in this model would be a, b, c, d. If the outcome of d holds, and c is not yet disproven, you may continue with c, d, a, and so forth; but if the outcome of d shows c to be false, you will have to go back to b and try to invent a new b, deduce a new c, look for d, and so forth. Note that this method can never absolutely verify (prove the truth of) b. It can only falsify b.

This methodology is very helpful since the researchers needed to ascertain if the variables identified as MNP inhibiting factors actually have relationship with non expansion of MNP in Nigeria. To assess also the impact of MNP since its introduction a hypothesis is equally required. Hence, the choice of the hypothesis-deductive model.

3.10.3 Structured Systems Analysis and Design Methodology

Structured systems analysis and design methodology (SSADM) is a kind of waterfall methodology by which an information system design can be arrived at. SSADM can be thought to represent a pinnacle of the rigorous document-led approach system design. There are three most important techniques that are used in SSADM are: Logical modeling, Dataflow modeling, and Entity behavior modeling. Logical data modeling is the process of identifying, modeling and documenting how data move around an information system. Data flow modeling examines processes (activities that transform data from one form to another), data stores (the holding areas for data), external entities (what sends data into a system or receives data from a system), and data flows (routes by which data can flow). Entity behaviour modeling is the process of identifying,

modeling and documenting the events that affect each entity and the sequence in which these events occur. The SSADM method involves the application of a sequence of analysis, documentation and design tasks concerned with the following stages namely: Feasibility study, investigation of the current environment, business system options, requirement specification, logical design, and physical design.

In this research the need for this SSADM methodology is very obvious. The mature separation of logical and physical aspects of the system, the well-defined techniques and documentation and the user involvement aspects of SSADM are needed in order to realize this project.

3.10.4 Prototyping Methodology

Software prototyping is the development approach of activities during software development, the creation of prototypes, i.e. incomplete versions of the software program being developed. The basic principles are: not a standalone complete development methodology, but rather an approach to handle selected parts of a larger, more traditional development methodology like incremental, spiral, or rapid application development. This methodology attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease-of-change during the development process. The user is involved throughout the development process, which increases the likelihood of user acceptance of the final implementation. And small-scale mock-ups of the system are developed following an iterative modification process until the prototype evolves to meet the users' requirements. While most prototypes are developed with the expectation that they will be discarded, it is possible in some cases to evolve from prototype to working system. A basic understanding of the fundamental business problem is necessary to avoid solving the wrong problem. For an information system of this nature, trying to develop a holistic system can be risky and cumbersome as well. Hence, the need for prototyping methodology that breaks the system into smaller manageable units.

3.10.5 Object Oriented Methodology

Another important development methodology is the Grady Booch's (OOD), also known as Object Oriented Analysis and Design Methodology (OOADM). This model makes use of six attributes: class, object, state transition, interaction, module, and process. Object Oriented Programming

(OOP) enables one to consider a real life entity as an object. In OOP, one creates a basic structure of a program and keeps extending the functionality of the program. The Object Oriented programming models the real world more accurately than the conventional or procedural approach. In OOP objects are independent of each other and maintained separately. One can make modifications on the required objects without affecting the functionality of others. OOP also enables one to evolve various versions of the software. Example of OOP languages are C++, Java, Visual basic, Visual Basic .net, C#, Python etc.

The Visual Basic.net (VB.net) is an object oriented programming language that is very easy to understand and code. A little background in the normal basic programming language is already an advantage. So in order to program this work a simple OOP that is to understand and modify is necessary, and that is why VB.net is the choice programming language for the dissertation.

3.11 Research Questions and Hypotheses

In a research of this nature the importance of hypothesis cannot be over emphasized. A hypothesis is an explanation or theory which has not yet been proven to be true. It is a scientific way of making inquiry to either prove or disprove any impression using a test on observable data. A test that could and does run contrary to predictions of the hypothesis is taken as a false, while a test that could but does not run contrary to the hypothesis corroborate the theory. And in this research the following research questions were formulated.

i) Why have Nigerians not fully embraced the deployed Mobile Number portability?

ii) What are the factors responsible for why MNP is yet to succeed in Nigeria?

iii) What is the impact of MNP since its inception on quality of service, employment opportunity for Nigerian youths, telephone density/internet diffusion, socio-economic revolution, call tariffs and fierce competition?

iv) What can be done to enhance MNP adoption in Nigeria?

v) Finally, the ultimate question: Is it possible to design a predictive model that will predict the growth trend of MNP in Nigeria if: one, the current inhibiting factors/government policies persist, two, if government decides improve/ remove the factors and third, if these government policies/ factors get worsen.

To answer the above questions, data needed to be gathered, and to gather these data questionnaires are distributed to subscribers. And to test the data the following two hypotheses have been postulated and after which the result are as presented below.

H_{01}: MNP failure in Nigeria has no relationship with the inhibiting factors: lack of formal education to the public on the benefits of MNP, clumsy porting administrative procedure, poor quality of service, switching costs, difficulty in porting, 48hr duration for porting to be achieved, 90-days lock-in period, and the need to be physically present in any of the network outlets in order to initiate a port.

$H_{A1:}$ The above factors in the null hypothesis have relationships with the failure of MNP in Nigeria.

H_{02}: MNP introduction in Nigeria has no impact on: quality of service, increased telephone density/internet diffusion, fierce competition, employment opportunity for the youths, reduced call tariffs, socio-economic revolution.

H_{A2}: MNP has impact on all the issues in the null hypothesis.

3.12 Data Collection and Analysis

3.12.1 Data Collection

Questionnaires were distributed to five hundred (500) respondents in all the 27 Local Government Areas in Imo State, out of which a total of 356 respondents returned their questionnaires. The questionnaire was meant to carry out a survey that identifies the demographic profile of subscribers in Nigeria, find out the factors responsible for why Mobile Number Portability is yet to succeed in Nigeria, rate the impact of Mobile Number Portability in Nigeria, and finally solicited for the recommendations of the respondents. All these are as indicated in the sample questionnaire attached in appendix C of this work. This survey form (questionnaire) as found in appendix C was designed and divided into four clusters namely clusters 1-4.

3.12.2 Report on Cluster One

Cluster one collected the demographic profile of respondents. Demographic findings show that the respondents comprised of male and female respondents, majority of them use MTN network with a few distributed to other networks. The table 3.2below summarizes the findings

Table 3.2: Demographic Profile of Respondents

No. of female respondents	154	43.3%
No. of male respondents	202	56.7%
No. aware of MNP	216	60.7%
No. in support of MNP	283	79.5%
No. that has ported before	79	22.2%
No. that intend to port	204	57.3%
No. that said network not improved	234	65.7%

From the above table though majority of the respondents are aware of MNP, a total of 140 respondents are not aware of the introduction of MNP in Nigeria. Observation also shows that many respondents (283 or 79.5%) are in support of the scheme, and therefore deserves to be improved upon. Also it is seen that only a handful (79 or 22.2%) has ported before, may be for reasons identified above. This is an indication that the Nigerians have not fully embraced the scheme. On the other hand the report shows that many people are interested in the scheme and intend to port if the problems inherent in the scheme are addressed. And finally it has been established empirically that network has not improved despite the introduction of MNP.

3.12.3 Report on Cluster Two

Cluster two rated the factors (here known as Inhibiting factors) responsible for non- workability of MNP in Nigeria. These factors as identified after systems analysis above include: No formal education to the public on the benefits of MNP, clumsy porting procedure, switching costs, poor quality of service even with the new network ported to, loss of contact after migration (porting), difficulty in practically switching (porting) numbers, the 48hr duration for a successful port, the 90days lock-in regulation before the next migration and the need to be physically present in order to initiate a port. All these factors were identified as the factors responsible for why Mobile

Number Portability is yet to Succeed in Nigeria and they were subsequently subjected to a five point Likert scale 0-4 comprising 0=> not important; 1=> less important; 2 => marginally important; 3 => important; 4 => very important.

The data collated were analyzed using multiple regressions (ANOVA) and the result is as shown in table 3.3 below:

Table 3.3: Result of Cluster Two Regression Analysis

Regression Ho1 Cluster 2

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Averag*	*ariance*
Column 1	346	802	2.32	1.21
Column 2	343	730	2.13	1.12
Column 3	344	672	1.95	1.29
Column 4	333	712	2.14	1.32
Column 5	341	708	2.08	1.39
Column 6	342	659	1.93	1.38
Column 7	341	694	2.04	1.27

ANOVA

Source of Variatio	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	35.70805568	6	5.95	4.64	0.000108001	2.102384188
Within Groups	3059.053869	2383	1.28			
Total	3094.761925	2389				

Anova: Single Factor Ho 2: MNP has no relationship with No formal education to the public, clumsy adm procedure, switching costs Poor quality of service even with the network being ported to, loss of contact due to migration, difficulty in practically switching numbers, 48-hours duration before a complete porting is achieved, 90 days lock in period before the next migration, the need to be Poor quality of service even with the network being ported to, losss of contact due to migration difficulty practically switching the need to be physically present in any of the networks outlet in order to initiate a port.

From table 3.3 above the f-cal $\alpha 0.05$= 4.63609013 is greater than F-critical = 2.102384 and the P-value of 0.000108001 being less than α= 0.05 indicates that the first null hypothesis which says that "MNP has no relationship with the factors…" is rejected and we then accept the alternative which states that "MNP non adoption in Nigeria has relationship with factors…". This has empirically shown that the above factors are actually responsible for non-workability of MNP in Nigeria. And based on this the NCC, in collaboration with the government should look into these factors in order to achieve functional porting of numbers in Nigeria.

Also, the data were again subjected to further analysis to enable us extract the beta coefficients of these factors that are responsible for non-adoption of MNP in Nigeria. Their beta coefficients will be plugged into the software to be designed and they will be used as predictors of MNP progress when no adequate measures are taken to either improve or remove them. This analysis was done using SPSS multiple regression and the result is as attached in appendix D of this work.

From the report of the analysis we were able to deduce the predictive model as:

$$\mathbf{Y = a + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n}$$

Where Y is our dependent variable and that is MNP, a = the intercept, and β is the beta coefficients obtained from the SPSS result, and X_1-X_n represent our variables (the MNP inhibiting factors).

3.12.4 Report on Cluster Three

Cluster three was used to assess the impact of MNP on the following areas as projected by NCC: impact on quality of service, impact on

employment opportunity for Nigerian Youths, impact on low sales of dual SIM phones, impact on call tariffs charged by network providers and impact on fierce competition.

The result is as shown in table 3.4 below and the result shows a P- value 3.3E-160 is less than α = 0.05 and F-cal $\alpha 0.05$ =147.376 is greater than F-critical$\alpha 0.05$ =2.102, indicating that the second null hypothesis which states that "MNP introduction in Nigeria has no impact on: quality of service, increased telephone density/internet diffusion, fierce competition, employment opportunity for the youths, reduced call tariffs, socio-economic revolution" should be rejected and the second alternative hypothesis accepted. See table 3.4 below.

Table 3.4: Result of Cluster Three Analysis

Anova: Single Factor		#NAME?					
MNP IMPACT							
SUMMARY							
Groups	*Count*	*Sum*	*Average*	*Variance*			
Column 1	355	51	0.143662	0.1233707			
Column 2	355	849	2.3915493	1.6908888			
Column 3	355	674	1.8985915	1.7975969			
Column 4	355	709	1.9971831	1.7542293			
Column 5	355	723	2.0366197	1.9675818			
Column 6	355	741	2.0873239	2.0234264			
Column 7	355	967	2.7239437	2.07612			
ANOVA							
Source of Variat	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
Between Gr	1444.2696	6	240.7116	147.37599	3.34E-160	2.1022389	
Within Group	4047.3577	2478	1.6333163				
Total	5491.6274	2484					

3.12.5 Report on Cluster Four

Then cluster four sampled the general opinion of the respondents concerning the deployed MNP in Nigeria under the following:

(a) Whether MNP should be cancelled out rightly or improved upon. Results show that out of the 356(100%) respondents, 283(79.5%) are in support that MNP should be improved upon while only 88 (24.7%) respondents said that MNP should be cancelled out rightly.

(b) This cluster also looked into how the quality of service can be improved upon beyond MNP. Majority (ie a total of 247 or 69.4%) are of the opinion Government should through NCC enforce a stringent regulation to the network providers or even rehabilitate landlines which will further put these mobile operators on their toes if they discover that most subscribers are now diverting to landlines. Rehabilitating landlines implies rehabilitating also NITEL which will surely create good job opportunities to the Nigerian citizenry. They also added that call tariffs are still very cheap in countries like USA, Canada and UK is because of the co-existence of the mobile communication and landlines.

(c) We equally used this cluster to gather suggestions from the respondents on the way forward towards improving teledensity and internet diffusion can be increased. The common suggestion is that the network providers should have parallel tariffs both for calls and data bundle which every provider must comply with. Government can also subsidize the tariffs per MB for internet /browsing.

(d) Finally on the way forward as to what NCC should do to attract Nigerians to porting. The summary of the all the suggestions is that NCC should work more on the existing clumsy procedures of porting lift the lock-in 90days which is discouraging, and the need to be physically present at the office of any of the network providers.

CHAPTER FOUR
SYSTEM DESIGN

4.1 Introduction

This chapter intends to identify the problems of MNP growth in Nigeria and design a Model that can be used to monitor MNP growth trajectory. It also tries to design and show the architecture and the algorithm for the implementation of the proposed hybrid call routing model for MNP in Nigeria. The chapter as such presents the following components relevant for the development of the predictor: Objectives of the design, the control centre and specifications of the engine including database structures, Program modules, Mathematical specifications, Input/output formats, overall dataflow diagrams of the proposed solution, all relevant algorithms to drive the engine, data dictionary and justification for the programming language platform are explained. The statistical indices identified in chapter three will be deployed in the programming of the inference engine (MNP Growth Trend Trajectory Simulator/Predictor - MNPGTTS). As an addition to this work, the database structure, input/output specifications or formats including the detailed algorithm for the implementation of the hybrid call routing framework have all been designed in this chapter.

4.2 Objectives of the Design

The objectives of this software design are:

To design a computational model that will be capable of:

a. Capturing all subscribers and store them in a database.

b. Capture their complaints on a regular basis and also store in a database.

c. Identify the Inhibiting factors and use a specialized multiple Regression tool encapsulated in the following equation to manipulate/simulate the inhibiting factors to alter the trajectory of MNP growth using the model equation:

$$Y = a+B_1X_1+B_2X_2+\ldots B_nX_n \qquad (4.1)$$

4.3 Control Centre Design

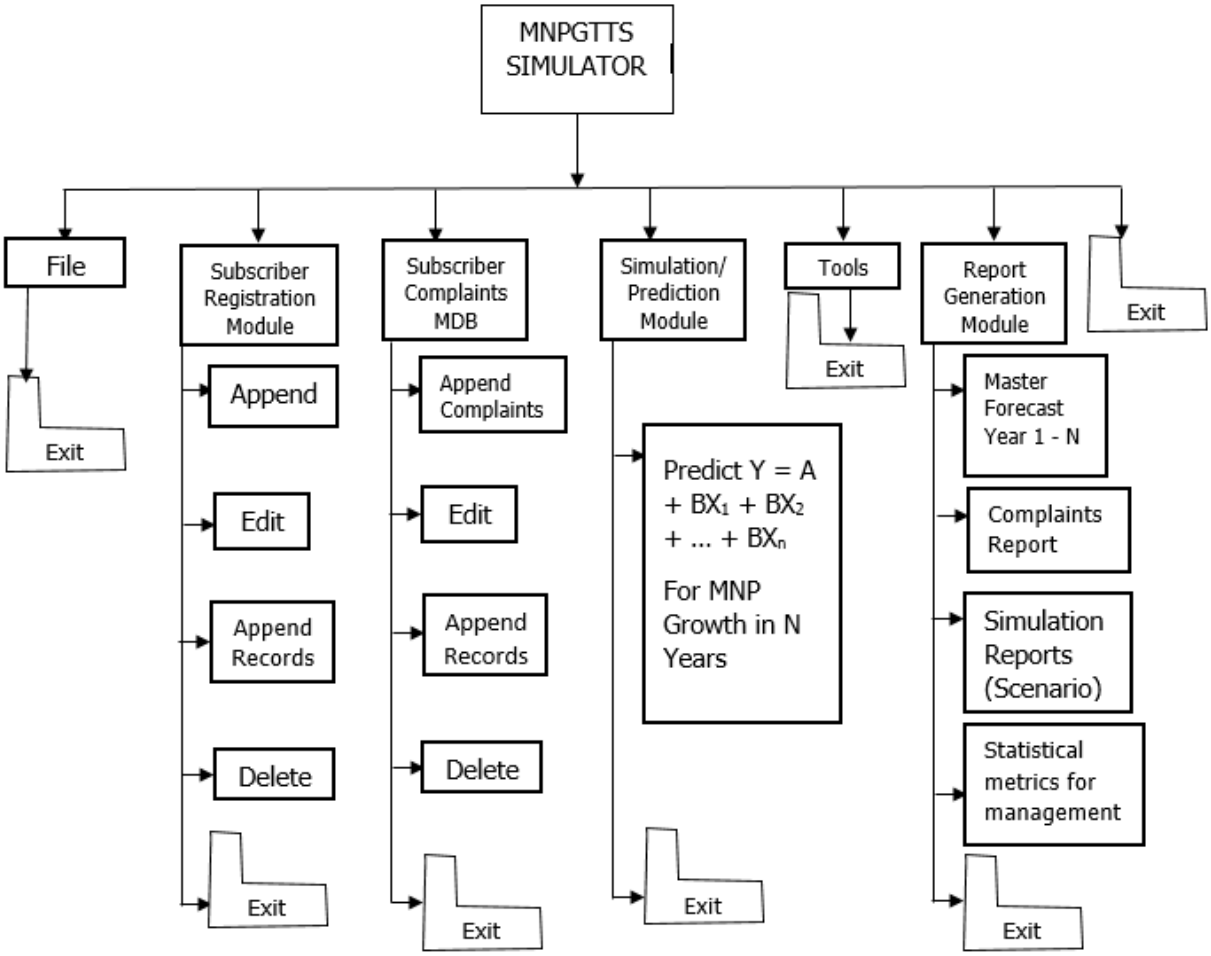


Fig. 4.1: Control Centre

4.4 Database Structure

Three databases have been identified:

a. Subscriber database - Complaint.MDB

b. Subscriber complaints database – Registration.MDB

c. Inhibiting factors database – SimTry.MDB

They are as shown in tables 4.1, 4.2, 4.3 below.

Table 4.1: Subscribe– Registration Database-SRDB

S/No	Field Name	Field Type	Size
1	Subscriber's Name	Text	50
2	Id Number	Text	15
3	Telephone Number	Text	15
4	Email Address	Text	25
5	Remark	Text	255

Table 4.2: The Subscriber's Complaints Database Table.

S/No	Field Name	Field Type	Size
1	Subscriber's Name	Text	50
2	Id Number	Text	15
3	Telephone Number	Text	15
4	Email Address	Text	25
5	Cell	Text	20
6	Nature of Complaint	Text	255
7	Action Taken	Text	255

Table 4.3: Inhibiting Factors Database – SimTry.MDB

S/No	Field Name	Field Type	Size
1	Year	Text	5
2	M1	Number	8
3	M2	Number	8
4	M3	Number	8
5	M4	Number	8
6	M5	Number	8
7	M6	Number	8
8	M7	Number	8
9	M8	Number	8
10	M9	Number	8

4.5 Mathematical Specifications

This specifies the equations to be deployed in coding the simulator/Predictor. Here Multiple Regression using Ordinary Differential Equation (ODE) is applied. The general purpose of multiple regression (the term was first used by Pearson, 1908) is to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable using a general model : $Y = a + b_1X_1 + b_2X_2 + ... + b_nX_n$ Where, a = Y intercept ; points $b_1, b_2, ... , b_n$ = the Slope of $X_1, X_2, ... , X_n$ respectively

Explaining the model in a more general term, given a data set $\{y_i, x_{i1}, \ldots, x_{ip}\}_{i=1}^{n}$ of *n* statistical units, a linear regression model assumes that the relationship –between the dependent variable y_i and the *p*-vector of regressors x_i is linear. This relationship is modelled through a disturbance term or error variable ε_i— an unobserved random variable that adds noise to the linear relationship between the dependent variable and regressors. Thus the model takes the form

$$y_i = \beta_1 x_{i1} + \cdots + \beta_p x_{ip} + \varepsilon_i = \mathbf{x}_i^{\mathrm{T}}\boldsymbol{\beta} + \varepsilon_i, \qquad i = 1, \ldots, n, \quad (4.2)$$

where ^{T} denotes the transpose, so that $\boldsymbol{x}_i^{T}\boldsymbol{\beta}$ is the inner product between vectors $\boldsymbol{x}_i$ and $\boldsymbol{\beta}$.

Often these *n* equations are stacked together and written in vector form as

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}, \quad \text{or } Y = a+BX \qquad (4.3)$$

where

The Ordinary Least Squares (OLS) method minimizes the sum of squared residuals, and leads to a closed-form expression for the estimated value of the unknown parameter β:

$$\hat{\boldsymbol{\beta}} = (\mathbf{X}^{\mathrm{T}}\mathbf{X})^{-1}\mathbf{X}^{\mathrm{T}}\mathbf{y} = \left(\sum \mathbf{x}_i \mathbf{x}_i^{\mathrm{T}}\right)^{-1}\left(\sum \mathbf{x}_i y_i\right). \qquad (4.4)$$

The estimator is unbiased and consistent if the errors have finite variance and are uncorrelated with the regressors.

$$\mathrm{E}[\mathbf{x}_i \varepsilon_i] = 0. \qquad (4.5)$$

Or

$$\hat{\mathrm{Y}} = \mathrm{b}_0 + \mathrm{b}_1\mathrm{X}_1 + \mathrm{b}_2\mathrm{X}_2 + \ldots + \mathrm{b}_\mathrm{p}\mathrm{X}_\mathrm{p} \qquad (4.6)$$

$\equiv$ $a+B_1X_1+B_2X_2 + \ldots B_nX_n$

Bo $\equiv$ a = constant

where $\hat{\mathrm{Y}}$ is the predicted or expected value of the dependent variable, X_1 through X_p are p distinct independent or predictor variables, b_0 is the value of Y when all of the independent variables (X_1 through X_p) are equal to zero, and b_1 through b_p are the estimated regression coefficients. Each regression coefficient represents the change in Y relative to a one unit change in the respective independent variable. In the multiple regression situations, b_1, for example, is the

change in Y relative to a one unit change in X_1, holding all other independent variables constant (i.e., when the remaining independent variables are held at the same value or are fixed).

The Inhibiting factors M1-M9 will be manipulated in the equation to observe changes (positive or negative) that may occur due to changes in their beta coefficients. Hence, in this design we intend:

(a) To use indices from the Inhibiting factors statistical analysis of cluster two to simulate the trajectory of future growth of the MNP if the trend remains linear or altered by policy summersaults,

(b) Maintain a subscribers database and complaints database,

Produce meaningful reports for management and policy making.

