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An enhanced fuzzy based Mobile Number Portability (MNP) migration platform in Nigeria

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Abstract

The paper presents an enhanced fuzzy based MNP migration platform in Nigeria. The parameters that could determine why customers would switch their operators are practically tariff plans, call quality factor, customer care services and network coverage parameters. In this research, these four parameters were used for MNP decision using fuzzy logic. On the basis of these four parameters, the decision whether MNP is to be done or not is considered. The tariff plan, call quality factor, customer care services and network coverage are input parameter and MNP is output parameter. Input parameter tariff plan gives the information of call rate per naira. Tariff plan was taking from minimum of 5 available tariff plans to a maximum of 15 available tariff plans. The whole range were distributed in three levels: small, medium and large. Based on the rule base decision rules, a fuzzy logic 3D surface diagrams were used for the result analysis. The results showed that a cheap tariff plan indicates a high MNP decision allowing the user to port to the test network. When the tariff plan is expensive and the MNP decision is low, the user decides not to port to the test network. When a user considers network coverage and cost of tariff plan, MNP decisions are usually difficult to make. This is because strength of network coverage does not determine the cost of the tariff plan to be used, that is in the case of WLAN networks in Nigeria. Therefore, from the research concludes that a cheap Tariff leads to a high MNP value, while an expensive tariff makes a low MNP decision. This approach demonstrates the replaceability of the existing GSM architecture with an adequate trusted computing model for all mobile network operators in the mobile communication value chain.

Keywords: Tariff plan, Call quality factor, Customer care services, Network coverage, Fuzzy, MNP

1. Introduction

Despite attempts by the GSM operators to woo customers in Nigeria, problems still linger such as: complicated tariffs, lower customer satisfaction, inefficient service delivery, interconnectivity problem, deceptive promotions, unsolicited promotions, unsolicited short messages (SMS), call drops, and unfairly and unjustifiable billings. These are performance indicators. Therefore, the GSM providers in Nigeria are faced with the challenges of demonstrating customer-focused and continuous service improvement, as a way to ensuring customer satisfaction, brand supremacy and ultimately customer loyalty (Ajay, *et al*., 2020).

Promoters recognizes that all attempt spent in advertising was intended in the direction of the drawing of fresh users and building greater and permanent worth for them, (Kotler, 2016). When GSM was initiated in Nigeria in 2001, users had to give soaring dues in order to obtain and utilize the services.

Also, consumers of these services had not much choice partly due to limited network providers; coverage and lack of much information both on information technology and GSM, hence were prepared to acknowledge the service as they were, (Odii and Onuoha, 2018). With the entrance of more service providers in the market and customers' better understanding of Mobile Number Portability (MNP), users now look for improved package and worth for their cash.

Thus, the aim of this rule is to encourage extra contest and aid the increase of recent or little network operators.

Before 2013, cellular network users were mandated to discard their old phone lines (numbers) for new numbers when porting among the little number of cellular network operators in the country.

This method was not suitable for the users because of the money involved. But they had no other option than to stick with their network operators even if they are not satisfied with their services, (ITU, 2018).

As the numbers of service providers have increased, many added packages and approaches targeted at bringing fresh clients is now universal and most importantly forcing the operators to sit up to their expectation which equally encourages healthy competition in that area.

Also, since the of government has removed their hand from guiding and regulation of telecommunication industry, healthy competition is now stronger by the day, as usually seen on privatization, and users now have a broad alternative to substantiate their money. Hence, respective service providers tries for the big market promote, forcing the telecommunication sector to be extra aggressive and vibrant as the effort to attract fresh users and keep the active ones becomes a major issue for all competing firms, (Odunaike, 2020).

Added to this competition, is the emergence of Mobile Number Portability (MNP) which has transformed the competition scene. Subscribers can switch/port among network providers without losing the mobile numbers and so it now lies on the providers to enhance the provisioning of better services offered to ensure that customers are always satisfied, or losing the customers.

Mobile number portability is a platform that allows mobile network users to migrate from one service provider to another, in the quest for improved services of better, while still retaining their original mobile phone numbers, (Okonedo, 2021).