4.5.1 Inhibiting Factors

The nine (9) factors identified to be slowing down MNP growth in Nigeria are in this work being referred to as Inhibiting factors [M1-M9]. Multiple Regression indices emanating from a generic linear function will be used to manipulate/simulate the behaviour of the model. For instance taking the first factor M1 which is lack of formal education for the subscribers, suppose there is an increase by number of literate subscribers via government policy on literacy, will this influence MNP patronage? We would want to know what the growth level is now and then forecast what will happen to the MNP growth if government policy on education has increased literacy rate. The same approach will be followed for M2 to M9 respectively so that government may be well advised on new policy trust if the MNP will make any future impact if it is retained.

4.5.2 Inhibiting Factors Identification Numbers

The following numbers or acronyms will be used for the identification the nine Inhibiting factors for simulation, coding and manipulation.

i. No formal education to the public on the benefits of MNP [M1].

ii. Clumsy porting administrative procedure [M2].

iii. Switching Costs [M3].

iv. Poor Quality of service even with the new network being ported to [M4].

v. Loss of contacts due to migration [M5].

vi. Difficulty in practically switching numbers [M6].

vii. The 48hr duration before a complete porting is achieved [M7].

viii. The 90 days lock-in period before the next migration [M8].

ix. The need to be physically present in any of the network's outlets in order to initiate a port [M9].

ΔM1 = Increase in literacy rate due to government policy on education

▼M1 = decrease in literacy rate due to government policy trust

This will be same for M2-M9 and each equation will carry statistical values such that:

a = constant or bo.

β = Beta coefficient which measures growth index.

X = Independent variable (years of forecast).

Y = Dependent Variable (value for the year being predicted).

4.6 Simulation and Scenario Manipulation

The program will manipulate the β, i.e. increase or decrease the growth index assuming a government policy changes which can improve an inhibiting factor and each scenario result will be printed out for policy simulation. The first scenario will be to predict the future of MNP with the statistical index as it is, (real). Then there will be future simulations based on changes in the inhibiting factors so that this can influence government actions if MNP must fulfill its place in the telecommunication industry.

4.7 Program Module Specification

Frm**Splash:** This program module displays the first screen before the software menu is statically displayed.

MdiFrmMenu: This presents the user option to choose any of the actions required.

FrmAdd_Subscriber: This module ensures the user is able to key in all variables related to each subscriber.

FrmAdd_Complain: This module gets the subscribers complaints keyed in stored in the data base memo field.

FrmSimulation:	This module handles the simulation of MNP for each specified period.
FrmReport:	This module generates all reports such as Complaints Reports, Subscriber database reports, performance metrics etc.
Purg.prg:	All records or subscribers that are no longer active for more than a year are archived and expunged from the database to allow new records to be accommodated.
Exit.prg:	Program exit module.
ExitPurg.prg:	Exits the Purge module after purging and returns control to the Control Centre.
ExitSR.prg:	Exits the subscribers registration module.
ExitSimulation.prg:	Exits simulation module.
ExitRGen.prg:	Exits the Report Generation Module after reports are generated.
AppendSubscr.prg:	Appends each subscriber's record in the Subscriber Registration Module.
AppendCompl.prg:	Appends each subscribers complaints in the complaints Memo field.
EditSub.prg:	Edits each record in the subscribers registration module.
EditCompl.pgr:	Edits each record in the subscribers Complaints data base.
BrowseSubscr.prg:	Browses records in the Subscribers Records Management Module.
BrowseCompl.prg:	Browses records in the subscribers complaints module.
DelSub.prg:	Deletes unwanted records in the Subscribers Records module.
DelAR.prg:	Deletes unwanted records in the Subscribers Complaint data base Module.
HybRout.prg:	This module implements the hybrid call routing.

4.8 Input/output Specifications

4.8.1 Inputs (Subscriber Registration Module)

i. SubscriberReg. Modue.MDB

Subscriber's Name :

ID. Number:

Telephone Number:

Email Address:

Remarks:

4.8.2 Subscriber Complaints Module

ii. **SubscrCompMDB**

Subscriber's Name:

ID. Number:

Telephone Number:

Email Address:

Cell:

Nature of Complain:

Action Taken:

4.8.3 Input for Simulator/Predictor

Input Beta value of M1

Input Beta value of M2

Input Beta value of M3

Input Beta value of M4

Input Beta value of M5

Input Beta value of M6

Input Beta value of M7

Input Beta value of M8

Input Beta value of M9

$Y = a+\beta_{m1}X_1+\beta_{m2}X_2+ \ldots\ldots\beta_{mn}X_n>$ Adjusted equation

4.8.5 Output Formats

Simulation of MNP Growth Trend Trajectory (2015-2025)

Table 4.4: Sample Output Format

Inhibiting Factor	Beta	Intercept	P-value	MNP Growth Prediction	2015	2016	2017	2018	2019	2020
M1	0.32	9999	0.0001		99999	9999999				
M2	0.51	2222	0.0222		99999	9999999				
M3	0.56	8888	0.5555		99999	9999999				
M4	0.66	9999	0.0001		99999	9999999				
M5	0.45	7777	0.2678		99999	9999999				
M6	0.47	6666	0.4567		99999	9999999				
M7	0.36	7777	0.6666		99999	9999999				
M8	0.37	9999	0.3245		99999	9999999				
M9	0.33	3333	0.4567		99999	9999999				

Table 4.5: Sample Subscriber- Registration Database Output Format

Subscriber	IDno.	Tel.No.	Email Address	Remark
Prof Osuagwu	ACN11235	08037101792	ProfOsuagwu@gmail.com	Active
Dr Ejiofor	Xxxxxx	99999999	Xxxxxxxxxxxxxxx	Xxxxx
Odii Juliet	Xxxxxx	99999999	jnodii2@futo.edu.ng	Xxxxx
Prof Odii	Xxxxxx	99999999	macaodii@yahoo.com	Active

Table 4.6: Sample Subscriber-Complain Database Format

Subscriber	IDno.	Tel.No.	Email Address	Cell	Nature of complaint	Action taken so far
Prof Osuagwu	ACN11235	08037101792	ProfOsuagwu@gmail.com	Active Egbu	Not hearing the message when linked	Base station under maintenance
Linda Jones	Xxxxxx	99999999	Xxxxxxxxxxxxxxx	Xxxxx	Xxxxx	Xxxxx
Obilor Ehiohere	Xxxxxx	99999999	Xxxxxxxxxxxxxxx	Xxxxx	Xxxxx	Xxxxx
Prof Odii	Xxxxxx	99999999	Xxxxxxxxxxxxxxx	Xxxxx	Xxxxx	Xxxxx

4.9 Overall Dataflow Diagram of the New System

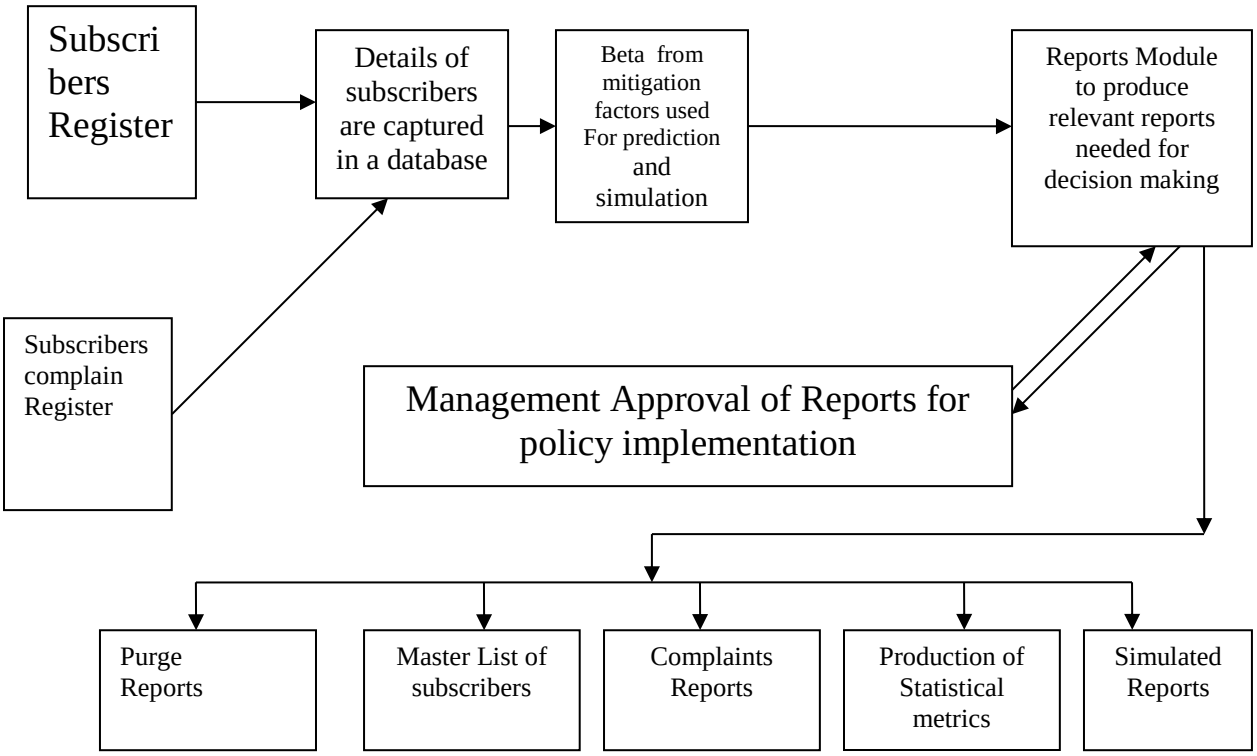


Figure 4.2: Overall Dataflow Diagram of the New System

4.10 Splashscreen01 - Displays (preliminary)

MNP Growth Trend Trajectory Simulator/Predictor
[MNPGTTS]
Nigerian Communications Commission
Odii Juliet N.
B.Tech (Maths/Computer Sc) FUTO
M.Sc (Computer Sc.) UNIZIK
Reg. No.: 2006517004P

In partial fulfillment for the Award of PhD in Computer Science
Nnamdi Azikiwe University, Awka
Version 1

4.11 Algorithms for Program Modules on the Control Centre Menu Choice

Control Centre – (MNPGTTS]

```
Make a choice:
 Choice = Purge
       Do purge.prg
 Exit
Choice = Subscriber Reg
        Do subscrib.prg
Exit

  Choice = Simulation
         Do Simulation.prg
Exit
Choice =  Complaints  > Do subcompl.prg  >  Save > Endif
```

Delete

If record > 10 years old

Delete

End if

Edit

If error occurs

Do Edit.prg

Purge

If record no longer wanted and subscriber no longer active

Archive Record

Do Del.prg

End if

Browse

If you want to look up database record of subscribers

Do browse.prg

Endif

These can be repeated for each function.

4.12 Data Dictionary

Name = first name+middle name+Surname - this variable records the first, middle and Surname of each subscriber.

Address = Street name+LGA+State+Country- Stores information about the address of the subscriber.

IDno. = year of entry+CellCode +Subscriber Number in the data base

YrSub = Date of initial subscription = day + month +year when telephone number was issued.

Cell = Base station No + Local Government Area no.

Complaints .mdb

Nature of complaint = Date of complaint + Cell + Nature of complaint + Request for solution.

4.13 Programming Language Platform

Visual Basic.Net version 10 is used in the development of MNPGTTS because it is very robust and can accommodate future expansions and modifications**.** While Microsoft Access DBMS is used for the database. Microsoft Access has no limitation on the size of organizations and volume of records to be stored. The codes are placed in Appendix A and Sample outputs in Appendix B of this work.

4.14 Design of Hybrid Call Routing Framework

The new hybrid framework to be implemented in addition to the predictive model above would be able to capture the following components and store them in the database:

a. Calling subscriber
b. Called subscriber
c. Originating network
d. Routing Number- central database
e. Donor network – local database
f. Recipient network

4.14.1 The Hybrid Database structure

The table 4.7 below shows the sample database structure for the hybrid model.

Table 4.7: The hybrid Framework Database- Hybrid.MDB

S/No	Field Name	Field Type	Size
1	Calling subscriber	Number	25
2	Called subscriber	Number	25
3	Originating network	Character	15
4	Routing number	Number	10
5	Donor network	Character	25
6	Recipient network	Character	25

4.14.2 Input Specification

Input for Hybrid Framework simulator

Hybrid.MDB

Calling Subscriber:

Called subscriber:

Originating network:

Routing Number:

Donor network:

Recipient network:

4.14.3 Output Specification

Table 4.8 : Sample Hybrid call Routing Output Format

Calling subscriber	Called subscriber	Originating Network	Routing Number	Donor Network	Recipient Network
9999999	**999999**	**xxxxxxx**	**9999999**	**9999999**	**999999**

4.14.4 Architecture of the Hybrid Call Routing Framework

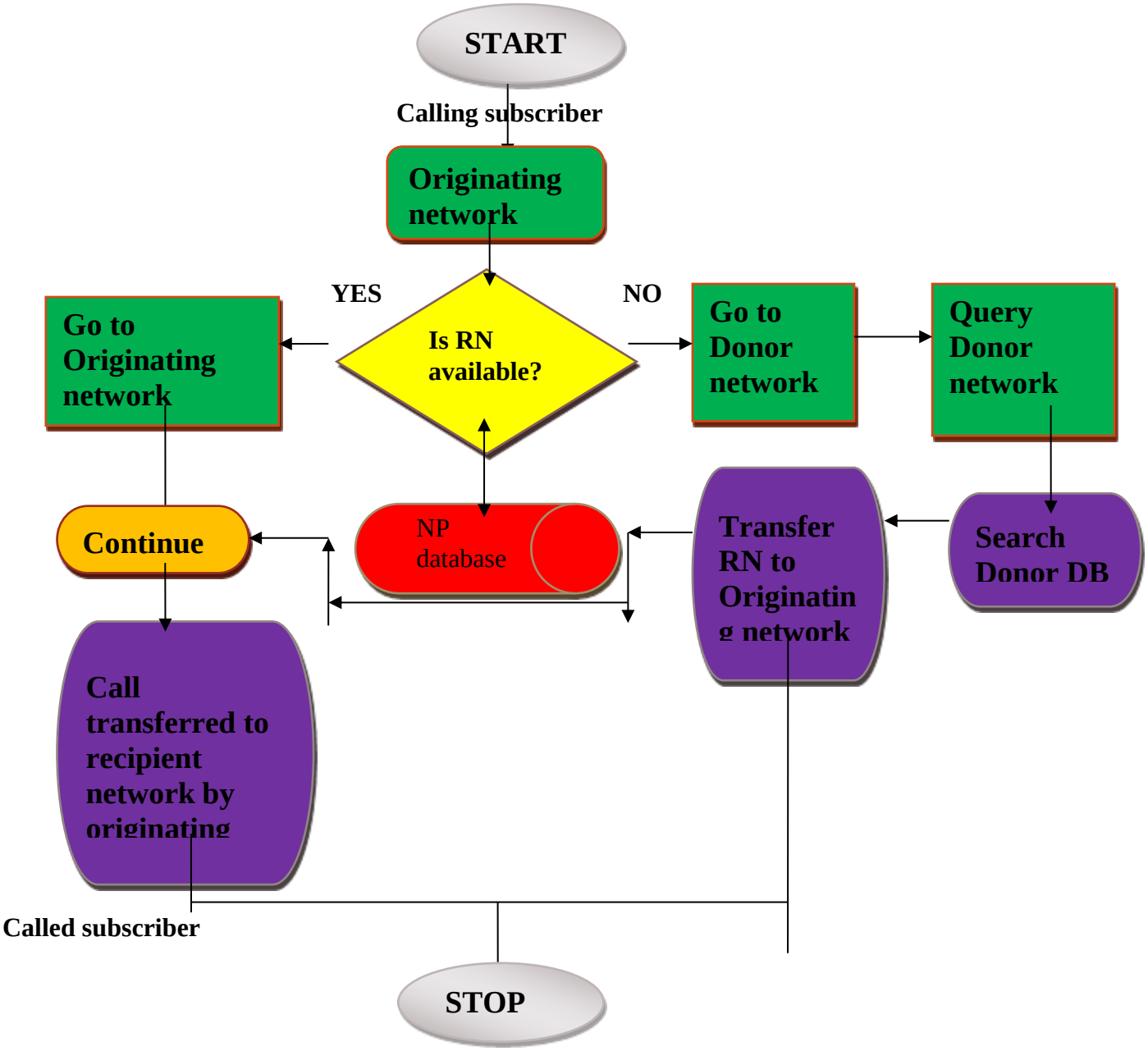


Figure 4.3: Architecture of the Hybrid Call Routing Framework

4.14.5 Algorithm for the Implementation New Hybrid Framework.

If the subscriber is calling, from the originating network

Verify the RN via the NP database

If RN is available

GO TO originating network

Transfer call to recipient network

Else

GO TO Donor network

Query donor network

Search donor databasefor RN

Transfer RN to originating network

Transfer call to recipient network

Endif

Endif

CHAPTER FIVE
SYSTEM IMPLEMENTATION

5.1 Introduction

This chapter describes in detail the system implementation, testing, running, conversion procedure, availability of hardware and software, development and installation of software, system requirements, training and software maintenance etc.

5.2 Hardware and Software Requirements

The new system is designed to be implemented by any IBM compatible microcomputer with the following specifications:

i. Pentium iv Celeron 2.4 GH_z or higher.
ii. Minimum of 2GB RAM.
iii. Higher resolution monitors VGA or SVGA with 64bit.
iv. CD/DVD ROM driver/writer.
v. 300GB hard disk space.
vi. Uninterrupted power supply (UPS).
vii. 2000W stabilizer.
viii. A printer that supports color printing or special printing peripherals.
ix. A mouse or other pointing devices.
x. Network card or board network card with RJ45.

5.2.1 Software Requirement

The software required for the smooth running of the new system is.

i. Windows XP professional or higher version.
ii. Microsoft office XP 2005 or higher.
iii. DBMS: Microsoft Access Version 7 or higher.
iv. Any strong Antivirus.
v. Extensive backup storage facilities e.g DVD CD plates, Flash Disks, reserved hard disks etc.
vi. Computer stationeries like designed output sheet.

5.3 Program Development

The program design identifies all modules of the software and the relationship between them and also the statement and coding of the solution. The Top-Down-Design method of modular programming will be adopted. The Top-Down-Design is a process of design where the software designer starts from the top most modules to break the entire system into subsystems. Each module has a task to perform and finally, all the modules will be integrated. The major idea of the Top-Down-Design is that the design must progress from the general purpose and each program module is designed progressively. The main program normally links the sub-programs. Each sub-program performs a logical task. Modular programming is simply the art of writing programs in independent modules. The central idea of modular programming is to subdivide the system into smaller units that can be tested independently and then integrated to accomplish the overall program objectives. Program flow charts are logical diagrams used by programmers to depict a sequence of operations and decisions graphically.

5.4 Choice of Programming Language

Thousands of programming languages exist and each performs a specific task which is dependent on the nature of the program and the task to be executed. For the easy implementation of this work, Visual Basic.Net is used.

Visual Basic .Net is a programming language that comes with a set of graphical tools and high level language constructs which makes it easy and quick to have an ideal and full fledged running application. Visual Basic.Net provides a graphical environment where one can design forms and controls that an application will use. It allows one to easily and quickly create windows application for your system even when one is not an expert in programming. It also supports many useful tools that will help one to be productive in one's works and design that will be used in the internet. Visual Basic.Net is very easy to use.

The full application of Visual Basic.Net is seen in

a. The development of software like the MNP software
b. Design of computer games.

5.5 Language Justification

The program was developed using Visual Basic.Net and Microsoft Access. Visual Basic.Net is an event-driven programming language with an integrated development environment (IDE) from Microsoft for its COM programming model. VB.Net is also relatively easy to learn and use because of its graphical development features and BASIC heritage. Microsoft Access on the other hand is a relational database management system. It is software designed to direct, control and manage data. Access also takes care of data authentication to some extent but not like SQL. The project started by developing a database using MS-Access, tables were created and linked up to Visual Basic.Net environment. In the Visual Basic.Net environment, forms and controls were created and codes were also written to direct them to perform required actions.

5.6 Program Testing

Program test run means testing of the new system. The main reason for program test run is to ensure compatibility. The program is subjected to trial run with test data. Data is simulated, analyzed and fed into the system as an inputted data. There are three (3) types of testing viz;

i. Unit testing,
ii. Integrated testing,
iii. System testing.

1. **Unit Testing:** This involves testing each program module that has been written and compiled successfully instruction by instruction with a test data that is well prepared. Each of the modules in this work is tested using unit testing.
2. **Integrated Testing:** This involves bringing together or combining the modules and testing then to see how well they interact with one another. The program structure as a whole has to be tested to see if it allows the required structure and if all response is working well. We used this method to also test all the program modules to see how they interact with one another.
3. **System Testing:** Here, the testing attention is on the whole program. It is tested according to the requirement and expectation as well as the specification of the program to see if the system would give us exactly what we desire from it. This is method of testing is equally adopted in this work.

5.7 Changeover Procedure

The change over procedure recommended by the researcher is the pilot implementation procedure. This is because the system developed has not come to replace the old method of porting but rather to help modify a section of it to ensure it is performing according to expectations. There are four methods of conversion, namely: parallel conversion, Phase, conversion, direct conversion and pilot conversion.

5.8 System Security

The system must be pass worded to avoid unauthorized users to penetrate; there must be weekly or monthly backups and cleanup of dumps files.

5.9 System Documentation

The new system was documented with the followings:

a. The hardware and software,
b. Management with Comprehensive test plan etc.

5.10 System Maintenance

Maintenance simply means a time-to-time check of the system to ensure its smooth running. The new system should be subjected to maintenance from time-to-time; which will eliminate or reduce the problems of hardware and software breakdown and consequently prevent delays in the system operation. The following practices should be strictly adhered to for the smooth running of the new system.

i. Time-to-time servicing of computer hardware and peripherals to prevent unforeseen breakdown.
ii. Backing up of the files on the hard disk so as not to lose them in the event of hard disk failure.
iii. Quarterly review of the software to improve and implement newer requirement.
iv. The system should be started up and shut down properly to avoid file data corruption or system hanging.

5.11 Running the Program

Once installation is completed, the user should:

i. Click on the start button,

ii. Point to programs,

iii. Point to the folder of the new system and then click on Trajectory/ Simulator icon. Trajectory Simulator is the program executable file. Also click on hybrid to run the call hybrid routing module.

5.12 Exiting the Software

To exit, the user will pull down the menu, save all works and then click exit and it will take you back to the desktop window environment.

5.13 Staff Training

In the implementation of a computerized system, operation cannot be effective if the users are unable to use it. General awareness and software specific training will be given. The essence of this is for the users to know how to use the software with ease so as to perform effectively. The training is going to be carried out on a batch-by batch process with the aim of not interrupting the working process of the service at any time.

5.14 System Implementation

Software implementation can be said to be the activities and all practices that hover around the deployment of the new system. It involves all the activities that help in the successful migration from the old system to the new one. When testing and training is completed and all necessary requirements put in place, implementation will take place immediately. After implementation, a review check will be carried out at intervals for a period of time to ensure:

i. Proper attendance to hardware problems,

ii. Proper collection of data,

iii. Adequate daily back-ups,

iv. Efficient monitoring of the software implementation,

v. Adequate data directory creation.