Nosiri *et al.* (2020) presented a paper on the implementation of fuzzy logic technology for improved Wideband Code Division Multiple Access (WCDMA) network using selected Key Performance Indicators (KPIs). Selected KPIs include Receive Signal Level (RXLEV), Call Setup Success Rate (CSSR), Call Drop Rate (CDR) and Call Completion Success Rate (CCSR) were used to evaluate the various performance characteristics of the networks based on the QoS. Results obtained from the field measurements computed using the selected KPIs could not meet up with any of the Nigeria Communication Commission (NCC) thresholds. Accessibility of NCC was 98.7%, Airtel 92.6%, and MTN 98%. An average of 60% increase in the customer's satisfaction was observed from the proposed system over the existing system.

Nnochiri and Okafor (2014) conducted research on the Mobile SIM networks using 3D fuzzy logic method as a way of improving the MNP system in Nigeria. They look at the subscriber viewpoint on the factors of QoS. Their study gave an insight on the method for the deployment from the user's viewpoint as well as from the network integration on QoS. The research was intended to serve as the first examination to show that an achievable novel platform is possible. However, the research failed to explore or empirically determine extent of improvement.

Shi (2017) reviewed the deployment of mobile number portability (MNP) in global context. The author found that determining reasons of subscribers' migrating aim in China has an analogous situation with Korea having same MNP policy. The outcome of study proved that subscriber's satisfaction and migrating costs have significant effects on users' porting behaviour. But the QoS benefits of MNP were not considered.

Shin and Kim (2018) investigated migrating bottlenecks on mobile number portability (MNP) in American mobile market. They used structural equation modelling analysis method to assess the causal model. They also applied the confirmatory factor analysis method to ascertain how reliable and valid the measured model seems to be. Demographics have a significant effect on the switching decision. Their findings indicated that user satisfaction and migrating bottlenecks appreciably have an effect on user's aim to churn. But the study was based only in USA where contractual obligations have contained MNP to a large extent.

Odii *et al.* (2020) did research on Predictive Model for Evaluating Mobile Number Portability in Nigeria. A model called Mobile Number Portability Growth Trend Trajectory Simulator/Predictor (MNPGTTS) was developed using Visual Basic.Net version 10and Microsoft Access as the DBMS engine. The MNPGTTS is capable of forecasting the impact of the MNP restrictions in the next 10-50 years. The MNPGTTS model was test run using the beta coefficients derived from SPSS multiple regressions and ANOVA of collected field data as their indices and later adjusted values of the indices were plugged into the program that enabled them assess the future possibility of MNP expansion. The result demonstrated that if government still allows the existing restrictions, subscribers may not be motivated to port. But they equally warned that should government further stiffen the restrictions, MNP will totally collapse.

Adegoke *et al.* (2019) appraised the performance of GSM operators in Nigeria and discovered that as revolutionary as GSM may seem to be, many problems have bedeviled the sector. The problems identified were instability in power supply, security of infrastructure, menace of social miscreants in host communities, multiple regulations and taxation as well as inter-network connectivity. They stated that all these factors contribute in one way or the other to the quality of services rendered by GSM operators in Nigeria.

Chuang (2018) used binary logic methods to study the issues that motivates customers to continue or switch in Taiwan's mobile phone industry. The outcome proved that "subscribers' contentment, migrating expenses, and convention force pessimistically decided switching motives, comprising a sucking consequence that encouraged users to remain with their original providers". But variables of alternative attractiveness were not considered in the study, pull effect and strength of habit.

Against these background as well as the poor method of MNP investigated in Nosiri, *et al.,* (2020), this research then proposed a unified system that seeks to improve the framework of MNP. The work leveraged the MNP concept to model a robust network integration framework in Nigeria, as such the integration framework formulated in this research will take cognizance of the NCC standard parameters to setup trusted reference MNP architecture using Fuzzy logic sets.

2.0 Material and methods

2.1 Materials

In actual, there are many parameters that could determine why customers would switch their operator but practically tariff plans, call quality factor, customer care services and network coverage parameters are more important for a customer to switch their operator.

2.1.1 Fuzzy Logic Technique

This section describes the fuzzy logic technique to determine the best network. The fuzzy rules and attributes used in fuzzy logic are convenient to modify. Users can easily modify the fuzzy member function as well as the fuzzy rules to obtain the most suitable output for the considered network environment. The basic steps of the fuzzy logic technique are:

i. The burst inputs are taken from chosen attributes and degree to which inputs of info have a place with each appropriate fuzzy set is resolved. This process is called fuzzification.

ii. At that point, this fuzzified input is taken and applied to the predecessor of the fuzzy principle.

iii. Aggregation is the step in which all the inputs are considered and merged.

iv. The output of the joined fuzzy set might be taken as input for defuzzification, and a single burst number is acquired as yield.