CHAPTER SIX
SYSTEM TESTING AND EVALUATION

6.1 Introduction

System testing is the process of subjecting the designed software to real data to ascertain whether it is performing as expected. It is a comprehensive test conducted on a system to evaluate the system's compliance to its specified requirements. In designing a system certain objectives are stated, after the system has been designed it is tested to check if any or all the objectives have been met. The purpose of this testing is to detect if there are inconsistencies among the program modules or not. Most of the times, the testing is done by the designer of the system before deploying it to the intended user. System testing is a form of black box testing and as such does not require the knowledge of the inner design of the code or logic. There are different types of testing employed in this work; they include unit testing, integration and system testing.

6.2 Test Plan

The test plan is a kind of approach a researcher adopts in testing his/her software or even hardware as the case may be. A test plan documents the strategy that will be used to verify and ensure that a system or software is working in accordance with its design objectives and specifications. The test plan actually shows a detailed understanding of the workflow. The MNPGTTS software was tested using three scenarios comprising scenario 1, scenario 2 and scenario 3. The first scenario tested the system with the beta coefficients of the inhibiting factors as obtained from the SPSS analysis, the second and third scenarios are adjustments depending on the government's disposition. This was done to ensure its efficiency, effectiveness and robustness. See the tables and graphs below

6.3 Test Data

The test data is the indices gotten from SPSS multiple regression and ANOVA. We plugged the beta coefficients derived from the analysis into the simulation program under different scenarios to enable us access the future possibility of MNP adoption.

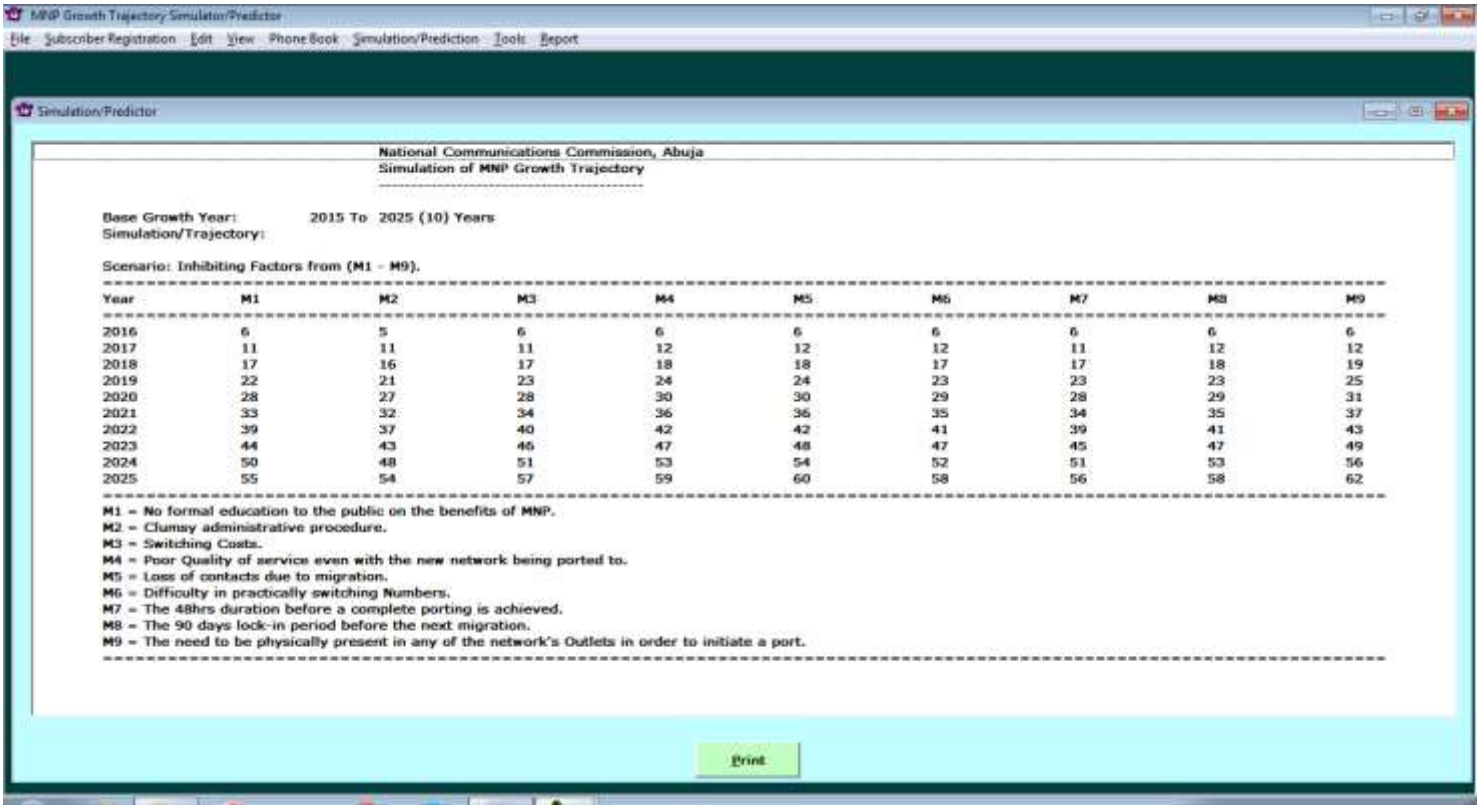
The first scenario is as derived from the original statistical analysis of field data as shown below and also on page 5 of appendix D of this work. The second and third scenarios are hypothetic adjustment of the beta coefficients used to simulate the government's policies when the indices

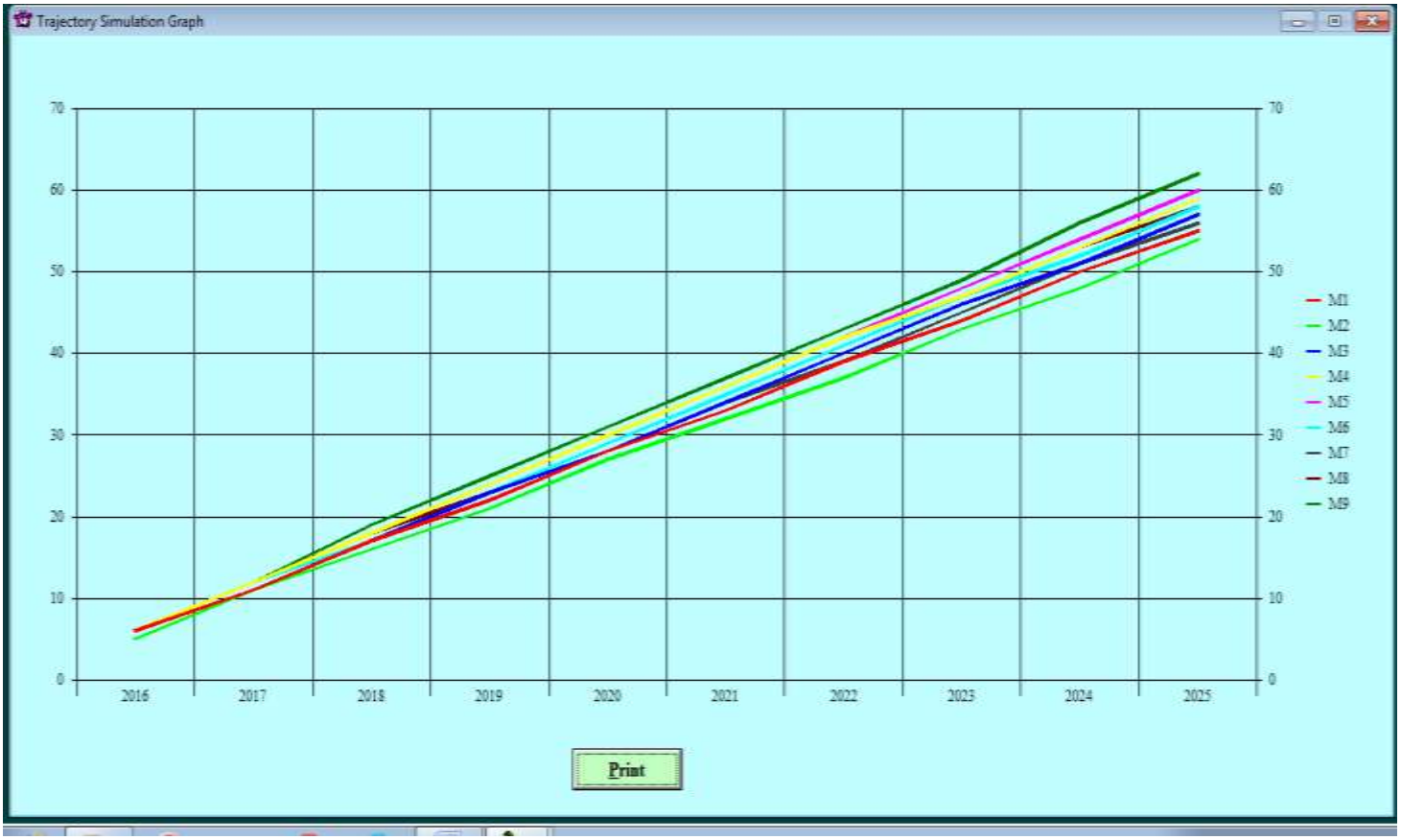
are improved or when they worsen respectively. The results are as shown below and also in the sample output in appendix B of this work

6.3.1 Test Data for Scenario I

The test data for scenario one are the beta coefficients of the inhibiting factors as obtained from the SPSS analysis and they are as shown: M_1=0.181, M_2=0.175, M_3= 0.186, M_4=0.194, M_5=0.195 M_6=0.190,M_7=0.184, M_8=0.191, M_9=0.202, BaseYr=2015 YrGap= 10years.The results are as shown in table 6.1 and graph 6.1 below

Table 6.1: Using prevailing indices from statistical analysis





Graph 6.1: Scenario 1: Data output/Graph.

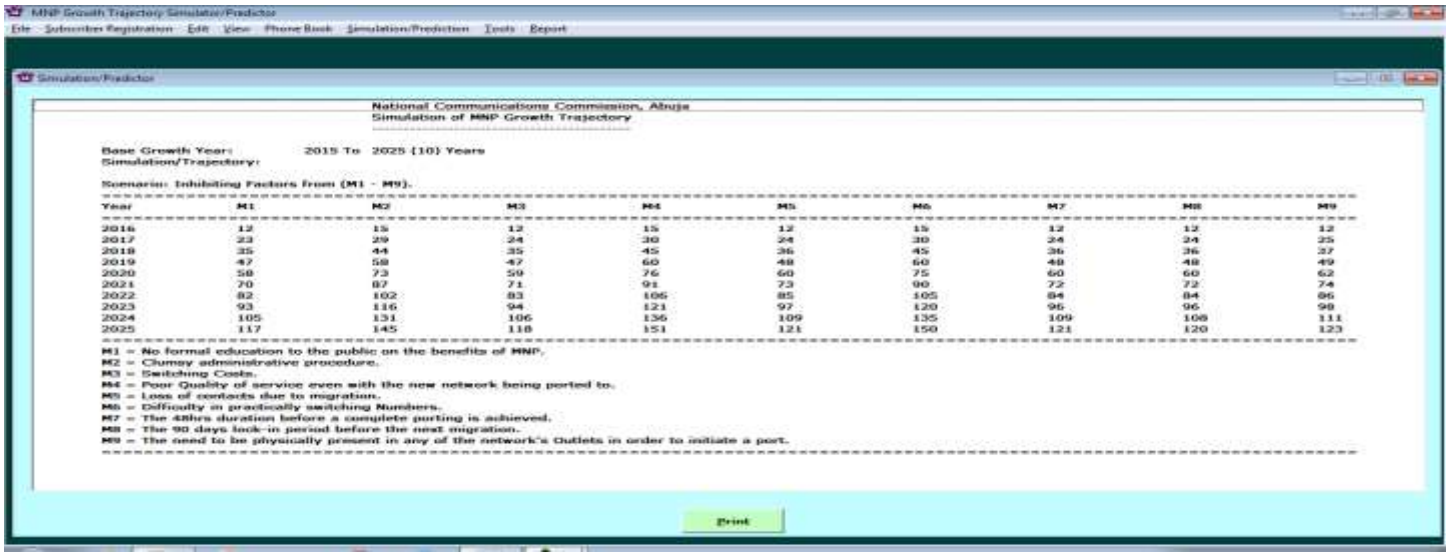
Scenario II

The second scenario tested the system when the beta coefficients are improved upon. The results are shown in table 6.2 and graph 6.2 below.

6.3.2 Test Data for Scenario II

M_1=0.381,M_2=0.475,M_3=0.386, M_4=0.491, M_5=0.395,M_6=0.490, M7=0.394,M8=0.391, M9=0.402: Base Yr=2015, Yr Gap= 10years.

Table 6.2: Showing when the Inhibiting factors are improved or adjusted positively.



MNP Growth Trajectory Simulator/Predictor

File Subscriber Registration Edit View Phone Book Simulation/Prediction Tools Report

Simulation/Predictor

National Communications Commission, Abuja
Simulation of MNP Growth Trajectory

Base Growth Year: 2015 To 2025 (10) Years
Simulation/Trajectory:

Scenario: Inhibiting Factors from (M1 - M9).

Year	M1	M2	M3	M4	M5	M6	M7	M8	M9
2016	12	15	12	15	12	15	12	12	12
2017	23	29	24	30	24	30	24	24	25
2018	35	44	35	45	36	45	36	36	37
2019	47	58	47	60	48	60	48	48	49
2020	58	73	59	76	60	75	60	60	62
2021	70	87	71	91	73	90	72	72	74
2022	82	102	83	106	85	105	84	84	86
2023	93	116	94	121	97	120	96	96	98
2024	105	131	106	136	109	135	109	108	111
2025	117	145	118	151	121	150	121	120	123

M1 = No formal education to the public on the benefits of MNP.
M2 = Clumsy administrative procedure.
M3 = Switching Costs.
M4 = Poor Quality of service even with the new network being ported to.
M5 = Loss of contacts due to migration.
M6 = Difficulty in practically switching Numbers.
M7 = The 48hrs duration before a complete porting is achieved.
M8 = The 90 days lock-in period before the next migration.
M9 = The need to be physically present in any of the network's Outlets in order to initiate a port.

Print

Trajectory Simulation Graph

160
140
120
100
80
60
40
20
0

2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

M1
M2
M3
M4
M5
M6
M7
M8
M9

Print

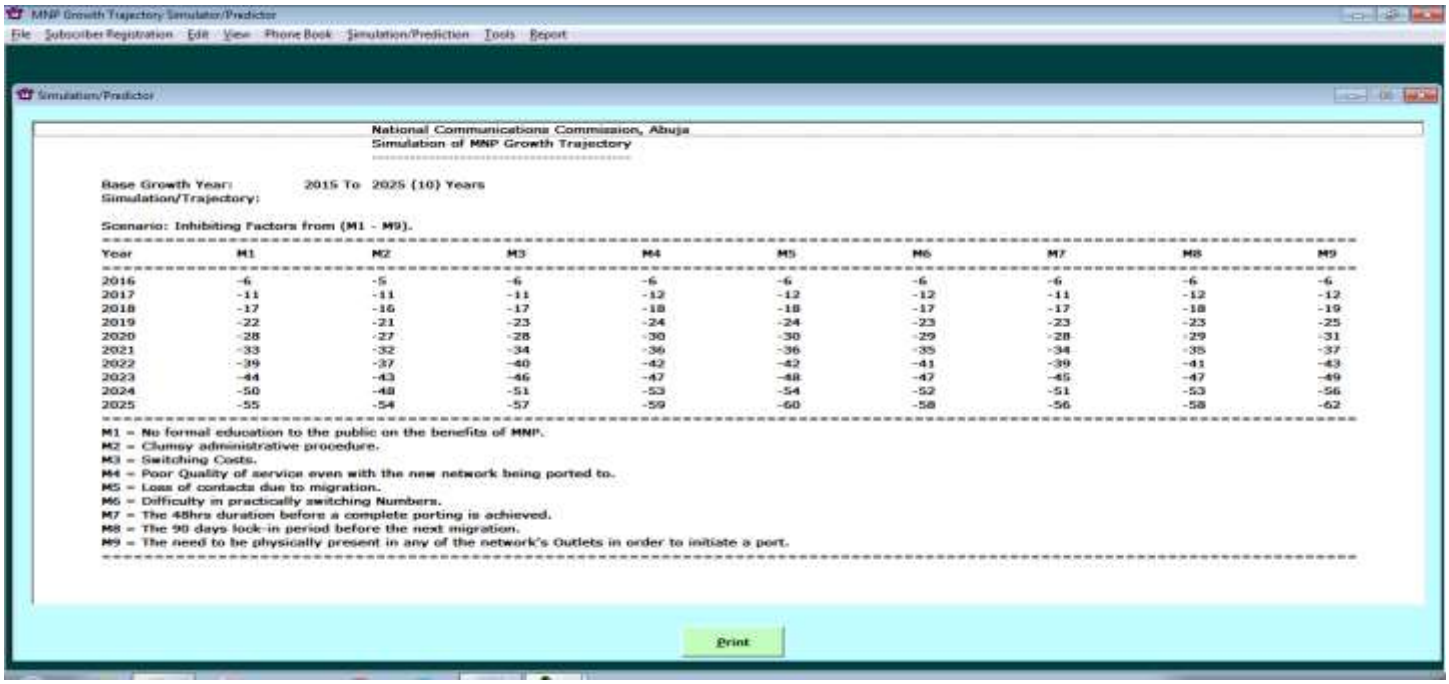
Graph 6.2: Scenario II: Data output / Graph

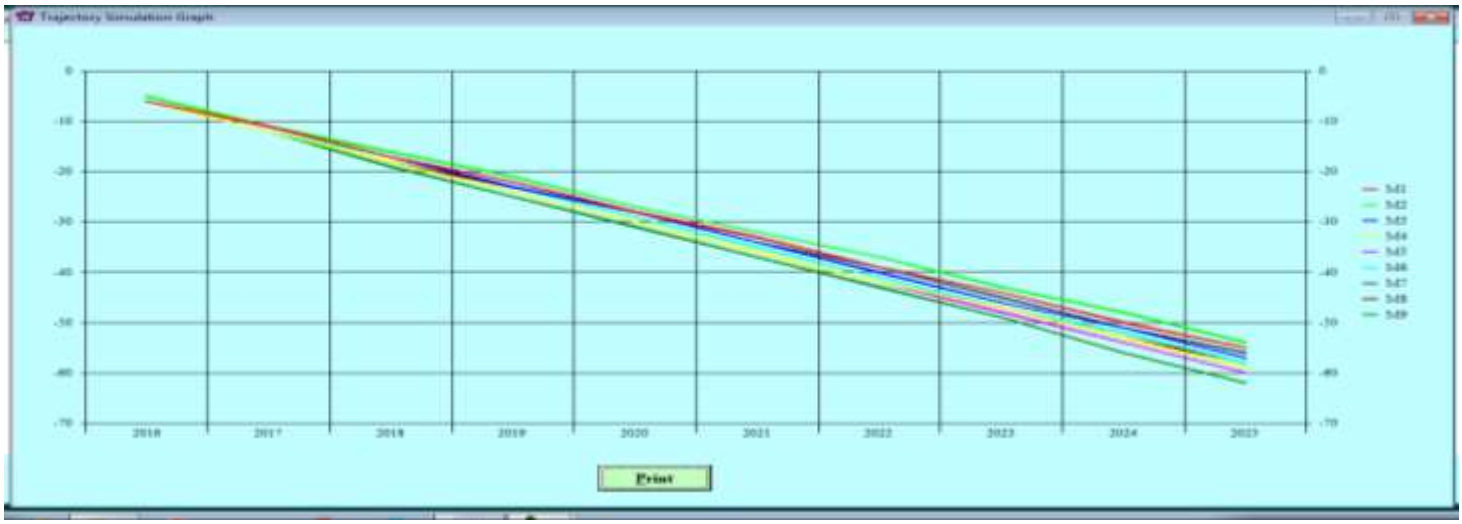
6.3.3 Test Data for Scenario III

The test data for scenario three are as given below and the results are as shown in table 6.3 and graph 6.3 below.

M1= -0.181, M2= -0.175, M3= -0.186, M4= -0.194, M5= -0.196, M6= -0.190, M7= -0.184, M8= -0.191, M9= -0.202: Base Yr=2015, Yr Gap=10 years

Table 6.3: Showing when the Inhibiting factors get worse or adjusted negatively.

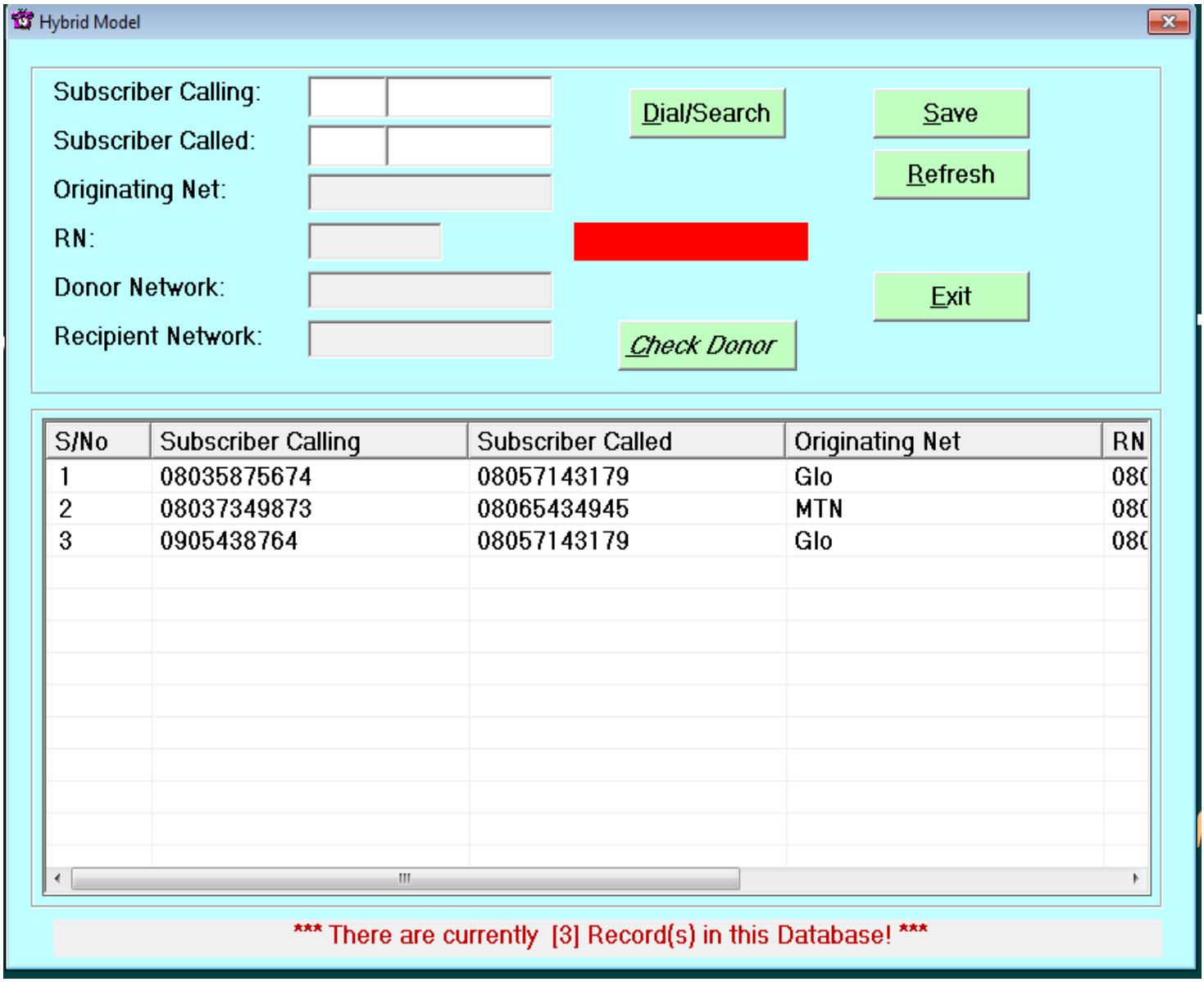




Graph 6.3: Scenario III: Data output/graph.