2.2 Method

In this section, the tariff plans, call quality factor, customer care services and network coverage would be used for MNP decision using fuzzy logic. On the basis of these four parameters, the decision whether MNP is to be done or not is considered. The tariff plan, call quality factor, customer care services and network coverage are input parameter and MNP is output parameter. Input parameter tariff plan gives the information of call rate per naira. In this research, tariff plan is taking from minimum of 5 available tariff plans to a maximum of 15 available tariff plans. The whole range is distributed in three levels: small, medium and large. The flow chart diagram in Figure 1 illustrates a typical MNP decision process of a customer considering to port from an originating network.

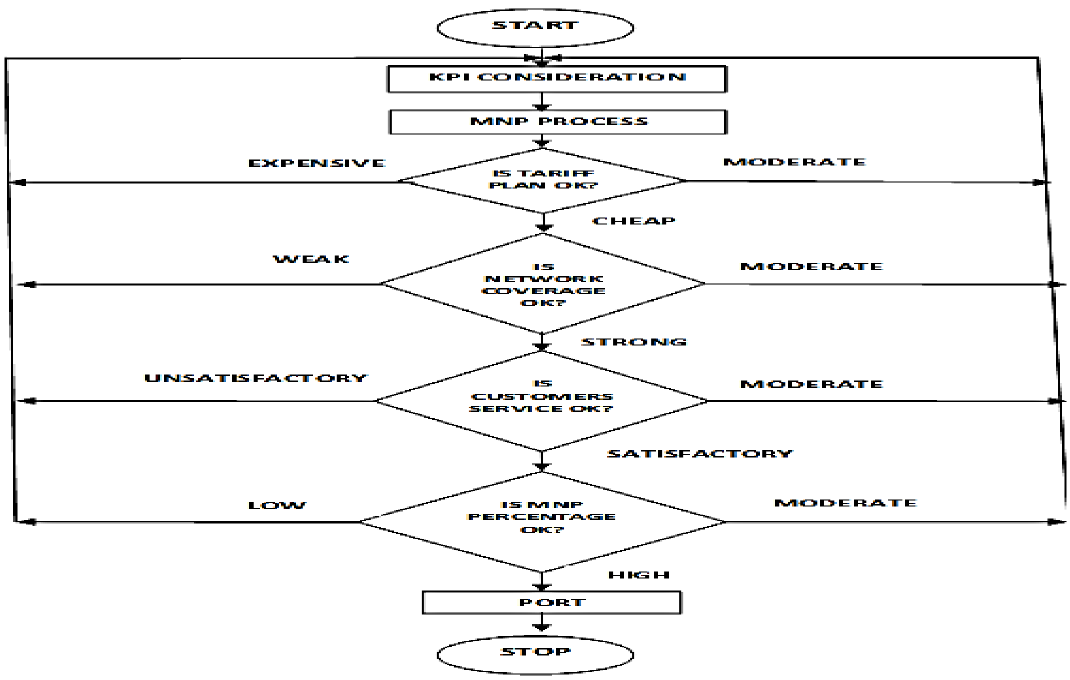

Figure 1: MNP decision algorithm

2.2.1 FUZZIFICATION

In fuzzification, the input variables; Network Coverage, Tariff plan/Billing, Customer Services are given a degree of suitable fuzzy sets. The burst inputs are a combination of Network Coverage, Tariff plan/Billing, Customer Services. The different possibilities for each attribute are given as below:

i. Network coverage: (Poor, Average, Strong)

ii. Tariff: (Cheap, Affordable, Expensive)

iii. Customer service: (Unsatisfactory, Moderate, Satisfactory)

To input and output variables, Figures 2–4 represent member function. For efficient computation, trapezoidal functions are used to design member function that gives excellent result.

Table 1 gives a rule block summary of the flow chart of figure defining the fuzzy logic decision rule. The MNP decision is taken based on the combination and analysis of the three input membership functions.

Table 1: Table showing 27 fuzzy inference rules for making MNP decision

		RULE BLOCK	
	IF		THEN
Network coverage	Tariff	Customer care	MNP
POOR	CHEAP	UNSATISFACTORY	LOW
POOR	CHEAP	MODERATE	LOW
POOR	CHEAP	SATISFACTORY	HIGH
POOR	AFFORDABLE	UNSATISFACTORY	LOW
POOR	AFFORDABLE	MODERATE	LOW
POOR	AFFORDABLE	SATISFACTORY	MEDIUM
POOR	EXPENSIVE	UNSATISFACTORY	VERY_ LOW
POOR	EXPENSIVE	MODERATE	VERY_ LOW
POOR	EXPENSIVE	SATISFACTORY	LOW
AVERAGE	CHEAP	UNSATISFACTORY	MEDIUM
AVERAGE	CHEAP	MODERATE	HIGH

AVERAGE	CHEAP	SATISFACTORY	HIGH
AVERAGE	AFFORDABLE	UNSATISFACTORY	MEDIUM
AVERAGE	AFFORDABLE	MODERATE	MEDIUM
AVERAGE	AFFORDABLE	SATISFACTORY	MEDIUM
AVERAGE	EXPENSIVE	UNSATISFACTORY	LOW
AVERAGE	EXPENSIVE	MODERATE	LOW
AVERAGE	EXPENSIVE	SATISFACTORY	MEDIUM
STRONG	CHEAP	UNSATISFACTORY	HIGH
STRONG	CHEAP	MODERATE	VERY_ HIGH
STRONG	CHEAP	SATISFACTORY	VERY_ HIGH
STRONG	AFFORDABLE	UNSATISFACTORY	MEDIUM
STRONG	AFFORDABLE	MODERATE	HIGH
STRONG	AFFORDABLE	SATISFACTORY	HIGH
STRONG	EXPENSIVE	UNSATISFACTORY	LOW
STRONG	EXPENSIVE	MODERATE	MEDIUM

STRONG	EXPENSIVE	SATISFACTORY	HIGH

From Table 1, a high MNP is obtained when there is either a moderate customer care, affordable tariff plan combined with strong network coverage. A low MNP is obtained when any two of the inputs are on the low side and the third input on the high side. A very low MNP is obtained when all three inputs are on the low side or any input on the medium and the other two input on the low side. The Table gives an understanding of the fuzzy rule using if and then comments.

Figure 2 describes the fuzzy inference system (FIS) showing the relationship among the three input membership functions cost tariff, network coverage, customer service and the output membership function. The FIS system is designed using the mamdani decision system with 27 inference rules.

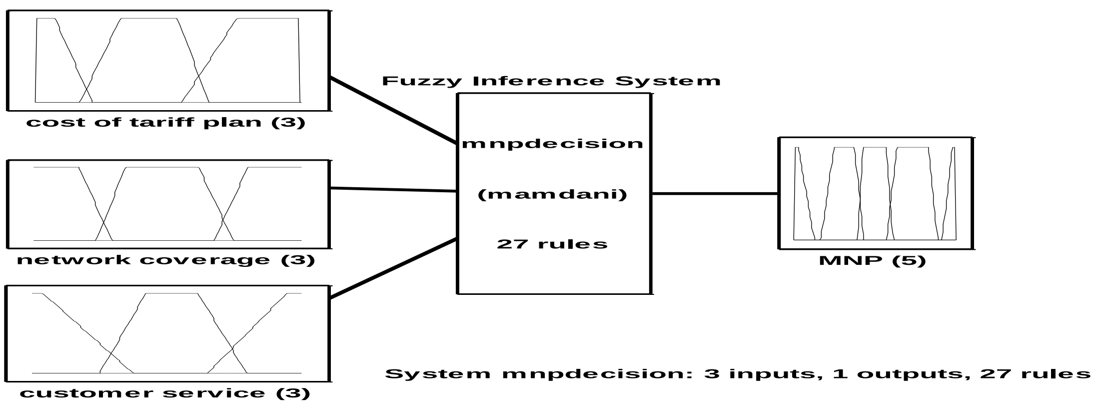

Figure 2: fuzzy inference system model showing all input and output functions with 27 rules

2.2.2. DEFUZZIFICATION

The method of obtaining a numerical result based on a defined fuzzy set and on an output member function is called defuzzification. The center of gravity technique is considered to defuzzify the fuzzy result. Equation (1) describes the defuzzifier technique.

$$fuzzycost = \frac{[\sum_{allrules} R_i \times \eta(R_i)]}{\sum_{allrules} \eta\,(k_i)} \quad (1)$$

Where Fuzzy Cost represents the degree of deciding factor R_i denotes all fuzzy rules $\eta(k_i)$ denotes all variables and $\eta(R_i)$ denotes its member function. The output of the Fuzzy Cost function is changed to numerical result based on the above described defuzzification method.