6.3.4 Test Data for the Hybrid Framework

The following numbers are used to test the workability of the hybrid framework. For searching the number portability database the following numbers are used: 08035373137 (for subscriber calling) and 08065434945 (for subscriber called). Then for searching the donor network database the following numbers are used: 08035373137 (for subscriber calling) and 08057143179 (for subscriber called). The result is as shown in the table 6.4 below.


Hybrid Model
Subscriber Calling:
Subscriber Called:
Originating Net:
RN:
Donor Network:
Recipient Network:
Dial/Search
Save
Refresh
Exit
Check Donor
S/No
Subscriber Calling
Subscriber Called
Originating Net
RN
1
08035875674
08057143179
Glo
2
08037349873
08065434945
MTN
3
0905438764
08057143179
Glo
*** There are currently [3] Record(s) in this Database! ***

6.4 Actual Versus Expected Test Result

Comparing the result of the three scenarios : In scenario one, the result shows that MNP non expansion in Nigeria has a relationship with the government policies like the 90-days lock-in period, 48hr duration before a successful port, need to be physically present in any of the network's outlet, clumsy porting administrative procedure, no formal education to the public on the benefits of MNP and other policies as identified during systems analysis, thus justifying the rejection of our first hypothesis (H_{01}) which stated that MNP has no relationship with the above factors. See the graph of scenario 1 above) and as shown in the sample output – appendix B of this dissertation. Adjusting the indices in scenario one positively (scenario two) indicating the removal or improvement on the above policies shows that MNP improved, and this is as expected. The result is as shown in graph of scenario 2 above and shown also in the sample output.

In scenario three, when the indices were adjusted negatively to test the future of MNP if government policies worsened, the result also indicates that if government still stiffens their policies that MNP will collapse completely. This is as indicated by the graph of scenario 3 above and in the sample output in appendix B of this dissertation.

6.5 Performance Evaluation

The results of the in-depth analysis and further synthesis of the actual result and the expected result described in sub section 6.4 above provided a further insight and a clear indication that the test data was true reflection of the challenges of MNP and thus that the software performed as expected.

6.6 Evaluation Criteria

The system is evaluated using the model:

$$\mathbf{Y = a+\beta_{m1}X_1+\beta_{m2}X_2+ \ldots\ldots\beta_{mn}X_n} \qquad \mathbf{(6.1)}$$

Where;

Y = MNP = the dependent variable; a = constant; m_1- mn are the government policies and X_1 – X_n is the period of forecast.

and β is the Beta coefficients applied in the three different scenarios;

i. As it is now with the government policies on MNP,

ii. Hypothetical adjustments of the Beta indices if government policies are removed,

iii. Hypothetical adjustments if government policies become stiffer or more restricted or gets worse.

The three scenarios demonstrated expected growth and decline of MNP.

6.7 Validation of the Hybrid Model

a) A hybrid MNP call routing framework was developed in the course of this research to address problem of poor quality of service prevalent in our networks due to inefficient way of routing calls. The utilization of the two databases in the developed hybrid model makes the model more efficient by reducing the time required to retrieve the routing number with which to route a call to a number.

b) This hybrid model which combines the efficiencies of the All Call Query and Call Dropback models offers less search complexity, moderate cost of implementation, flexibility of network resources and reduced network traffic as opposed to only ACQ or Call Dropback models.

c) The hybrid model is cost effective as porting becomes more common or prevalent.

d) The utilization of the two databases in proposed hybrid model makes the model more efficient by reducing the time required to retrieve the routing number with which to route a call to a number.

e) Hence in the hybrid model there is a low network traffic per call and it is therefore cheaper, faster and records a low number of dropped calls which are the ingredients of good quality of services that porting is meant to offer.

CHAPTER SEVEN
SUMMARY, CONCLUSIONAND RECOMMENDATION

7.1 Introduction

This chapter provides a summary of the research work in this dissertation including the potential industrial application of the solution model. It also recognizes various contributions made by other researchers in relation to Mobile number portability problems and most importantly it not only showcases the major contributions of the work to ICT body of knowledge, but also identifies future research direction to address the prevalent problems in Mobile Number Portability in Nigeria.

7.2 Summary

As challenging as this research problem is, efforts were made to evaluate the feasibility and viability of MNP adoption in Nigeria as a tool for improving the quality of service and expansion of telephone density and reduction in call tariffs. Real-time interviews were conducted to capture real life feedback from subscribers to strengthen the quality of analysis and close any gap in prediction model developed. In fact, a hypothetic-deductive method was employed to collect field data from subscribers and these data were analyzed using SPSS analysis. The indices derived from the statistical analysis were deployed into our model:

$$\mathbf{Y = a+B_1X_1+B_2X_2 + \dots B_nX_n} \quad (7.1)$$

Translated to

$$\mathbf{Y = a+\beta_{m1}X_1+\beta_{m2}X_2+ \dots\dots \beta_{mn}X_n} \quad (7.2)$$

Resulting to the production into the MNP predictive model (MNPPM) (7.2) which is based on multiple linear regression model (7.1).

Nine variables were adopted for the manipulation the program and they include:

1. No formal education to the public on the benefits of MNP [M1].
2. Clumsy porting administrative procedure [M2].
3. Switching Costs [M3].
4. Poor Quality of service even with the new network being ported to [M4].
5. Loss of contacts due to migration [M5].
6. Difficulty in practically switching numbers [M6].

7. The 48hr duration before a complete porting is achieved [M7].
8. The 90 days lock-in period before the next migration [M8].
9. The need to be physically present in any of the network's Outlets in order to initiate a port [M9].

Three scenarios were also adopted for the prediction:

a. When the restrictions (indices) remain as they are
b. When the restrictions (indices) are removed or improved upon
c. When the restrictions get worse.

The conclusions drawn from the three scenarios are:

1. If government allows the existing restrictions to remain subscribers may not be motivated to embrace MNP.
2. If government reduces or eliminates most of the restrictions MNP may become feasible and viable.
3. If government further stiffens the current restrictions, MNP will totally fail in the not distant future.

The MNPGTTS designed in this research is an excellent software that can assist government functionaries to try "what if" assessment of new telecommunication policies before, during and after implementation. The dissertation is organized as follows:

This dissertation is written in seven chapters. The first chapter - introduction presented the general introduction to the concept of Number portability, a short historical perspective drawn from experiences across the world, the statement of the problem or what motivated the research, objectives of the study, significance, limitations or problems encountered in the course of carrying out this research, and the scope of the research were equally outlined.

The second chapter reviewed a host of literatures which have some relevance to the topic under study. The history and the motivation for the concept as well as the various approaches to Number portability scheme were also reviewed. In this chapter also the researcher reviewed the work of other researchers in the area under study extracting their opinions, contributions, achievements, suggestions, failures, and where they stopped, and their recommendations for future work that warranted the necessity of this work. The chapter went further to examine some successful case

studies so as to draw from their experiences while at the same time avoiding their mistakes. Based on the above literatures the research questions were drawn and outlined in this chapter.

Chapter three was mainly devoted for systems analysis and the methodology adopted in the research. Here, an analysis of the present or existing system of porting visa vis its weaknesses /problems were highlighted. The various existing call routing models were analyzed extracting both the strengths and weaknesses of each of the models to enable the researchers come up with a more efficient hybrid model. The researchers went further to ascertain from users the factors militating against the success of MNP adoption in Nigeria. The impact of MNP since its inception in Nigeria was also assessed. All these were made possible through the use of questionnaires that were administered to a total of five hundred respondents in all the Local Governments Areas of Imo State Nigeria out which 356 returned their questionnaires. Data presentation and analysis were equally outlined in this chapter. The researchers at this juncture postulated two null hypotheses: Ho_1 which states that the failure of MNP has no relationship with the isolated factors; Ho_2 which states that MNP has impact on quality of service, tariff reduction, employment opportunity, fierce competition etc. The Data collated were analyzed using the SPSS multiple regression and ANOVA and the results were presented and interpreted in this chapter. The results of the analysis showed that: MNP has a very close relationship with factors identified as inhibiting factors affecting the success of MNP in Nigeria and based on this the first null hypothesis was rejected. Secondly, MNP has failed to produce the desired impact on the quality of service, fierce competition, reduction in call tariff etc as envisaged by the NCC and of course the second null hypothesis was accepted.

Then chapter four is where the researchers carried out the design of the schematic view of how simulator/ predictor modeland the hybrid model will look like. It covered the objective of the new design, database structure, development tool, system flowchart, and the Input/ Output specifications. The algorithm for implementation of the hybrid call routing model is also presented.

Then in chapter five, the new system's documentation and implementation were presented. Program development was discussed in details, the justification for the hardware and software platforms were discussed as well as program testing and maintenance considerations.

Chapter six is all about testing and evaluation. Here extensive testing of the software was carried out using raw data to ascertain its functionality. Also the performance of the model previously defined in this dissertation was evaluated. Finally in chapter seven the researchers summarized the

work, drew some conclusions, made also some recommendations and suggested other areas for future work.

7.3 Review of Achievements

We have been able to analyze the concept of Mobile Number portability as currently deployed by the NCC in Nigeria, identified the inhibiting factors that are responsible for why it is yet to succeed in Nigeria. We also assessed the impact of the already deployed Mobile Number Portability since its inception on the quality of service, employment opportunities, telephone density and internet diffusion, socio-economic revolution (eg low sales of new phones, dual / multiple SIM phones, call tariffs and fierce competition. Finally we have developed a predictive software model that will assist the NCC to predict the future of MNP in the near future and this was tested using three scenarios, and a hybrid model of call routing framework for the enhancement of MNP in Nigeria. The predictive model particularly proved to be very useful and efficient in the assessment of government policies on telecommunication adoption before, during and after implementation. Also an algorithm was equally developed to test the hybrid framework and integrated with the original program.

7.4 Areas of Potential Industrial Applications.

The software can be deployed in predicting the performance of new technologies before adoption. This will demand a field research and statistical analysis to abstract the beta coefficients and other necessary statistical indices needed to be plugged into the mathematical model. This model can be adapted by any organization where predictive models are needed to forecast into the future. In addition also the framework can be can be deployed in research institutes / information and communication industries.

7.5 Major Contributions to Knowledge

(a)This research work has led credence to a number of pertinent issues through the analysis and investigative work done to dive at the core underlying issues surrounding the success of MNP in Nigeria.

(b) Some segments of this work have been presented at a number of conferences in and across Nigeria and the feedback from the academic community were impressive.

(c) The predictive model proposed in this research work has clearly highlighted the pertinent issues negatively impacting on the adoption of MNP in Nigeria.

(d) The research represents a concise domain independent practical predictive model to address the Nigerian Mobile Number Portability problem.

(e) While other researchers adopted opinion research approach, this work was an empirical work and focused on the paramterizing the issues that negatively impact the implementation of the MNP in Nigeria and results clearly highlighted the role of government as a key mitigating factor in the resolution of the present issues and future enhancements the MNP technology.

(e) Original indigenous software has been developed in this work, and it can be used to predict the future of MNP or any new technology adoption before, during and after adoption.

(f). A hybrid MNP call routing framework was developed in the course of this research to address problem of poor quality of service prevalent in our networks due to inefficient way of routing calls to called numbers and the result is as shown in the sample output of this work. This has opened other research questions or horizon in the academic community.

(g). In the course of the research it was gathered that NCC introduced MNP and shortly discovered it was not working according to expectation and had the intention of reviewing /revisiting it but undoubtedly or unfortunately kept silent over it probably because they had not been able to isolate the actual problems of MNP full adoption in Nigeria and how to go about it. This research is therefore an eye opener to the NCC in particular and also the Nigerian subscribers in general to the way forward to the smooth running of MNP in Nigeria.

(h).This work also contributed to knowledge by developing a predictive model that can guide the NCC to predict and forecast the future outlook of the Nigerian communication industry.

7.6 Suggestions for Future Work

A framework for simulating / predicting the impact of MNP adoption in Nigeria was developed in this dissertation as a guide to other type of prediction/ simulation of any new technology adoption, before, during and after adoption both in and outside Nigeria. The researchers therefore wish to make the following suggestions for future research in communication industry.

1. A statistical framework should be developed as part of the simulator which will accept field data as input and use the result of the analysis as input to the simulator/ predictor. This is beyond the scope of the present dissertation.

2. There should be development of a framework for migrating from GSM to CDMA type of networks. This will further cut down on the tariffs since CDMA networks are known for their cheap rates.
3. There should be complete Integration of NPDB between service providers. This will ensure transparency in all the networks and of course reverses undue victimizations.
4. Another research can delve into developing a framework that can pull NPDB for every Mobile to Mobile call and report back to NCC. This will equally ensure no gross misconduct by the mobile operators.
5. Develop an application that should monitor quality of service and subscriber satisfaction in the Nigerian telecommunication industry.

7.7 Recommendations

1. Government should encourage the viability of MNP by removing most of the restrictions identified as inhibiting user patronage of MNP.
2. Government should provide meaningful procedure for user migration.
3. Encourage telecommunication industry to reduce tariff for users willing to migrate by placing a uniform tariff to all network operators.
4. National orientation agency should be mandated to educate the public on the benefits of migration to MNP.

7.8 Conclusion

Mobile Number portability is undoubtedly the concept that can bring about the desired growth in the Nigeria`s telecommunication market, not only because it can provide improvements in the quality of services but also , as uncovered in this dissertation, it will proliferate creativity among service operators to embrace value added services to remain competitive. As Nigeria is playing catch-up in the evolution of the MNP scheme already successful in many countries, the government has a strategic role to play. Government's role should focus on providing strategic directives using functional by-laws that will provide enlightenment and trust by the members of the public. The research conducted in this dissertation has indicated that subscribers are more privy to embrace the MNP scheme if the government ameliorates the bottlenecks in the mobile number portability process. There is also increasing likelihood that the subscribers will embrace the MNP

scheme if members of the public understand that the mobile operators are dependent on government policies. This is where the predictive model proposed in this research highlighted and identified the significance of these impending parameters as the incumbent factors inhibiting the success of the MNP scheme in Nigeria.

But if government allows the existing restrictions on MNP adoption to remain, subscribers may not be motivated to embrace MNP. The reduction or elimination of most of the restrictions makes MNP feasible and viable. And of course, should government further stiffen the current restrictions, MNP will totally die in the not distant future.

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APPENDIX A

PROGRAM SOURCE CODE

```
Dim M1(100)
Dim M2(100)
Dim M3(100)
Dim M4(100)
Dim M5(100)
Dim M6(100)
Dim M7(100)
Dim M8(100)
Dim M9(100)
Dim GR(100)
Dim K(100)
Dim BYR(100)
Dim Dd(100)
Dim Bpop2(100)
Dim STA As String
Dim Cout As String
Dim YGAP(100)
Dim Bpop As Double
Dim Gr1 As Double
Dim BYR1 As Double
Dim YGAP1 As Double
Dim YR1(100) ' As Integer
Dim LB1(100)
Dim Totdeat As Double
Dim Liv2(100)
Dim Prop1(100)
Dim Gr2 As Double
Private Sub CmdRun_Click()
On Error GoTo errortrapping
```

```
BYR1 = InputBox("Enter Base Year: ")
2 YGAP1 = InputBox("Enter Year Gap: ")
If Val(YGAP1) > 50 Or Val(YGAP1) < 5 Then
MsgBox ("Invalid Year Gap Entry. The Minimium Year Gap is 5 Years and Maximium Year Gap
is 50 Years."), vbCritical
GoTo 2
End If
bt1 = InputBox("Enter Beta Value of M1:")
bt2 = InputBox("Enter Beta Value of M2:")
bt3 = InputBox("Enter Beta Value of M3:")
bt4 = InputBox("Enter Beta Value of M4:")
bt5 = InputBox("Enter Beta Value of M5:")
bt6 = InputBox("Enter Beta Value of M6:")
bt7 = InputBox("Enter Beta Value of M7:")
bt8 = InputBox("Enter Beta Value of M8:")
bt9 = InputBox("Enter Beta Value of M9:")
' Year Computation
Fyear = Val(BYR1) + Val(YGAP1)

'First Computation on Population Growth
Gr2 = 1 + Val(Gr1) / 100
With DatRun.Recordset
   '.AddNew
For X = 1 To YGAP1
Randomize Timer
M1(X) = Val((bt1) * Val(X) * 9999)
M2(X) = Val((bt2) * Val(X) * 2222) '0.5) * Val(bt2) * Val(Gr2)) * 2222 * x
M3(X) = Val((bt3) * Val(X) * 8888) '0.5) * Val(bt3) * Val(Gr2)) * 8888 * x
M4(X) = Val((bt4) * Val(X) * 9999) '0.5) * Val(bt4) * Val(Gr2)) * 9999 * x
M5(X) = Val((bt5) * Val(X) * 7777) '0.5) * Val(bt5) * Val(Gr2)) * 7777 * x
M6(X) = Val((bt6) * Val(X) * 6666) '0.5) * Val(bt6) * Val(Gr2)) * 6666 * x
```

```
M7(X) = Val((bt7) * Val(X) * 7777) '0.5) * Val(bt7) * Val(Gr2)) * 7777 * x
M8(X) = Val((bt8) * Val(X) * 9999) '0.5) * Val(bt8) * Val(Gr2)) * 9999 * x
M9(X) = Val((bt9) * Val(X) * 3333) '0
YR1(X) = Val(BYR1)
'Prop1(x) = Val(bpop1)
'FrmResult.LblYR(19).Caption = Round(Prop1(x), 0)5:
YR1(X) = Val(YR1(X)) + X
.AddNew
   ![Year] = YR1(X)
   ![M1] = Round(M1(X), 0)
   ![M2] = Round(M2(X), 0)
   ![M3] = Round(M3(X), 0)
   ![M4] = Round(M4(X), 0)
   ![M5] = Round(M5(X), 0)
   ![M6] = Round(M6(X), 0)
   ![M7] = Round(M7(X), 0)
   ![M8] = Round(M8(X), 0)
   ![M9] = Round(M9(X), 0)
.Update
Yx = X
If Val(YR1(X)) < Val(YGAP1) Then
GoTo 5
End If
Next X
End With
'YR1 = Val(BYR1)
100:
FrmSimulation.Show
FrmSimulation.List1.AddItem vbTab & vbTab & vbTab & vbTab & vbTab & "National Communications Commission, Abuja"
```

```
FrmSimulation.List1.AddItem vbTab & vbTab & vbTab & vbTab & vbTab & "Simulation of MNP Growth Trajectory"
FrmSimulation.List1.AddItem vbTab & vbTab & vbTab & vbTab & vbTab & "----------
----------"
FrmSimulation.List1.AddItem "  "

FrmSimulation.List1.AddItem vbTab & "Base Growth Year: " & vbTab & (Val(BYR1)) & " To " & vbTab & (Val(Fyear)) & " " & "(" & X - 1 & ")" & " " & "Years"
FrmSimulation.List1.AddItem vbTab & "Simulation/Trajectory:"
FrmSimulation.List1.AddItem " "
FrmSimulation.List1.AddItem vbTab & "Scenario 1: Inhibiting Factors from (M1 - M9)."
FrmSimulation.List1.AddItem vbTab & "========================="
FrmSimulation.List1.AddItem vbTab & "Year" & vbTab & vbTab & "M1" & vbTab & vbTab & "M2" & vbTab & vbTab & "M3" & vbTab & vbTab & "M4" & _ vbTab & vbTab & "M5" & vbTab & vbTab & "M6" & vbTab & vbTab & "M7" & vbTab & vbTab & "M8" & vbTab & vbTab & "M9"
FrmSimulation.List1.AddItem vbTab & "==========================="
For X = 1 To YGAP1
FrmSimulation.List1.AddItem vbTab & YR1(X) & vbTab & vbTab & Round(M1(X), 0) & vbTab & vbTab & Round(M2(X), 0) & vbTab & vbTab &Round(M3(X), 0) & vbTab & vbTab & Round(M4(X), 0) & vbTab & vbTab & Round(M5(X), 0) & _
vbTab & vbTab & Round(M6(X), 0) & vbTab & vbTab & Round(M7(X), 0) & vbTab & vbTab & Round(M8(X), 0) & vbTab & vbTab & Round(M9(X), 0)
Next X
FrmSimulation.List1.AddItem vbTab &"==========================="
FrmSimulation.List1.AddItem vbTab & "Scenario 1: Using Prevaluing Statistical growth Indices."
FrmSimulation.List1.AddItem vbTab & "Scenario 2: If Inhibiting factors are improved by Government intervention."
FrmSimulation.List1.AddItem vbTab & "Scenario 3: If Inhibiting factors are worsen."
FrmSimulation.List1.AddItem vbTab & "================================="
```

```
FrmSimulation.List1.AddItem vbTab & "M1 = No formal education to the public on the benefits of MNP."
FrmSimulation.List1.AddItem vbTab & "M2 = Clumsy administrative procedure."
FrmSimulation.List1.AddItem vbTab & "M3 = Switching Costs."
FrmSimulation.List1.AddItem vbTab & "M4 = Poor Quality of service even with the new network being ported to."
FrmSimulation.List1.AddItem vbTab & "M5 = Loss of contacts due to migration."
FrmSimulation.List1.AddItem vbTab & "M6 = Difficulty in practically switching Numbers."
FrmSimulation.List1.AddItem vbTab & "M7 = The 48hrs duration before a complete porting is achieved."
FrmSimulation.List1.AddItem vbTab & "M8 = The 90 days lock-in period before the next migration."
FrmSimulation.List1.AddItem vbTab & "M9 = The need to be physically present in any of the network's Outlets in order to initiate a port."
'FrmSimulation.List1.AddItem vbTab & "==================================="
Exit Sub
errortrapping:
MsgBox ("Invalid Entry(ies)"), vbCritical
End Sub
Private Sub Form_Load()
FrmRun.Move (Screen.Width - FrmRun.Width) * 0.5, _
(Screen.Height - FrmRun.Height) * 0.3
DatRun.Visible = False
DatRun.DatabaseName = App.Path & "\Simulation.mdb"
DatRun.RecordSource = "SimTry"
End Sub
Private Sub CmdClear_Click()
TxtName.Text = Empty
TxtId.Text = Empty
TxtTel.Text = Empty
TxtMail.Text = Empty
```

```
TxtRem.Text = Empty
TxtName.SetFocus
End Sub
Private Sub CmdClose_Click()
Unload Me
End Sub

Private Sub CmdSave_Click()
On Error GoTo eTry
With DatRegister.Recordset
   .AddNew
   ![Subscriber's Name] = TxtName.Text
   ![Id Number] = TxtId.Text
   ![Telephone Number] = TxtTel.Text
   ![Email Address] = TxtMail.Text
   ![Remark] = TxtRem.Text
   .Update
End With
CmdClear_Click
MsgBox ("New Subscriber Details Successfully Added."), vbInformation
Exit Sub
eTry:
MsgBox ("Subscriber's Details is unable to Register."), vbCritical
End Sub
Private Sub Form_Load()
FrmAdd_Subscriber.Move (Screen.Width - FrmAdd_Subscriber.Width) * 0.5, _
(Screen.Height - FrmAdd_Subscriber.Height) * 0.3
DatRegister.Visible = False
DatRegister.DatabaseName = App.Path & "\Simulation.mdb"
DatRegister.RecordSource = "sRegistration"
End Sub
```

```
Private Sub CmdClear_Click()
TxtName.Text = Empty
TxtId.Text = Empty
TxtTel.Text = Empty
TxtMail.Text = Empty
TxtCell.Text = Empty
TxtNature.Text = Empty
TxtAction.Text = Empty
TxtName.SetFocus
End Sub
Private Sub CmdClose_Click()
Unload Me
End Sub
Private Sub CmdSave_Click()
On Error GoTo eTry
With DatComplain.Recordset
   .AddNew
   ![Subscriber's Name] = TxtName.Text
   ![Id Number] = TxtId.Text
   ![Telephone Number] = TxtTel.Text
   ![Email Address] = TxtMail.Text
   ![Cell] = TxtCell.Text
   ![Nature of Complaint] = TxtNature.Text
   ![Action Taken] = TxtAction.Text
   .Update
End With
CmdClear_Click
MsgBox ("New Subscriber Complaint Successfully Added."), vbInformation
Exit Sub
eTry:
MsgBox ("Subscriber's Complaints is unable to Register."), vbCritical
```

```
End Sub
Private Sub Form_Load()
FrmAdd_Complain.Move (Screen.Width - FrmAdd_Complain.Width) * 0.5, _
(Screen.Height - FrmAdd_Complain.Height) * 0.3
DatComplain.Visible = False
DatComplain.DatabaseName = App.Path & "\Simulation.mdb"
DatComplain.RecordSource = "sComplaint"
End Sub
Private Conn As ADODB.Connection
Private rs As ADODB.Recordset
Private Sub CmdPrint_Click()
On Error GoTo eTry
Me.PrintForm
Exit Sub
eTry:
MsgBox ("Printer Error. Check the printer Cable."), vbCritical
End Sub
Private Sub Form_Load()
FrmReport.Move (Screen.Width - FrmReport.Width) * 0.5, _
(Screen.Height - FrmReport.Height) * 0.3
DatRun.Visible = False
DatRun.DatabaseName = App.Path & "\Simulation.mdb"
DatRun.RecordSource = "SimTry"
On Error Resume Next  'GoTo errorhandler
istView.ListItems.Clear
Dim num As Integer
Set Conn = New ADODB.Connection
 Conn.ConnectionString = "Provider=Microsoft.Jet.OLEDB.4.0;" & _
     "Data Source=" & App.Path & "\Simulation.mdb"
   Conn.Open
Dim strSql As String
```

```
num = 1
 Set rs = New ADODB.Recordset
 strSql = "select * from SimTry"
 With rs
   .Source = strSql
   .ActiveConnection = Conn
   .CursorType = adOpenDynamic
   .LockType = adLockPessimistic
   .Open Options:=adCmdText
    End With
    ' search
 If rs.BOF = False Then rs.MoveFirst
Do Until rs.EOF
'If rs![LGA] = UCase(Combo1.Text) Then
istView.ListItems.Add num, "a" & Str(num), Str(num)
With istView.ListItems.Item(num)
     .SubItems(1) = rs![Year]
     .SubItems(2) = rs![M1]
     .SubItems(3) = rs![M2]
     .SubItems(4) = rs![M3]
     .SubItems(5) = rs![M4]
     .SubItems(6) = rs![M5]
     .SubItems(7) = rs![M6]
     .SubItems(8) = rs![M7]
     .SubItems(9) = rs![M8]
     .SubItems(10) = rs![M9]
End With
num = num + 1
'End If
If rs.EOF = False Then rs.MoveNext
Loop
```

```
num = num - 1
If num = 0 Then Pnum = 0 Else Pnum = num
'lblinfo.Caption = " *** There are currently  [" & Trim(Str(Pnum)) & "] Record(s) in this Database!
***"
rs.Close
Set rs = Nothing
Exit Sub
errorhandler:
MsgBox ("There is no record for the ceriteria you selected."), vbInformation
End Sub
Dim strSql As String
Private Sub CmdClear_Click()
TxtSearch.Text = Empty
TxtName.Text = Empty
TxtId.Text = Empty
TxtTel.Text = Empty
TxtMail.Text = Empty
TxtRem.Text = Empty
TxtSearch.SetFocus
End Sub
Private Sub CmdClose_Click()
Unload Me
End Sub
Private Sub CmdDelete_Click()
On Error GoTo eTry
   With DatRegister.Recordset
      .Delete
      .MoveFirst
   End With
   CmdClear_Click
MsgBox ("Subscriber's Record Deleted Successfully."), vbCritical
```

```
Exit Sub
eTry:
MsgBox ("Subscriber's Details is unable to Delete or No Details to be Delete."), vbCritical
End Sub
Private Sub CmdSave_Click()
On Error GoTo eTry
With DatRegister.Recordset
   .Edit
   ![Subscriber's Name] = TxtName.Text
   ![Id Number] = TxtId.Text
   ![Telephone Number] = TxtTel.Text
   ![Email Address] = TxtMail.Text
   ![Remark] = TxtRem.Text
   .Update
End With
CmdClear_Click
MsgBox ("Subscriber Details Successfully Updated."), vbInformation
Exit Sub
eTry:
MsgBox ("Subscriber's Details is unable to Update."), vbCritical
End Sub
Private Sub CmdSearch_Click()
On Error GoTo eTry
strSql = "Select * from sRegistration where [Id Number]='" & TxtSearch.Text & "'"
DatRegister.RecordSource = strSql
DatRegister.Refresh
rDisplay
Exit Sub
eTry:
MsgBox ("The Id Number can not find in the database."), vbCritical
End Sub
```

```
Private Sub Form_Load()
FrmEditSubs.Move (Screen.Width - FrmEditSubs.Width) * 0.5, _
(Screen.Height - FrmEditSubs.Height) * 0.3
DatRegister.Visible = False
DatRegister.DatabaseName = App.Path & "\Simulation.mdb"
DatRegister.RecordSource = "sRegistration"
End Sub
Private Sub rDisplay()
With DatRegister.Recordset
   TxtName.Text = ![Subscriber's Name]
   TxtId.Text = ![Id Number]
   TxtTel.Text = ![Telephone Number]
   TxtMail.Text = ![Email Address]
   TxtRem.Text = ![Remark]
End With
TxtName.SetFocus
End Sub
Dim strSql As String
Private Sub CmdClear_Click()
TxtSearch.Text = Empty
TxtName.Text = Empty
TxtId.Text = Empty
TxtTel.Text = Empty
TxtMail.Text = Empty
TxtCell.Text = Empty
TxtNature.Text = Empty
TxtAction.Text = Empty
TxtSearch.SetFocus
End Sub
Private Sub CmdClose_Click()
Unload Me
```

```
End Sub
Private Sub CmdDelete_Click()
On Error GoTo eTry
   With DatComplain.Recordset
      .Delete
      .MoveFirst
   End With
   CmdClear_Click
MsgBox ("Subscriber's Complaint Record Deleted Successfully."), vbCritical
Exit Sub
eTry:
MsgBox ("Subscriber's Complaint Record is unable to Delete or No Complaint to be Delete."),
vbCritical
End Sub
Private Sub CmdSave_Click()
On Error GoTo eTry
With DatComplain.Recordset
   .Edit
   ![Subscriber's Name] = TxtName.Text
   ![Id Number] = TxtId.Text
   ![Telephone Number] = TxtTel.Text
   ![Email Address] = TxtMail.Text
   ![Cell] = TxtCell.Text
   ![Nature of Complaint] = TxtNature.Text
   ![Action Taken] = TxtAction.Text
   .Update
End With
CmdClear_Click
MsgBox ("Subscriber Complaint Successfully Updated."), vbInformation
Exit Sub
eTry:
```

```
MsgBox ("Subscriber's Complaints is unable to Update."), vbCritical
End Sub
Private Sub CmdSearch_Click()
On Error GoTo eTry
strSql = "Select * from sComplaint where [Id Number]='" & TxtSearch.Text & "'"
DatComplain.RecordSource = strSql
DatComplain.Refresh
rDisplay
Exit Sub
eTry:
MsgBox ("The Id Number can not be found in the database."), vbCritical
End Sub
Private Sub Form_Load()
FrmEditSubscom.Move (Screen.Width - FrmEditSubscom.Width) * 0.5, _
(Screen.Height - FrmEditSubscom.Height) * 0.3
DatComplain.Visible = False
DatComplain.DatabaseName = App.Path & "\Simulation.mdb"
DatComplain.RecordSource = "sComplaint"
End Sub
Private Sub rDisplay()
With DatComplain.Recordset
   TxtName.Text = ![Subscriber's Name]
   TxtId.Text = ![Id Number]
   TxtTel.Text = ![Telephone Number]
   TxtMail.Text = ![Email Address]
   TxtCell.Text = ![Cell]
   TxtNature.Text = ![Nature of Complaint]
   TxtAction.Text = ![Action Taken]
End With
TxtName.SetFocus
End Sub
```

APPENDIX B

PROGRAM SAMPLE OUTPUT

MNP Growth Trajectory Simulation / Predictor

Nigerian Communications Commission

By Odii Juliet Nnenna

B-Tech(Maths/Computer)FUTO,
MSc(Computer Science) UNIZIK

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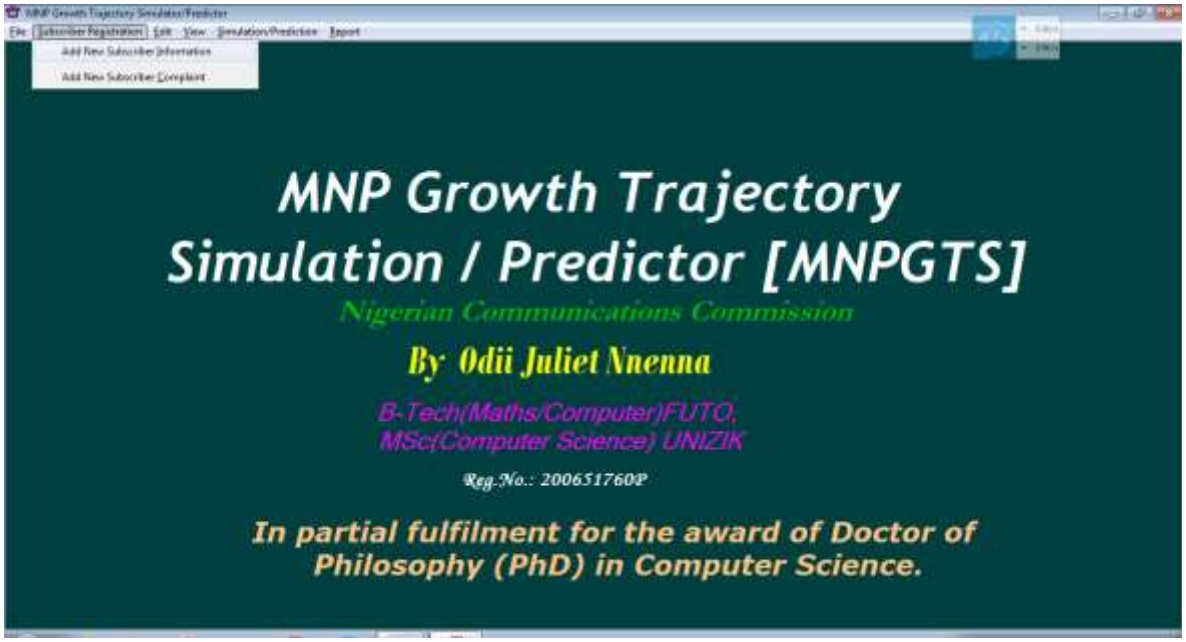
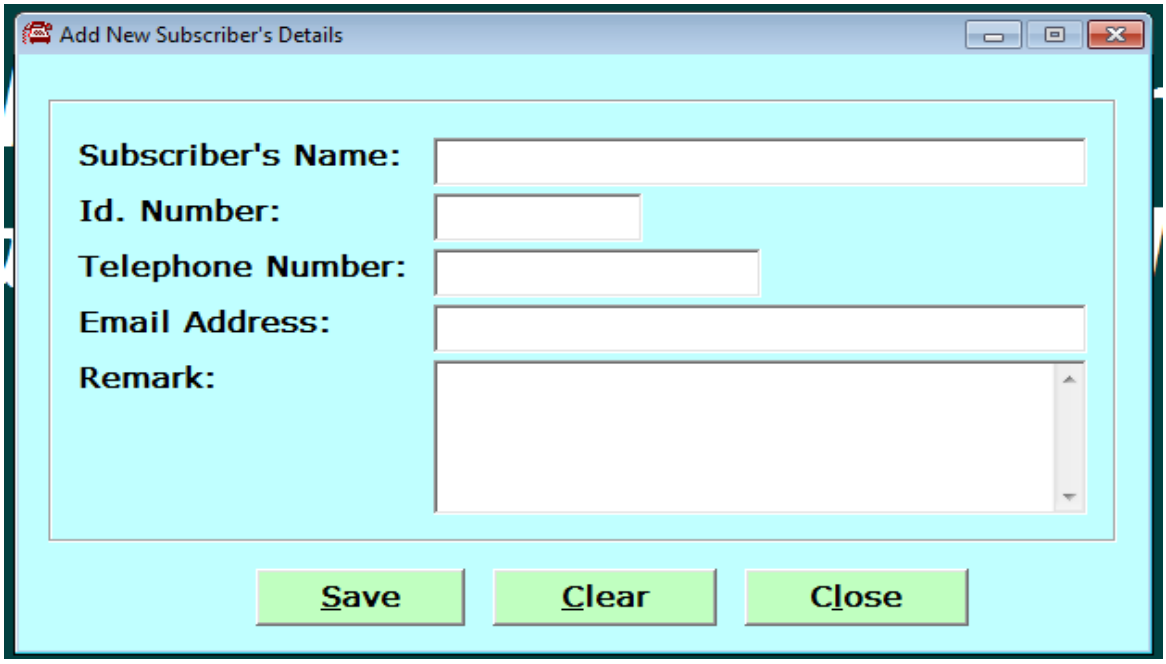
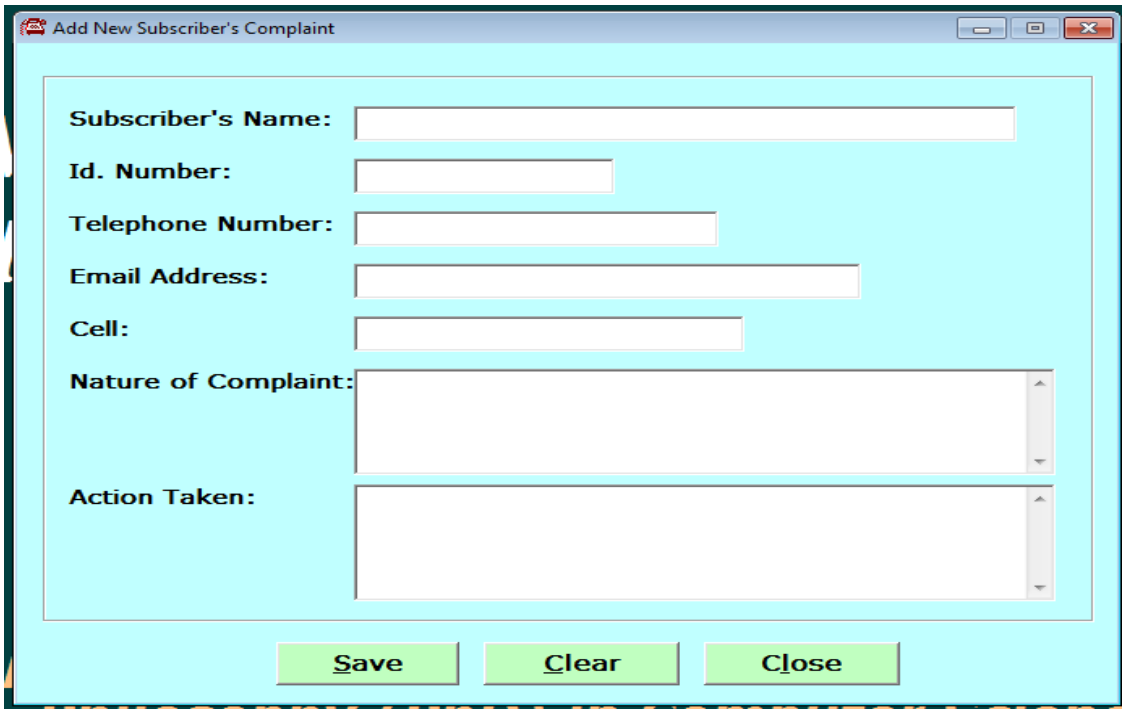
In partial fulfilment for the award of Doctor of Philosophy (PhD) in Computer Science, Nnamdi Azikiwe University, Awka, Anambra State.

Version 1.0

January 2015

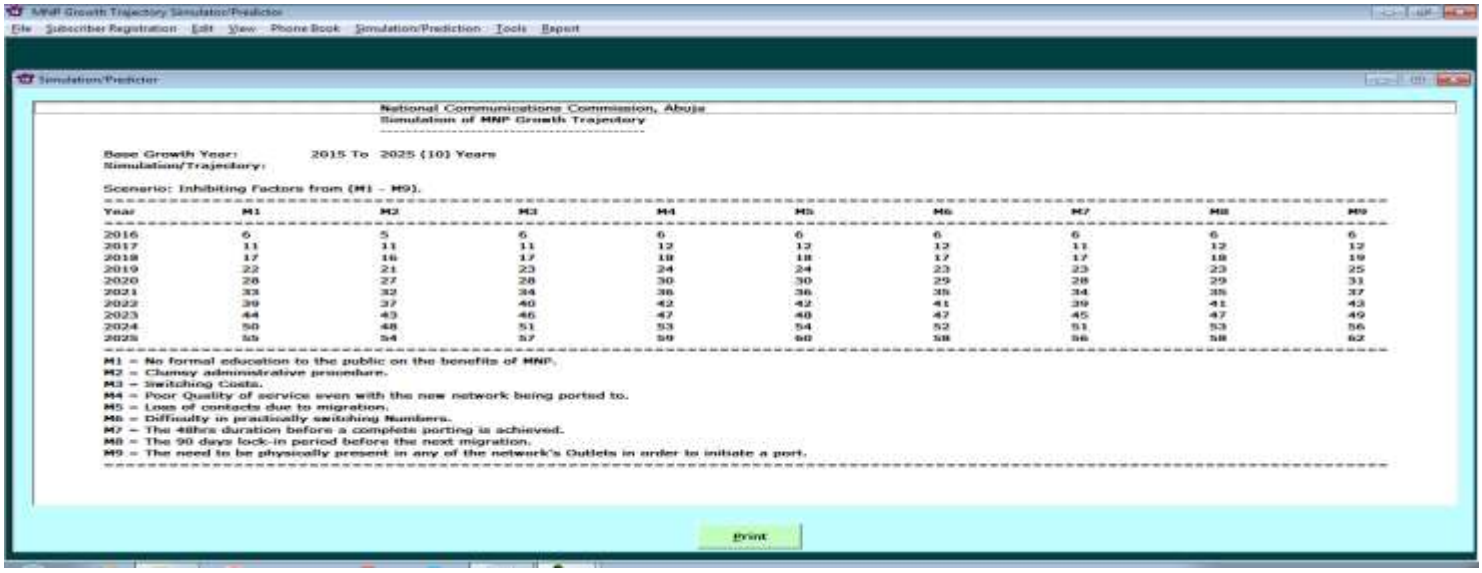



Add New Subscriber's Details
Subscriber's Name:
Id. Number:
Telephone Number:
Email Address:
Remark:
Save
Clear
Close


Add New Subscriber's Complaint
Subscriber's Name:
Id. Number:
Telephone Number:
Email Address:
Cell:
Nature of Complaint:
Action Taken:
Save
Clear
Close

Scenario 1

Using Prevailing indices gotten from Statistical Analysis



National Communications Commission, Abuja
Simulation of MNP Growth Trajectory

Base Growth Year: 2015 To 2025 (10) Years
Simulation/Trajectory:

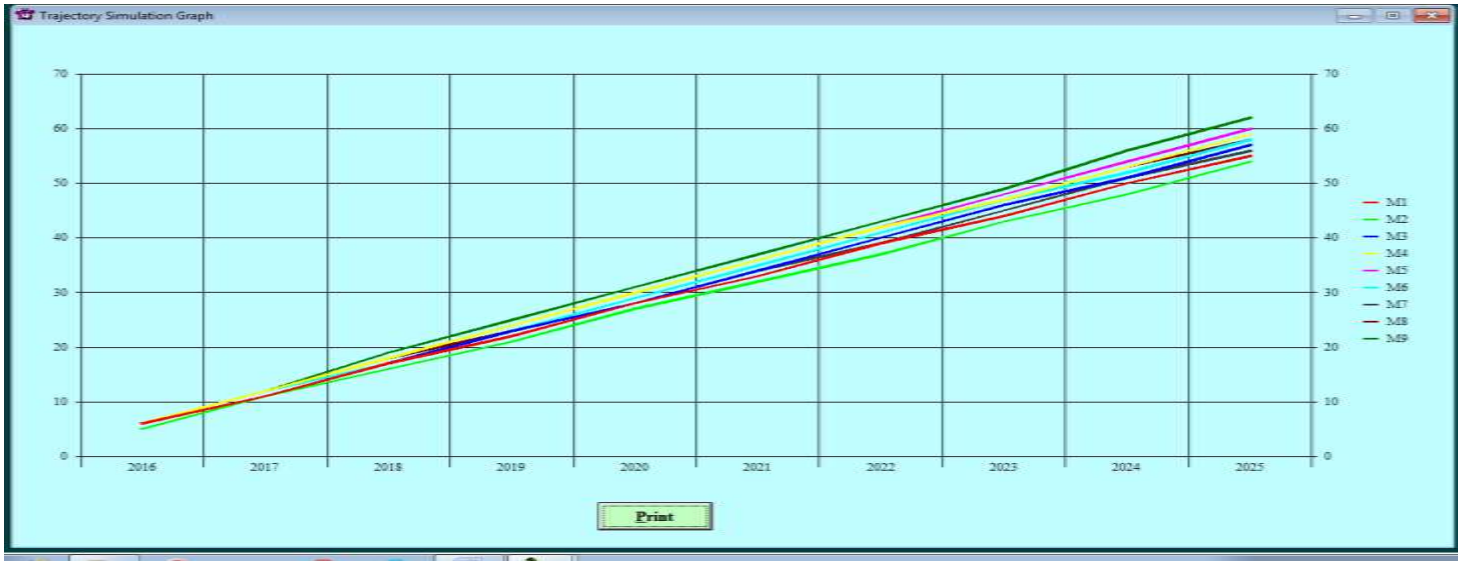
Scenario: Inhibiting Factors from (M1 – M9).

Year	M1	M2	M3	M4	M5	M6	M7	M8	M9
2016	6	5	6	6	6	6	6	6	6
2017	11	11	11	12	12	12	11	12	12
2018	17	16	17	18	18	17	17	18	19
2019	22	21	23	24	24	23	23	23	25
2020	28	27	28	30	30	29	28	29	31
2021	33	32	34	36	36	35	34	35	37
2022	39	37	40	42	42	41	39	41	43
2023	44	43	46	47	48	47	45	47	49
2024	50	48	51	53	54	52	51	53	56
2025	55	54	57	59	60	58	56	58	62

M1 = No formal education to the public on the benefits of MNP.
M2 = Clumsy administrative procedure.
M3 = Switching Costs.
M4 = Poor Quality of service even with the new network being ported to.
M5 = Loss of contacts due to migration.
M6 = Difficulty in practically switching Numbers.
M7 = The 48hrs duration before a complete porting is achieved.
M8 = The 90 days lock-in period before the next migration.
M9 = The need to be physically present in any of the network's Outlets in order to initiate a port.

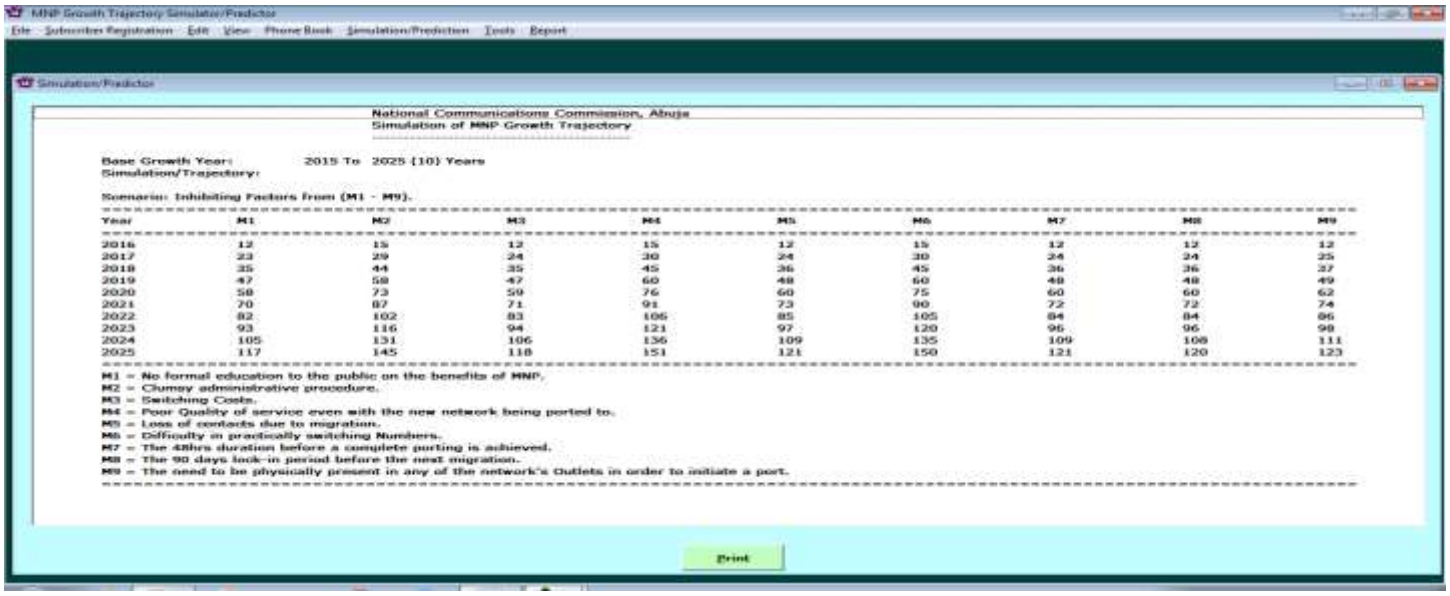
Print

Scenario 1: Data output/Graph.



Scenario II:

Showing when the Inhibiting factors are improved or adjusted positively.



National Communications Commission, Abuja
Simulation of MNP Growth Trajectory

Base Growth Year: 2015 To 2025 (10) Years
Simulation/Trajectory:

Scenario: Inhibiting Factors From (M1 - M9).

Year	M1	M2	M3	M4	M5	M6	M7	M8	M9
2016	12	15	12	15	12	15	12	12	12
2017	23	29	24	30	24	30	24	24	25
2018	35	44	35	45	36	45	36	36	37
2019	47	58	47	60	48	60	48	48	49
2020	58	73	59	76	60	75	60	60	62
2021	70	87	71	91	73	90	72	72	74
2022	82	102	83	106	85	105	84	84	86
2023	93	116	94	121	97	120	96	96	98
2024	105	131	106	136	109	135	109	108	111
2025	117	145	118	151	121	150	121	120	123

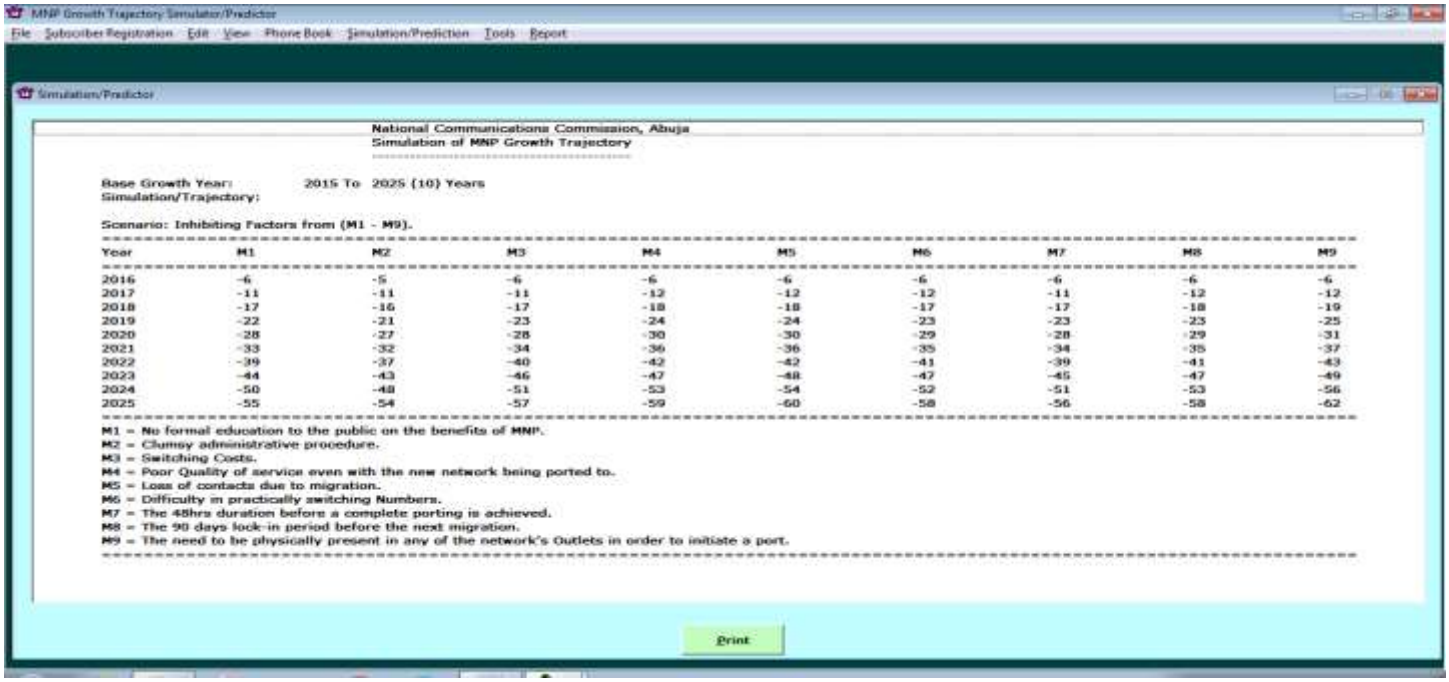
M1 = No formal education to the public on the benefits of MNP.
M2 = Clumsy administrative procedure.
M3 = Switching Costs.
M4 = Poor Quality of service even with the new network being ported to.
M5 = Loss of contacts due to migration.
M6 = Difficulty in practically switching Numbers.
M7 = The 48hrs duration before a complete porting is achieved.
M8 = The 90 days lock-in period before the next migration.
M9 = The need to be physically present in any of the network's Outlets in order to initiate a port.

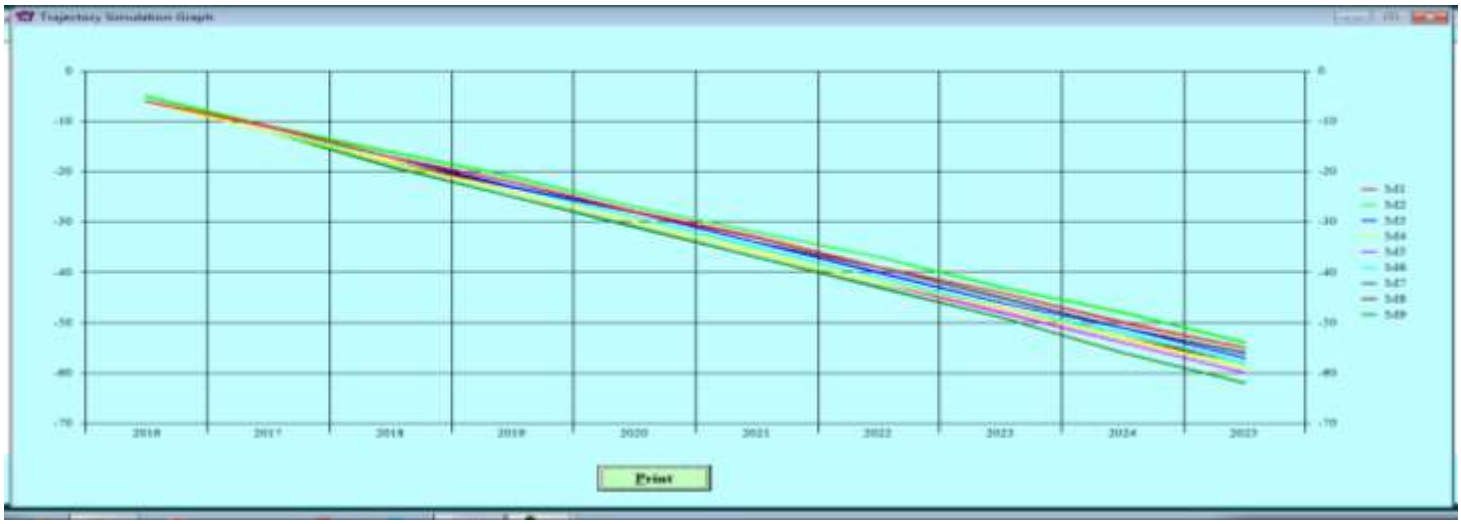
Print

Scenario II: Data output / Graph

Scenario III:

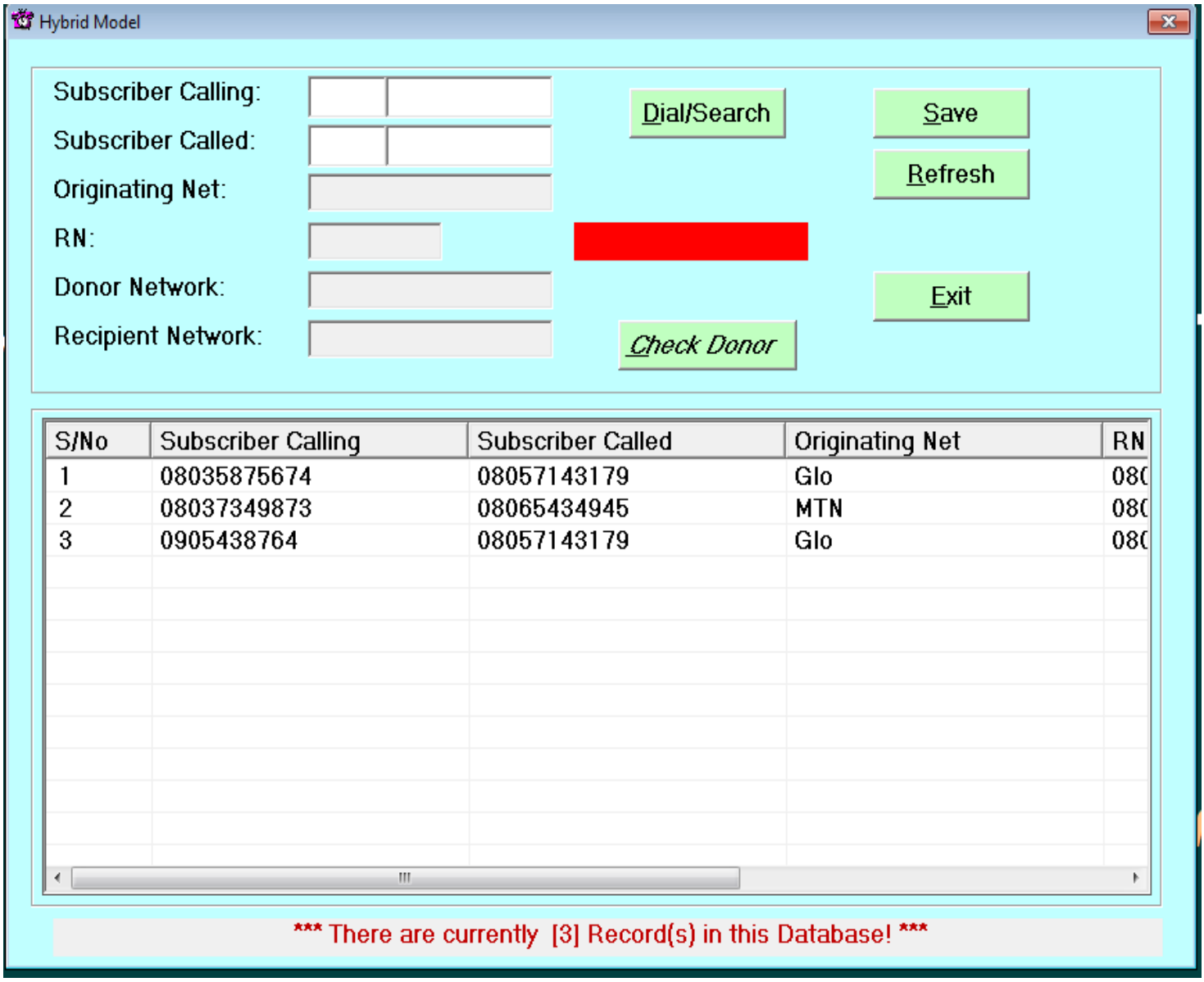
Showing when the Inhibiting factors get worse or adjusted negatively.





Scenario III: Data output/Graph

Output for the Hybrid Model



APPENDIX C

QUESTIONNAIRE

Mobile number portability was deployed on April 22, 2013 by Nigeria Communication Commission (NCC) to enable subscribers in Nigeria to change their service providers (port) without changing their numbers, thereby giving subscribers the privilege to easily change from networks that are not serving them well and also return when the network improves.
Please kindly help us to answer these questions as your opinion really counts for MNP workability in Nigeria.

CLUSTER 1: DEMOGRAPHIC PROFILE OF RESPONDENTS

1. Name: _____
2. Sex: _____
3. Age _____
4. Marital status: _____
5. Name of Industry (Business, education, etc): _____
6. Educational qualification: _____
7. LGA /State of residence: _____
8. Which network(s) are you currently using? _____
9. How long have you used the network? _____
10. Are you aware of MNP implementation in Nigeria YES/NO____
11. Do you support MNP YES /NO_____
12. Has services improved since MNP was introduced YES/NO____
13. Have you ported before? YES/NO: _____
14. Do you intend to port YES / NO: _____
15. If NO, why: _____

CLUSTER 2: MNP INHIBITING FACTORS

Rate the following factors as responsible for why number portability is yet to fully succeed in Nigeria.: 0 to 4 ; 0 = unimportant; 1 = less important; 2=marginally important; 3 = important; 4 = very important

a) No formal education to the public on the benefits of MNP

b) Clumsy administrative procedure

c) Switching Costs

d) Poor Quality of service even with the new network being ported to.

e) Loss of contacts due to migration

f) Difficulty in practically switching Numbers.

g) The 48hr duration before a complete porting is achieved.

h) The 90 days lock-in period before the next migration

i) The need to be physically present in any of the network's Outlets in order to initiate a port

CLUSTER 3: MNP IMPACT

Rate your feeling 0 to 4 on the following questions, indicating : 0 = Negative impact; , 1 = No impact; 2= marginal positive impact, 3 = fair impact, 4 = positive Impact

a) To what extent do you believe the introduction of MNP has improved the quality of service

b) Has MNP expanded the employment opportunities for the Nigeria youths?

c) Has MNP increased Telephone density and internet diffusion in Nigeria?

d) Has MNP led to socio –economic revolution eg low sales for new? phones, dual / multiple SIM phones

e) Has MNP any effect on Charges by the Network providers.

f) Has it instigated any fierce Competition among the service providers?

CLUSTER 4. USER RECOMMENDATION

Answer YES/NO

1. Should MNP be:
   (a) Cancelled outright YES/NO
   (b) Improved upon YES/NO

2. What in your opinion should be done if you choose 1(b) above?

_____

_____

_____

_____

_____

3. In your opinion, state other ways Quality of Service (QoS) can be improved upon beyond MNP

_____

_____

_____

_____

_____

4. In which ways do you suggest teledensity or network diffusion can be increased?

_____

_____

_____

_____

5. Suggest what NCC can do so as to attract Nigerian subscribers to embrace MNP

_____

_____

_____

_____

_____

APPENDIX D

```
SAVE OUTFILE='D:\PhDOdii\SPSSOdii\Regression.sav'
/COMPRESSED. REGRESSION
/DESCRIPTIVES MEAN STDDEV CORR SIG N
/MISSING LISTWISE
/STATISTICS COEFF OUTS CI BCOV R ANOVA COLLIN TOL CHANGE ZPP
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Total
/METHOD=ENTER noformaledu clumsyprocedure switchingcost poorQoS
ContactLoss portingdifficulty fortyeighthrlockin ninetyDaysLockin
PhyscialPresence
/RESIDUALS DURBIN.
```

Regression

[DataSet0] D:\PhDOdii\SPSSOdii\Regression.sav **Descriptive Statistics**

	Mean	Std. Deviation	N
Total	18.0375	6.23446	347
noformaledu	2.2767	1.12953	347
clumsyprocedure	2.0836	1.08933	347
switchingcost	1.8963	1.16086	347
poorQoS	2.0461	1.20843	347
ContactLoss	2.0144	1.21280	347
portingdifficulty	1.9076	1.18645	347
fortyeighthrlockin	1.9971	1.14926	347
ninetyDaysLockin	1.8934	1.19132	347
PhyscialPresence	1.9222	1.25953	347

Correlations

		Total	noformaledu	clumsyprocedure	switchingcost
Pearson Correlation	Total	1.000	.557	.571	.546
	noformaledu	.557	1.000	.352	.247
	clumsyprocedure	.571	.352	1.000	.263
	switchingcost	.546	.247	.263	1.000
	poorQoS	.561	.215	.245	.220
	ContactLoss	.627	.235	.273	.362
	portingdifficulty	.576	.183	.241	.215
	fortyeightthrlockin	.543	.281	.270	.223
	ninetyDaysLockin	.599	.228	.203	.201
	PhyscialPresence	.615	.251	.241	.176
Sig. (1-tailed)	Total		.000	.000	.000
	noformaledu	.000		.000	.000
	clumsyprocedure	.000	.000		.000
	switchingcost	.000	.000	.000	
	poorQoS	.000	.000	.000	.000
	ContactLoss	.000	.000	.000	.000
	portingdifficulty	.000	.000	.000	.000
	fortyeightthrlockin	.000	.000	.000	.000
	ninetyDaysLockin	.000	.000	.000	.000
	PhyscialPresence	.000	.000	.000	.000
N	Total	347	347	347	347
	noformaledu	347	347	347	347
	clumsyprocedure	347	347	347	347
	switchingcost	347	347	347	347
	poorQoS	347	347	347	347
	ContactLoss	347	347	347	347
	portingdifficulty	347	347	347	347
	fortyeightthrlockin	347	347	347	347
	ninetyDaysLockin	347	347	347	347
	PhyscialPresence	347	347	347	347

Correlations

		poorQoS	ContactLoss	portingdifficulty	fortyeightthlockin
Pearson Correlation	Total	561	627	576	.843
	noformaledu	.215	.235	.183	.261
	clumsyprocedure	.245	.273	.241	.270
	switchingcost	.220	.332	.216	.223
	poorQoS	1.000	.272	.239	.254
	ContactLoss	.272	1.000	.397	.259
	portingdifficulty	.239	.397	1.000	.335
	fortyeightthlockin	.254	.259	.335	1.000
	ninetyDaysLockin	.272	.215	.195	.424
	PhysicalPresence	.234	.288	.237	.367
Sig. (1-tailed)	Total	.000	.000	.000	.000
	noformaledu	.000	.000	.000	.000
	clumsyprocedure	.000	.000	.000	.000
	switchingcost	.000	.000	.000	.000
	poorQoS		.000	.000	.000
	ContactLoss	.000		.000	.000
	portingdifficulty	.000	.000		.000
	fortyeightthlockin	.000	.000	.000	
	ninetyDaysLockin	.000	.000	.000	.000
	PhysicalPresence	.000	.000	.000	.000
N	Total	347	347	347	347
	noformaledu	347	347	347	347
	clumsyprocedure	347	347	347	347
	switchingcost	347	347	347	347
	poorQoS	347	347	347	347
	ContactLoss	347	347	347	347
	portingdifficulty	347	347	347	347
	fortyeightthlockin	347	347	347	347
	ninetyDaysLockin	347	347	347	347
	PhysicalPresence	347	347	347	347

Correlations

		ninetyDays Lockin	Physcial Presence
Pearson Correlation	Total	556	615
	noformaledu	.228	.251
	clumsyprocedure	.203	.241
	switchingcost	.201	.178
	poorQoS	.272	.234
	ContactLoss	.215	.286
	portingdifficulty	.195	.237
	fortyeighthrlockin	.424	.367
	ninetyDaysLockin	1.000	.412
	PhyscialPresence	.412	1.000
Sig. (1-tailed)	Total	.000	.000
	noformaledu	.000	.000
	clumsyprocedure	.000	.000
	switchingcost	.000	.000
	poorQoS	.000	.000
	ContactLoss	.000	.000
	portingdifficulty	.000	.000
	fortyeighthrlockin	.000	.000
	ninetyDaysLockin		.000
	PhyscialPresence	.000	
N	Total	347	347
	noformaledu	347	347
	clumsyprocedure	347	347
	switchingcost	347	347
	poorQoS	347	347
	ContactLoss	347	347
	portingdifficulty	347	347
	fortyeighthrlockin	347	347
	ninetyDaysLockin	347	347
	PhyscialPresence	347	347

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	Physcial Presence, switchingcost, portingdifficulty, poorQoS, noformaledu, clumsyprocedure, ninetyDaysLockin, ContactLoss, fortyeighthrlockin[a]		Enter

a. All requested variables entered.

b. Dependent Variable: Total

Coefficients[a]

Model		95% Confidence Interval for B		Correlations		
		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	.000	.000			
	noformaledu	1.000	1.000	.557	1.000	.162
	clumsyprocedure	1.000	1.000	.571	1.000	.155
	switchingcost	1.000	1.000	.546	1.000	.166
	poorQoS	1.000	1.000	.561	1.000	.177
	ContactLoss	1.000	1.000	.627	1.000	.165
	portingdifficulty	1.000	1.000	.576	1.000	.167
	fortyeighthrlockin	1.000	1.000	.643	1.000	.154
	ninetyDaysLockin	1.000	1.000	.599	1.000	.162
	PhyscialPresence	1.000	1.000	.615	1.000	.174

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	noformaledu	.802	1.247
	clumsyprocedure	.787	1.271
	switchingcost	.811	1.233
	poorQoS	.832	1.202
	ContactLoss	.715	1.398
	portingdifficulty	.769	1.300
	fortyeightHrlockin	.698	1.433
	ninetyDaysLockin	.722	1.386
	PhysicalPresence	.741	1.349

a. Dependent Variable: Total

Coefficient Correlations[a]

Model			Physical Presence	switchingcost	portingdifficulty	poorQoS
1	Correlations	PhysicalPresence	1.000	.013	-.044	-.049
		switchingcost	.013	1.000	-.026	-.069
		portingdifficulty	-.044	-.026	1.000	-.082
		poorQoS	-.049	-.069	-.082	1.000
		noformaledu	-.051	-.103	-.001	-.059
		clumsyprocedure	-.065	-.109	-.075	-.095
		ninetyDaysLockin	-.265	-.057	.012	-.128
		ContactLoss	-.125	-.241	-.272	-.103
		fortyeightHrlockin	-.153	-.047	-.194	-.055
	Covariances	PhysicalPresence	3.15E-017	4.17E-019	-1.45E-018	-1.52E-018
		switchingcost	4.17E-019	3.39E-017	-8.70E-019	-2.22E-018
		portingdifficulty	-1.45E-018	-8.70E-019	3.42E-017	-2.66E-018
		poorQoS	-1.52E-018	-2.22E-018	-2.66E-018	3.04E-017
		noformaledu	-2.75E-018	-3.59E-018	-5.09E-020	-1.98E-018
		clumsyprocedure	-2.25E-018	-4.00E-018	-2.75E-018	-3.31E-018
		ninetyDaysLockin	-8.85E-018	-1.98E-018	4.20E-019	-4.23E-018
		ContactLoss	-4.14E-018	-8.32E-018	-9.44E-018	-3.36E-018
		fortyeightHrlockin	-5.44E-018	-1.74E-018	-7.20E-018	-1.93E-018

Coefficient Correlations[a]

Model			noformaledu	clumsyprocedure	ninetyDaysLockin
1	Correlations	PhyscialPresence	-.081	-.066	-.265
		switchingcost	-.103	-.109	-.057
		portingdifficulty	-.001	-.075	.012
		poorQoS	-.059	-.095	-.128
		noformaledu	1.000	-.233	-.047
		clumsyprocedure	-.233	1.000	-.008
		ninetyDaysLockin	-.047	-.008	1.000
		ContactLoss	-.051	-.078	-.010
		fortyeighthrlockin	-.106	-.079	-.268
	Covariances	PhyscialPresence	-2.75E-018	-2.28E-018	-6.95E-018
		switchingcost	-3.59E-018	-4.00E-018	-1.98E-018
		portingdifficulty	-5.09E-020	-2.75E-018	4.20E-019
		poorQoS	-1.96E-018	-3.31E-018	-4.23E-018
		noformaledu	3.61E-017	-8.81E-018	-1.66E-018
		clumsyprocedure	-8.81E-018	3.96E-017	-2.94E-019
		ninetyDaysLockin	-1.68E-018	-2.94E-019	3.61E-017
		ContactLoss	-1.81E-018	-2.90E-018	-3.51E-019
		fortyeighthrlockin	-4.04E-018	-3.14E-018	-1.02E-017

Coefficient Correlations[a]

Model			ContactLoss	fortyeighth rlockin
1	Correlations	PhyscialPresence	-.125	-.153
		switchingcost	-.241	-.047
		portingdifficulty	-.272	-.194
		poorQoS	-.103	-.055
		noformaledu	-.051	-.106
		clumsyprocedure	-.078	-.079
		ninetyDaysLockin	-.010	-.268
		ContactLoss	1.000	-.014
		fortyeighthrlockin	-.014	1.000
	Covariances	PhyscialPresence	-4.14E-018	-5.44E-018
		switchingcost	-8.32E-018	-1.74E-018
		portingdifficulty	-9.44E-018	-7.20E-018
		poorQoS	-3.38E-018	-1.93E-018
		noformaledu	-1.81E-018	-4.04E-018
		clumsyprocedure	-2.90E-018	-3.14E-018
		ninetyDaysLockin	-3.51E-019	-1.02E-017
		ContactLoss	3.52E-017	-5.13E-019
		fortyeighthrlockin	-5.13E-019	4.01E-017

a. Dependent Variable: Total

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index
1	1	8.387	1.000
	2	.291	5.369
	3	.232	6.018
	4	.206	6.374
	5	.197	6.530
	6	.184	6.760
	7	.147	7.553
	8	.137	7.632
	9	.132	7.960
	10	.087	9.797

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions					
		(Constant)	noformaledu	clumsypro cedure	switchingcost	poorCoS	ContactLoss
1	1	.00	.00	.00	.00	.00	.00
	2	.00	.00	.01	.13	.00	.07
	3	.01	.08	.05	.10	.02	.08
	4	.01	.01	.02	.33	.43	.07
	5	.01	.15	.17	.10	.40	.04
	6	.00	.00	.02	.07	.05	.08
	7	.00	.02	.02	.22	.04	.46
	8	.00	.03	.10	.02	.01	.18
	9	.02	.51	.56	.00	.00	.01
	10	.96	.20	.04	.02	.04	.00

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions			
		portingdifficulty	fortyeighthlockin	ninetyDaysLockin	Physcial Presence
1	1	.00	.00	.00	.00
	2	.04	.04	.21	.20
	3	.46	.01	.01	.02
	4	.03	.00	.01	.11
	5	.02	.02	.07	.00
	6	.05	.20	.17	.47
	7	.06	.07	.30	.19
	8	.23	.56	.22	.01
	9	.05	.09	.03	.00
	10	.03	.00	.02	.00

a. Dependent Variable: Total

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.0000	27.0000	18.0375	6.23446	347
Residual	.00000	.00000	.00000	.00000	347
Std. Predicted Value	-2.893	1.438	.000	1.000	347
Std. Residual	.000	.000	.000	.000	347

a. Dependent Variable: Total

APPENDIX E

FIELD DATA

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiff
1	1.00	.00	2.00	.00	3.00	2.00	3,00
2	2.00	2.00	1.00	3.00	2.00	3.00	2.00
3	3.00	1.00	.00	.00	.00	.00	3.00
4	3.00	3.00	3.00	2.00	3.00	3.00	3.00
5	5.00	3.00	3.00	.00	3,00	3.00	3.00
6	6.00	3.00	3.00	1.00	.00	.00	3.00
7	7.00	.00	1.00	3.00	2.00	3.00	3.00
8	8.00	3.00	3.00	3.00	2.00	3.00	3.00
9	9.00	3.00	2.00	3.00	3.00	3.00	2.00
10	10.00	3.00	1.00	3.00	3.00	3.00	2.00
11	11.00	1.00	.00	.00	3.00	3.00	3.00
12	12.00	.00	.00	.00	3.00	3.00	.00
13	13.00	3.00	3.00	3.00	3.00	1.00	.00
14	13.00	3.00	3.00	2,00	3.00	3.00	2.00
15	15.00	3.00	3.00	2,00	3.00	3.00	3.00
16	16.00	3.00	3.00	2.00	3.00	3.00	3.00
17	17.00	3.00	3.00	2.00	3.00	3.00	3.00
18	18.00	3.00	3.00	3.00	3.00	3.00	3.00
19	19.00	3.00	3.00	3.00	3.00	3.00	3.00
20	20.00	3.00	2.00	2.00	3.00	3.00	.00
21	21.00	3.00	3.00	2.00	3.00	3.00-	2.00
22	22.00	3.00	3.00	.00	3.00	1.00	3.00
23	23.00	3.00	3.00	3.00	3.00	2.00	2.00
24	23.00	1.00	2.00	3.00	.00	2.00	1.00
25	' 25.00	3.00	2.00	3.00	3.00	.00	3.00
26	26.00	3.00	3.00	3.00	3.00	3.00	3.00
27	27.00	3.00	3.00	3.00	3.00	3.00	2.00
28	28.00	3.00	3.00	2.00	2.00	3.00	3.00
29	29.00	3.00	3.00	3.00	3.00	.00	2.00
30	30.00	3.00	3.00	3.00	3.00	3.00	3.00
31	31.00	3.00	3.00	1.00	3,00	3.00	3.00
32	33.00	.00	3.00	2.00	.00	1.00	1.00
33	33.00	3.00	3.00	3.00	.00	3.00	3.00
34	35.00	3.00	2.00	300	2.00	3.00	3.00
35	36.00	1.00	1.00	2.00	.00	2.00	1.00
36	37.00	1.00	1.00	3.00	3.00	2.00	3.00
37	38.00	3.00	3.00	1.00	.00	3.00	3.00
38	39.00	2.00	1.00	3.00	3.00	2.00	.00
39	30.00	3.00	2.00	2.00	2.00	3.00	3.00
40	31.00	3.00	2.00	.00	.00	.00	2.00
41	32.00	3.00	2.00	1.00	3.00	3.00	1.00
42	33.00	3.00	2.00	.00	.00	2.00	2.00
43	33.00	3.00	3.00	3.00	1.00	1.00	.00

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	fortyeighthr	ninetyDays	PhyscialPr	Total
1	3.00	3.00	3.00	19.00
2	1.00	3.00	2.00	19.00
3	3.00	3.00	.00	10.00
4	2.00	3.00	3.00	25.00
5	2.00	3.00	2.00	22.00
6	3.00	1.00	3.00	17.00
7	1.00	2.00	.00	15.00
8	3.00	3.00	3.00	26.00
9	3.00	3.00	3.00	25.00
10	2.00	3.00	3.00	23.00
11	2.00	.00	3.00	15.00
12	.00	3.00	.00	9.00
13	3.00	3.00	1.00	20.00
14	3.00	3.00	2.00	24.00
15	3.00	2.00	2.00	24.00
16	3.00	1.00	2.00	23.00
17	3.00	1.00	2.00	23.00
18	2.00	3.00	3.00	26.00
19	3.00	1.00	3.00	25.00
20	3.00	3.00	3.00	22.00
21	1.00	.00	.00	17.00
22	3.00	2.00	3.00	21.00
23	3.00	3.00	3.00	25.00
24	1.00	2.00	3.00	15.00
25	3.00	2.00	3.00	22.00
26	3.00	3.00	3.00	27.00
27	3.00	3.00	3.00	26.00
28	1.00	1.00	3.00	21.00
29	3.00	3.00	3.00	23.00
30	3.00	3.00	3.00	27.00
31	3.00	.00	3.00	22.00
32	2.00	3.00	.00	12.00
33	3.00	3.00	3.00	24.00
34	.00	1.00	2.00	19.00
35	1.00	.00	2.00	10.00
36	3.00	2.00	3.00	21.00
37	3.00	.00	.00	16.00
38	2.00	2.00	2.00	17.00
39	3.00	3.00	3.00	24.00
40	1.00	1.00	2.00	11.00
41	3.00	2.00	2.00	20.00
42	1.00	1.00	2.00	13.00
43	3.00	1.00	.00	15.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiffi
44	35.00	2.00	3.00	2.00	3.00	2.00	.00
45	36.00	3.00	3.00	3.00	.00	3.00	.00
46	37.00	3.00	.00	3.00	3.00	3.00	1.00
47	38.00	3.00	3.00	3.00	3.00	3.00	3.00
48	39.00	2.00	.00	.00	.00	.00	.00
49	50.00	3.00	3.00	2.00	1.00	2.00	1.00
50	51.00	3.00	3.00	1.00	3.00	1.00	2.00
51	52.00	.00	2.00	3.00	1.00	2.00	1.00
52	53.00	3.00	3.00	3.00	3.00	3.00	2.00
53	53.00	3.00	2.00	1.00	3.00	.00	1.00
54	55.00	.00	.00	.00	.00	.00	.00
55	56.00	3.00	2.00	.00	.00	3.00	1.00
56	57.00	3.00	2.00	3.00	3.00	3.00	.00
57	58.00	.00	.00	.00	.00	.00	.00
58	59.00	3.00	2.00	3.00	3.00	3.00	1.00
59	60.00	3.00	3.00	.00	2.00	.00	.00
60	61.00	3.00	2.00	3.00	3.00	3.00	3.00
61	62.00	3.00	3.00	3.00	3.00	3.00	3.00
62	63.00	2.00	3.00	3.00	3.00	3.00	2.00
63	64.00	3.00	3.00	1.00	3.00	3.00	3.00
64	65.00	3.00	3.00	2.00	2.00	3.00	3.00
65	66.00	1.00	2.00	.00	2.00	.00	2.00
66	67.00	3.00	2.00	2.00	3.00	3.00	3.00
67	68.00	3.00	2.00	3.00	3.00	3.00	1.00
68	69.00	1.00	2.00	3.00	3.00	3.00	2.00
69	70.00	3.00	2.00	3.00	2.00	1.00	3.00
70	71.00	3.00	3.00	2.00	3.00	3.00	3.00
71	72.00	1.00	3.00	3.00	2.00	3.00	3.00
72	73.00	1.00	.00	.00	3.00	3.00	3.00
73	73.00	1.00	3.00	.00	3.00	2.00	2.00
74	75.00	3.00	3.00	2.00	3.00	.00	3.00
75	76.00	.00	1.00	.00	3.00	1.00	1.00
76	77.00	3.00	3.00	3.00	3.00	3.00	1.00
77	78.00	3.00	3.00	.00	3.00	3.00	3.00
78	79.00	3.00	3.00	3.00	3.00	3.00	3.00
79	80.00	3.00	3.00	1.00	3.00	2.00	3.00
80	81.00	3.00	1.00	3.00	3.00	.00	.00
81	82.00	.00	2.00	3.00	3.00	3.00	2.00
82	83.00	.00	.00	.00	.00	.00	.00
83	83.00	2.00	3.00	2.00	3.00	2.00	3.00
84	85.00	3.00	3.00	3.00	.00	3.00	3.00
85	86.00	3.00	.00	3.00	.00	3.00	3.00
86	87.00	3.00	.00	.00	.00	1.00	2.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
44	.00	.00	3.00	15.00
45	1.00	3.00	3.00	19.00
46	3.00	3.00	3.00	22.00
47	3.00	3.00	3.00	27.00
48	.00	.00	.00	2.00
49	3.00	1.00	.00	16.00
50	1.00	2.00	1.00	17.00
51	2.00	1.00	3.00	15.00
52	1.00	2.00	2.00	22.00
53	1.00	2.00	3.00	16.00
54	.00	.00	.00	.00
55	2.00	3.00	3.00	17.00
56	3.00	3.00	3.00	23.00
57	.00	.00	.00	.00
58	2.00	3.00	3.00	23.00
59	.	3.00	3.00	14.00
60	3.00	1.00	.00	21.00
61	.00	.00	.00	18.00
62	2.00	2.00	3.00	23.00
63	3.00	3.00	1.00	23.00
64	3.00	3.00	3.00	25.00
65	3.00	3.00	3.00	16.00
66	1.00	2.00	1.00	20.00
67	3.00	3.00	2.00	23.00
68	3.00	3.00	3.00	23.00
69	3.00	3.00	2.00	22.00
70	3.00	3.00	2.00	25.00
71	3.00	2.00	2.00	22.00
72	3.00	3.00	3.00	19.00
73	2.00	2.00	2.00	17.00
74	.00	3.00	.00	17.00
75	1.00	1.00	.00	8.00
76	3.00	3.00	2.00	24.00
77	3.00	1.00	.00	19.00
78	3.00	3.00	.00	24.00
79	1.00	3.00	3.00	22.00
80	3.00	3.00	1.00	17.00
81	3.00	3.00	3.00	22.00
82	.00	.00	.00	.00
83	3.00	3.00	3.00	24.00
84	3.00	3.00	3.00	24.00
85	3.00	.00	3.00	18.00
86	.00	.00	1.00	7.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContectLos	portingdiffi
87	88.00	2.00	3.00	3.00	3.00	3.00	3.00
88	89.00	3.00	1.00	2.00	3.00	.00	.00
89	90.00	.00	.00	.00	3.00	.00	.00
90	91.00	1.00	.00	3.00	1.00	3.00	1.00
91	92.00	3.00	3.00	2.00	3.00	2.00	2.00
92	93.00	.00	2.00	.00	.00	.00	.00
93	93.00	3.00	3.00	2.00	3.00	2.00	1.00
94	95.00	3.00	3.00	1.00	.00	.00	.00
95	96.00	.00	.00	2.00	3.00	3.00	3.00
96	97.00	3.00	3.00	3.00	.00	00	.00
97	98.00	3.00	1.00	3.00	2.00	3.00	2.00
98	99.00	2.00	3.00	1.00	1.00	2.00	1.00
99	100.00	3.00	2.00	3.00	3.00	3.00	3.00
100	101.00	3.00	3.00	2.00	2.00	3.00	.00
101	102.00	3.00	3.00	2.00	3.00	3.00	3.00
102	103.00	2.00	1.00	1.00	3.00	00	2.00
103	103.00	3.00	3.00	2.00	1.00	1.00	2.00
104	105.00	1.00	2.00	3.00		3.00	.00
105	106.00	3.00	3.00	2.00	1.00	2.00	3.00
106	107.00	.00	00	2.00	.00	1.00	2.00
107	108.00	3.00	2.00	3.00	3.00	2.00	.00
108	109.00	3.00	00	3.00	2.00	2.00	3.00
109	110.00	3.00	3.00	3.00	.00	3.00	1.00
110	111.00	3.00	.00	1.00	1.00	.00	3.00
111	112.00	3.00	1.00	3.00	3.00	3.00	1.00
112	113.00	3.00	3.00	3.00	3.00	3.00	3.00
113	113.00	3.00	3.00	1.00	3.00	1.00	3.00
114	115.00	1.00	2.00	3.00	3.00	2.00	2.00
115	116.00	2.00	3.00	2.00	3.00	2.00	3.00
116	117.00	2.00	2.00	2.00	2.00	2.00	2.00
117	118.00	00	00	00	00	.00	00
118	119.00	3.00	.00	3.00	2.00	3.00	3.00
119	120.00	3.00	3.00	3.00	3.00	3.00	00
120	121.00	3.00	3.00	1.00	00	.00	00
121	122.00	1.00	2.00	2.00	3.00	3.00	.00
122	123.00	3.00	3.00	3.00	3.00	3.00	2.00
123	123.00	3.00	3.00	00	.00	.00	.00
124	125.00	3.00	3.00	.00	.00	.00	3.00
125	126.00	3.00	3.00	.00	3.00	.00	.00
126	127.00	3.00	3.00	2.00	3.00	2.00	2.00
127	128.00	3.00	3.00	1.00	3.00	3.00	3.00
128	129.00	.00	00	2.00	3.00	1.00	2.00
129	130.00	3.00	3.00	3.00	2.00	.00	3.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
87	3.00	3.00	3.00	26.00
88	1.00	2.00	.00	12.00
89	.00	3.00	.00	6.00
90	3.00	.00	1.00	13.00
91	3.00	3.00	3.00	24.00
92	.00	.00	.00	2.00
93	3.00	3.00	1.00	21.00
94	3.00	2.00	3.00	15.00
95	1.00	3.00	1.00	16.00
96	.00	.00	.00	9.00
97	1.00	3.00	3.00	21.00
98	3.00	1.00	.00	14.00
99	1.00	1.00	3.00	22.00
100	3.00	3.00	3.00	22.00
101	3.00	3.00	1.00	24.00
102	1.00	3.00	3.00	16.00
103	3.00	1.00	.00	16.00
104	1.00	1.00	2.00	13.00
105	3.00	3.00	.00	20.00
106	2.00	2.00	.00	9.00
107	3.00	3.00	3.00	22.00
108	3.00	2.00	.00	18.00
109	2.00	3.00	1.00	19.00
110	.00	.00	3.00	11.00
111	2.00	3.00	3.00	22.00
112	3.00	2.00	3.00	26.00
113	3.00	.00	1.00	18.00
114	2.00	1.00	1.00	17.00
115	3.00	3.00	3.00	24.00
116	2.00	2.00	2.00	18.00
117	.00	.00	.00	.00
118	3.00	.00	1.00	18.00
119	2.00	3.00	1.00	21.00
120	.00	.00	3.00	10.00
121	2.00	3.00	3.00	19.00
122	2.00	.00	1.00	20.00
123	1.00	1.00	3.00	11.00
124	3.00	3.00	3.00	18.00
125	3.00	3.00	3.00	18.00
126	3.00	3.00	3.00	24.00
127	1.00	3.00	2.00	22.00
128	2.00	2.00	.00	12.00
129	3.00	3.00	2.00	22.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiffi
130	131.00	3.00	3.00	.00	3.00	.00	2.00
131	132.00	3.00	2.00	.00	.00	3.00	3.00
132	133.00	3.00	3.00	3.00	3.00	.00	3.00
133	133.00	3.00	3.00	.00	3.00	1.00	3.00
134	135.00	2.00	3.00	3.00	3.00	3.00	3.00
135	136.00	2.00	3.00	3.00	3.00	3.00	3.00
136	137.00	3.00	3.00	3.00	3.00	2.00	2.00
137	138.00	2.00	2.00	2.00	3.00	3.00	2.00
138	139.00	2.00	3.00	2.00	3.00	2.00	3.00
139	130.00	2.00	3.00	3.00	3.00	1.00	.00
140	131.00	3.00	.00	1.00	.00	.00	.00
141	132.00	3.00	3.00	1.00	3.00	3.00	1.00
142	133.00	3.00	2.00	3.00	3.00	3.00	3.00
143	133.00	3.00	3.00	1.00	3.00	3.00	.00
144	135.00	.00	3.00	2.00	.00	3.00	2.00
145	136.00	3.00	2.00	2.00	3.00	3.00	3.00
146	137.00	3.00	3.00	1.00	3.00	3.00	3.00
147	138.00	.00	.00	.00	.00	.00	.00
148	139.00	3.00	1.00	1.00	3.00	.00	2.00
149	150.00	.00	.00	3.00	3.00	1.00	.00
150	151.00	.00	2.00	3.00	3.00	.00	3.00
151	152.00	3.00	.00	3.00	.	3.00	2.00
152	153.00	3.00	3.00	3.00	2.00	3.00	3.00
153	153.00	3.00	.00	.00	.00	.00	.00
154	155.00	1.00	1.00	2.00	2.00	3.00	2.00
155	156.00	3.00	1.00	.00	.00	3.00	3.00
156	157.00	3.00	2.00	3.00	.00	3.00	2.00
157	158.00	2.00	3.00	3.00	.00	3.00	3.00
158	159.00	3.00	2.00	3.00	1.00	2.00	3.00
159	160.00	2.00	2.00	2.00	2.00	2.00	2.00
160	161.00	1.00	2.00	3.00	1.00	3.00	2.00
161	162.00	2.00	1.00	1.00	3.00	.00	2.00
162	163.00	3.00	.00	3.00	2.00	3.00	3.00
163	163.00	.00	2.00	1.00	.00	.00	.00
164	165.00	3.00	2.00	1.00	1.00	1.00	.00
165	166.00	3.00	3.00	2.00	2.00	3.00	2.00
166	167.00	1.00	1.00	1.00	1.00	1.00	1.00
167	168.00	3.00	2.00	2.00	3.00	.00	3.00
168	169.00	3.00	.00	1.00	.00	.00	.00
169	170.00	.00	.00	.00	.00	.00	.00
170	171.00	3.00	3.00	3.00	3.00	3.00	3.00
171	172.00	3.00	3.00	3.00	3.00	3.00	3.00
172	173.00	3.00	3.00	3.00	3.00	3.00	3.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
130	3.00	3.00	3.00	20.00
131	3.00	3.00	3.00	20.00
132	3.00	3.00	3.00	24.00
133	2.00	3.00	3.00	21.00
134	3.00	3.00	3.00	26.00
135	3.00	3.00	3.00	26.00
136	3.00	3.00	3.00	25.00
137	3.00	3.00	3.00	23.00
138	3.00	3.00	3.00	24.00
139	1.00	1.00	.00	14.00
140	3.00	2.00	3.00	12.00
141	3.00	1.00	3.00	21.00
142	3.00	3.00	3.00	26.00
143	3.00	1.00	3.00	20.00
144	1.00	2.00	3.00	16.00
145	2.00	3.00	3.00	24.00
146	3.00	1.00	3.00	23.00
147	.00	.00	.00	.00
148	3.00	1.00	3.00	17.00
149	2.00	3.00	.00	12.00
150	3.00	.00	3.00	17.00
151	1.00	3.00	1.00	16.00
152	3.00	3.00	3.00	26.00
153	.00	.00	.00	3.00
154	1.00	2.00	1.00	15.00
155	3.00	3.00	2.00	18.00
156	1.00	2.00	3.00	19.00
157	.00	00	.00	14.00
158	2.00	2.00	5.00	23.00
159	2.00	2.00	2.00	18.00
160	1.00	2.00	3.00	18.00
161	1.00	3.00	3.00	16.00
162	3.00	3.00	1.00	21.00
163	.00	00	.00	3.00
164	2.00	3.00	1.00	14.00
165	2.00	1.00	2.00	20.00
166	1.00	1.00	1.00	9.00
167	3.00	3.00	3.00	22.00
168	3.00	2.00	3.00	12.00
169	.00	.00	.00	.00
170	2.00	3.00	3.00	26.00
171	3.00	3.00	3.00	27.00
172	3.00	3.00	3.00	27.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
130	3.00	3.00	3.00	20.00
131	3.00	3.00	3.00	20.00
132	3.00	3.00	3.00	24.00
133	2.00	3.00	3.00	21.00
134	3.00	3.00	3.00	26.00
135	3.00	3.00	3.00	26.00
136	3.00	3.00	3.00	25.00
137	3.00	3.00	3.00	23.00
138	3.00	3.00	3.00	24.00
139	1.00	1.00	.00	14.00
140	3.00	2.00	3.00	12.00
141	3.00	1.00	3.00	21.00
142	3.00	3.00	3.00	26.00
143	3.00	1.00	3.00	20.00
144	1.00	2.00	3.00	16.00
145	2.00	3.00	3.00	24.00
146	3.00	1.00	3.00	23.00
147	.00	.00	.00	.00
148	3.00	1.00	3.00	17.00
149	2.00	3.00	.00	12.00
150	3.00	.00	3.00	17.00
151	1.00	3.00	1.00	16.00
152	3.00	3.00	3.00	26.00
153	.00	.00	.00	3.00
154	1.00	2.00	1.00	15.00
155	3.00	3.00	2.00	18.00
156	1.00	2.00	3.00	19.00
157	.00	.00	.00	14.00
158	2.00	2.00	5.00	23.00
159	2.00	2.00	2.00	18.00
160	1.00	2.00	3.00	18.00
161	1.00	3.00	3.00	16.00
162	3.00	3.00	1.00	21.00
163	.00	.00	.00	3.00
164	2.00	3.00	1.00	14.00
165	2.00	1.00	2.00	20.00
166	1.00	1.00	1.00	9.00
167	3.00	3.00	3.00	22.00
168	3.00	2.00	3.00	12.00
169	.00	.00	.00	.00
170	2.00	3.00	3.00	26.00
171	3.00	3.00	3.00	27.00
172	3.00	3.00	3.00	27.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
173	3.00	1.00	2.00	23.00
174	.00	.00	.00	18.00
175	2.00	.00	3.00	20.00
176	.00	.00	2.00	19.00
177	.00	.00	1.00	13.00
178	3.00	2.00	3.00	26.00
179	1.00	.00	1.00	16.00
180	1.00	3.00	2.00	16.00
181	3.00	3.00	2.00	24.00
182	1.00	1.00	.00	7.00
183	2.00	2.00	3.00	25.00
184	3.00	2.00	3.00	25.00
185	3.00	1.00	.00	19.00
186	2.00	1.00	.00	15.00
187	.00	.00	.00	.00
188	1.00	.00	3.00	17.00
189	3.00	3.00	3.00	23.00
190	.00	.00	1.00	12.00
191	.00	.00	1.00	12.00
192	3.00	3.00	3.00	26.00
193	.00	.00	.00	.00
194	.00	.00	.00	8.00
195	2.00	3.00	1.00	21.00
196	.00	.00	1.00	15.00
197	3.00	3.00	3.00	20.00
198	.00	.00	.00	8.00
199	3.00	3.00	2.00	22.00
200	1.00	3.00	.00	14.00
201	2.00	3.00	3.00	22.00
202	2.00	3.00	3.00	23.00
203	3.00	.00	3.00	12.00
204	.00	.00	.00	.00
205	.00	3.00	3.00	22.00
206	3.00	3.00	2.00	20.00
207	3.00	3.00	3.00	23.00
208	1.00	2.00	3.00	19.00
209	1.00	1.00	.00	16.00
210	3.00	3.00	3.00	26.00
211	1.00	2.00	.00	14.00
212	3.00	3.00	1.00	21.00
213	2.00	3.00	3.00	20.00
214	3.00	3.00	3.00	25.00
215	.00	3.00	.	12.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiffi
216	217.00	3.00	3.00	3.00	1.00	3.00	2.00
217	218.00	2.00	1.00	3.00	3.00	3.00	3.00
218	219.00	3.00	1.00	.00	3.00	3.00	1.00
219	220.00	.00	2.00	3.00	2.00	.00	2.00
220	221.00	3.00	.00	1.00	3.00	.00	1.00
221	222.00	3.00	.00	2.00	3.00	3.00	3.00
222	223.00	1.00	2.00	2.00	3.00	3.00	1.00
223	223.00	.00	1.00	2.00	00	3.00	1.00
224	225.00	2.00	2.00	3.00	3.00	3.00	3.00
225	226.00	3.00	3.00	2.00	1.00	3.00	3.00
226	227.00	3.00	00	3.00	3.00	3.00	3.00
227	228.00	3.00	1.00	3.00	00	1.00	.00
228	229.00	3.00	1.00	3.00	.00	1.00	2.00
229	230.00	.00	3.00	3.00	3.00	3.00	3.00
230	231.00	3.00	3.00	.00	3.00	.00	.00
231	232.00	3.00	2.00	1.00	3.00	3.00	1.00
232	233.00	3.00	2.00	3.00	.	.00	3.00
233	233.00	3.00	3.00	3.00	3.00	3.00	3.00
234	235.00	3.00	3.00	2.00	1.00	.00	1.00
235	236.00	2.00	2.00	1.00	.00	1.00	2.00
236	237.00	3.00	.00	2.00	.00	.00	2.00
237	238.00	3.00	3.00	2.00	.	3.00	3.00
238	239.00	3.00	2.00	1.00	3.00	1.00	3.00
239	230.00	.00	00	.00	.00	.00	.00
240	231.00	3.00	2.00	.00	3.00	3.00	3.00
241	232.00	3.00	2.00	3.00	3.00	3.00	2.00
242	233.00	1.00	3.00	00	3.00	3.00	2.00
243	233.00	1.00	3.00	2.00	.00	3.00	3.00
244	235.00	3.00	2.00	2.00	3.00	3.00	3.00
245	236.00	3.00	3.00	3.00	1.00	3.00	3.00
246	237.00	3.00	2.00	3.00	2.00	1.00	1.00
247	238.00	3.00	3.00	.00	2.00	3.00	2.00
248	239.00	3.00	3.00	3.00	.00	3.00	2.00
249	250.00	3.00	3.00	3.00	.00	3.00	2.00
250	251.00	3.00	3.00	3.00	2.00	3.00	3.00
251	252.00	.00	2.00	1.00	.00	2.00	1.00
252	253.00	3.00	.00	2.00	3.00	.00	3.00
253	253.00	2.00	1.00	2.00	3.00	1.00	1.00
254	255.00	3.00	3.00	00	3.00	3.00	2.00
255	256.00	2.00	.00	2.00	1.00	2.00	3.00
256	257.00	3.00	.00	00	1.00	.00	2.00
257	258.00	3.00	3.00	1.00	3.00	.00	3.00
258	259.00	1.00	1.00	1.00	3.00	3.00	3.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
216	1.00	1.00	.00	17.00
217	3.00	1.00	2.00	21.00
218	3.00	2.00	3.00	19.00
219	2.00	.00	.00	11.00
220	2.00	.00	3.00	13.00
221	2.00	3.00	3.00	22.00
222	.00	2.00	3.00	17.00
223	1.00	1.00	1.00	10.00
224	3.00	.00	3.00	22.00
225	3.00	3.00	3.00	24.00
226	3.00	1.00	1.00	20.00
227	2.00	3.00	1.00	14.00
228	.00	3.00	3.00	16.00
229	3.00	.00	3.00	21.00
230	3.00	3.00	2.00	17.00
231	3.00	2.00	3.00	21.00
232	3.00	3.00	1.00	18.00
233	3.00	3.00	1.00	25.00
234	1.00	1.00	3.00	15.00
235	2.00	2.00	2.00	14.00
236	1.00	1.00	.00	9.00
237	3.00	3.00	2.00	22.00
238	1.00	1.00	.00	15.00
239	.00	.00	.00	.00
240	3.00	3.00	3.00	23.00
241	2.00	2.00	3.00	23.00
242	2.00	2.00	2.00	18.00
243	3.00	2.00	1.00	18.00
244	2.00	3.00	3.00	24.00
245	3.00	.00	.00	19.00
246	.00	.00	.00	12.00
247	3.00	3.00	3.00	22.00
248	3.00	.00	3.00	20.00
249	3.00	.00	3.00	20.00
250	3.00	3.00	3.00	26.00
251	1.00	1.00	3.00	11.00
252	.00	2.00	3.00	16.00
253	1.00	1.00	1.00	13.00
254	3.00	1.00	1.00	19.00
255	.00	3.00	1.00	14.00
256	3.00	3.00	.00	12.00
257	3.00	3.00	3.00	22.00
258	3.00	3.00	3.00	21.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiffi
259	260.00	.00	1.00	3.00	3.00	2.00	3.00
260	261.00	3.00	3.00	3.00	2.00	1.00	1.00
261	262.00	3.00	3.00	2.00	3.00	3.00	1.00
262	263.00	3.00	2.00	3.00	3.00	1.00	1.00
263	263.00	3.00	2.00	2.00	1.00	3.00	1.00
264	265.00	3.00	3.00	3.00	3.00	3.00	.00
265	266.00	3.00	3.00	2.00	3.00	3.00	3.00
266	267.00	3.00	3.00	3.00	3.00	2.00	2.00
267	268.00	1.00	3.00	1.00	3.00	2.00	3.00
268	269.00	3.00	1.00	.00	3.00	.00	1.00
269	270.00	2.00	3.00	1.00	3.00	.00	.00
270	271.00	2.00	1.00	3.00	3.00	2.00	1.00
271	272.00	3.00	3.00	3.00	3.00	3.00	3.00
272	273.00	2.00	1.00	.00	2.00	.00	1.00
273	273.00	3.00	1.00	3.00	2.00	3.00	3.00
274	275.00	3.00	3.00	3.00	2.00	.00	3.00
275	276.00	3.00	3.00	3.00	3.00	3.00	1.00
276	277.00	3.00	2.00	3.00	3.00	3.00	2.00
277	278.00	.00	3.00	1.00	2.00	3.00	3.00
278	279.00	3.00	3.00	2.00	3.00	3.00	1.00
279	280.00	3.00	.00	3.00	3.00	2.00	3.00
280	281.00	3.00	3.00	3.00	3.00	2.00	3.00
281	282.00	3.00	3.00	2.00	3.00	3.00	2.00
282	283.00	3.00	3.00	.00	3.00	3.00	2.00
283	283.00	3.00	2.00	3.00	1.00	1.00	.00
284	285.00	3.00	1.00	1.00	3.00	3.00	3.00
285	286.00	3.00	1.00	1.00	2.00	1.00	.00
286	287.00	3.00	1.00	.00	1.00	3.00	3.00
287	288.00	2.00	3.00	2.00	2.00	1.00	2.00
288	289.00	3.00	3.00	3.00	2.00	3.00	3.00
289	290.00	3.00	1.00	3.00	1.00	3.00	1.00
290	291.00	3.00	3.00	1.00	3.00	3.00	3.00
291	292.00	3.00	3.00	3.00	3.00	3.00	3.00
292	293.00	.00	2.00	.00	3.00	.00	3.00
293	293.00	3.00	3.00	2.00	2.00	1.00	.00
294	295.00	3.00	3.00	3.00	3.00	3.00	3.00
295	296.00	.00	1.00	.00	.00	2.00	1.00
296	297.00	2.00	3.00	2.00	3.00	3.00	3.00
297	298.00	3.00	3.00	2.00	2.00	3.00	3.00
298	299.00	3.00	3.00	3.00	3.00	3.00	3.00
299	300.00	3.00	3.00	3.00	3.00	1.00	.00
300	301.00	3.00	3.00	2.00	3.00	3.00	3.00
301	302.00	3.00	.00	3.00	3.00	2.00	1.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
259	3.00	3.00	3.00	21.00
260	.00	.00	1.00	14.00
261	.00	.00	1.00	16.00
262	3.00	2.00	.00	18.00
263	3.00	2.00	.00	17.00
264	.00	3.00	3.00	21.00
265	2.00	3.00	3.00	25.00
266	3.00	.00	3.00	22.00
267	3.00	3.00	3.00	22.00
268	1.00	1.00	1.00	11.00
269	.00	3.00	3.00	15.00
270	3.00	.00	3.00	18.00
271	3.00	3.00	1.00	25.00
272	2.00	.00	3.00	11.00
273	3.00	1.00	3.00	22.00
274	2.00	3.00	.00	19.00
275	3.00	3.00	3.00	25.00
276	3.00	3.00	3.00	25.00
277	2.00	1.00	.00	15.00
278	3.00	3.00	2.00	23.00
279	3.00	3.00	1.00	21.00
280	2.00	2.00	.00	21.00
281	.00	3.00	3.00	22.00
282	.00	3.00	2.00	19.00
283	1.00	.00	.00	11.00
284	3.00	3.00	3.00	23.00
285	3.00	1.00	.00	12.00
286	3.00	3.00	3.00	20.00
287	2.00	2.00	2.00	18.00
288	3.00	3.00	3.00	26.00
289	3.00	2.00	3.00	20.00
290	1.00	.00	.00	17.00
291	.00	2.00	3.00	23.00
292	3.00	3.00	3.00	17.00
293	1.00	2.00	3.00	17.00
294	3.00	3.00	3.00	27.00
295	1.00	1.00	1.00	7.00
296	3.00	3.00	3.00	25.00
297	3.00	2.00	3.00	24.00
298	1.00	3.00	2.00	24.00
299	1.00	1.00	00	15.00
300	2.00	3.00	2.00	24.00
301	2.00	3.00	1.00	18.00

	SN	noformaled	clumsyproc	switchingc	poorQoS	ContactLos	portingdiffi
302	303.00	1.00	3.00	3.00	2.00	3.00	.00
303	303.00	3.00	3.00	3.00	1.00	3.00	3.00
304	305.00	3.00	2.00	3.00	1.00	3.00	.00
305	306.00	3.00	3.00	2.00	3.00	1.00	.00
306	307.00	3.00	2.00	3.00	2.00	2.00	2.00
307	308.00	1.00	2.00	.00	.00	1.00	2.00
308	309.00	3.00	3.00	2.00	3.00	3.00	3.00
309	310.00	3.00	.00	.00	2.00	3.00	1.00
310	311.00	.00	3.00	1.00	.00	.00	2.00
311	312.00	3.00	1.00	3.00	2.00	3.00	3.00
312	313.00	.00	1.00	1.00	1.00	2.00	1.00
313	313.00	2.00	3.00	1.00	3.00	3.00	3.00
314	315.00	3.00	3.00	2.00	.00	3.00	3.00
315	316.00	3.00	3.00	3.00	2.00	3.00	.00
316	317.00	.00	3.00	3.00	1.00	1.00	3.00
317	318.00	3.00	3.00	3.00	2.00	3.00	.00
318	319.00	3.00	3.00	3.00	2.00	3.00	3.00
319	320.00	3.00	2.00	2.00	3.00	3.00	3.00
320	321.00	3.00	3.00	3.00	.00	3.00	2.00
321	322.00	3.00	3.00	3.00	3.00	3.00	3.00
322	323.00	1.00	1.00	.00	.00	3.00	3.00
323	323.00	2.00		3.00	3.00	3.00	3.00
324	325.00	3.00	3.00	.00	3.00	.00	.00
325	326.00	3.00	3.00	3.00	3.00	.00	3.00
326	327.00	1.00	1.00	3.00	3.00	2.00	.00
327	328.00	3.00	2.00	2.00	1.00	1.00	3.00
328	329.00	2.00	1.00	3.00	3.00	1.00	.00
329	330.00	.00	3.00	3.00	3.00	3.00	3.00
330	331.00	.00	.00	.00	.00	.00	.00
331	332.00	3.00	2.00	1.00	2.00	1.00	3.00
332	333.00	.00	3.00	3.00	3.00	3.00	3.00
333	333.00	.00	.00	.00	.00	.00	.00
334	335.00	3.00	3.00	3.00	3.00	2.00	2.00
335	336.00	.00	3.00	1.00	3.00	3.00	2.00
336	337.00	3.00	2.00	3.00	3.00	2.00	3.00
337	338.00	3.00	3.00	3.00	3.00	3.00	.00
338	339.00	3.00	3.00	.00	3.00	3.00	.00
339	330.00	.00	1.00	3.00	3.00	3.00	3.00
340	331.00	3.00	3.00	3.00	3.00	3.00	3.00
341	332.00	2.00	.00	3.00	1.00	2.00	3.00
342	333.00	1.00	1.00	1.00	3.00	3.00	3.00
343	333.00	3.00	.00	3.00	3.00	3.00	3.00
344	335.00	.00	.00	.00	.00	.00	.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
302	3.00	2.00	3.00	20.00
303	3.00	3.00	3.00	25.00
304	3.00	3.00	3.00	21.00
305	3.00	1.00	.00	16.00
306	3.00	3.00	2.00	22.00
307	1.00	1.00	.00	8.00
308	.00	.00	2.00	19.00
309	.00	3.00	3.00	15.00
310	1.00	.00	.00	7.00
311	2.00	1.00	3.00	21.00
312	1.00	.00	3.00	10.00
313	2.00	1.00	3.00	21.00
314	3.00	3.00	3.00	23.00
315	3.00	2.00	3.00	22.00
316	3.00	3.00	.00	17.00
317	3.00	3.00	2.00	22.00
318	3.00	3.00	3.00	26.00
319	3.00	3.00	3.00	25.00
320	3.00	2.00	3.00	22.00
321	.00	.00	3.00	21.00
322	3.00	1.00	3.00	15.00
323	3.00	3.00	3.00	23.00
324	3.00	3.00	3.00	18.00
325	3.00	.00	2.00	20.00
326	1.00	1.00	.00	12.00
327	3.00	.00	1.00	16.00
328	.00	1.00	.00	11.00
329	3.00	.00	.00	18.00
330	.00	.00	.00	.00
331	.00	.00	.00	12.00
332	3.00	3.00	3.00	24.00
333	.00	.00	.00	.00
334	1.00	3.00	3.00	23.00
335	3.00	2.00	3.00	20.00
336	3.00	2.00	.00	21.00
337	1.00	3.00	3.00	22.00
338	1.00	.00	.00	13.00
339	3.00	3.00	3.00	22.00
340	2.00	2.00	3.00	25.00
341	.00	1.00	1.00	13.00
342	3.00	3.00	1.00	19.00
343	3.00	3.00	3.00	24.00
344	.00	.00	.00	.00

	fortyeighthr	ninetyDays	PhyscialPr	Total
345	1.00	3.00	3.00	20.00
346	3.00	3.00	3.00	16.00
347	1.00	3.00	.00	17.00
348	1.00	2.00	3.00	12.00
349	.00	3.00	3.00	17.00
350	2.00	2.00	1.00	14.00
351	3.00	3.00	3.00	14.00
352	3.00	2.00	3.00	22.00
353	2.00	2.00	.00	11.00
354	.00	2.00	1.00	6.00
355	2.00	1.00	3.00	15.00

APPENDIX F

Country	How calls are routed from a mobile network to another mobile network
Austria	All call query
Belgium	All call query & query on release
Croatia	All call query
Cyprus	All call query
Denmark	All call query
Estonia	All call query
Finland	All call query
France	Phase 1: onward routing Phase 2: all call query
Germany	All call query
Hungary	Phase 1: all call query & query on release
Iceland	All call query
Ireland	All call query
Italy	All call query
Lithuania	All call query
Luxembourg	All call query
Malta	All call query
Netherlands	All call query
Norway	All call query
Poland	All call query
Portugal	All call query & query on release
Slovenia	All call query
Spain	Onward routing
Sweden	Onward routing & all call query
Switzerland	Onward routing
United Kingdom	Onward routing

Methods of routing calls to ported mobile numbers in CEPT Countries

APPENDIX G

Country	Type of ported mobile number database
Austria	Distributed
Belgium	Centralised
Croatia	Centralised
Cyprus	Distributed
Denmark	Centralised
Estonia	Centralised
Finland	Centralised
France	Centralised
Germany	Centralised
Hungary	Centralised
Iceland	Centralised
Ireland	Centralised
Italy	Centralised
Lithuania	Centralised
Luxembourg	Centralised
Malta	Distributed
Netherlands	Hybrid distributed & centralized
Norway	Centralised
Portugal	Centralised
Poland	Centralised
Slovenia	Centralised
Sweden	Centralised
Switzerland	Centralised

Types of ported mobile number database