2.3 MNP DECISION RULE OPTIMIZATION

Optimization problems in engineering have been a standard used for the selection of the best elements with regards to the best criterion, from some set of available alternatives. Solving optimization problems in polynomial at times seems impossible. So, finding their approximation algorithms has long been an attractive area in theoretical engineering.

2.3.1 SL-REDUCTION (LOGIC METHOD)

Papadimotriou and Yannakakis defined a strict form of transformation in their paper which was called ‘’L-REDUCTION’’, while Panconese and Ranjan defined a stronger one which gives a much stronger version of it.

Definition 1. Let Π and Π' be two maximum (minimum) problems. We say that Π SL-reduces to Π' if there are two algorithms f, g for each instance $I of\ \Pi$,

(1) Algorithm f produces an instance $I' = f(I) of \Pi'$, such that the optima of $I and I', OPT(I) = OPT(I')$.

(2) Given any solution of I' with cost c', algorithm g produces a solution of I with a cost c, such that $c = c'$.

In order to optimize the MNP decision rules for convenience, there is need to de-multiplex the input rules to two output conditions, a negative and a positive condition.

As shown in Table 2, the output conditions for MNP decision will be de-multiplexed in MNP (YES) and MNP (NO). The minimum values of the both MNP conditions are $low = L and very low = VL$. The maximum values of the MNP conditions are $High = H and Very\ High = VH$. For the condition $OPT(I) = OPT(I')$, the condition is $Moderate = M$

Table 2: The summarized algorithm of the output MNP decision

Π	Π'	$\boldsymbol{OPT(I) = OPT(I')}$	
H	L	M	M
H	H	H	VH
M	M	M	M
L	L	L	VL
H	H	L	H
M	M	L	H
L	L	H	L
L	L	M	L
H	H	M	H

The optimization of rules will consider only two inputs factors each, customer services and network coverage.

3.0 Results and Discussions

Figure 3 shows the input membership function of the tariff plan. Cheap, affordable and expensive are used in defining the tariff plan.

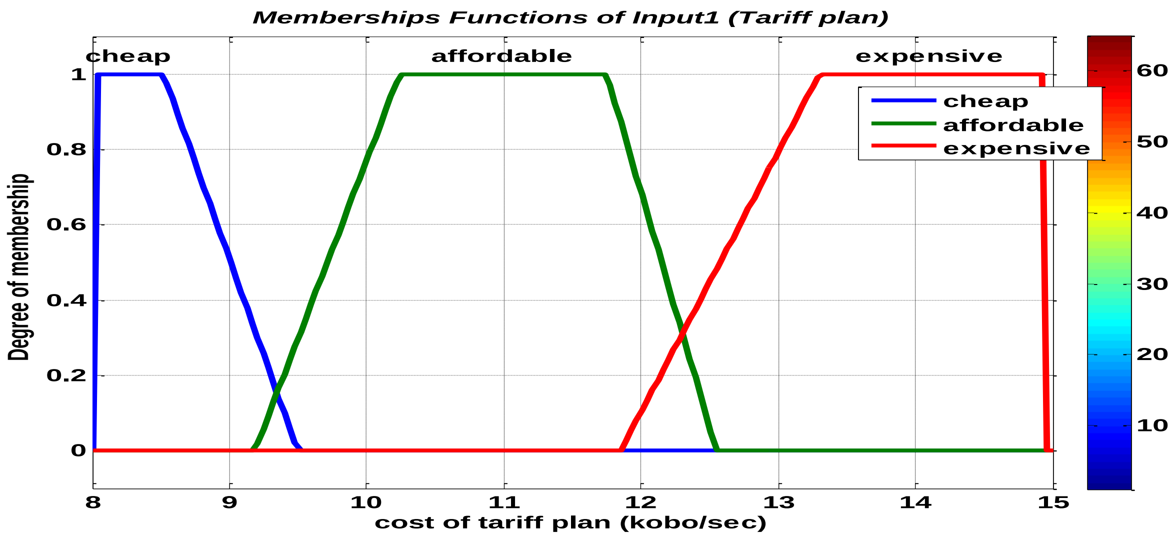

Figure 3: Input membership function1 (tariff plan)

From Figure 3, it was seen that the degree of membership function for the tariff plan are equal, but the cost of the plan (kobo/sec) differs. When the cost of plan falls within 0 to 9.5 (kobo/sec), the tariff plan is said to be cheap. When it falls within 9.2 to 12.5 (kobo/sec), the tariff is said to be affordable. When it falls within11.9 to 15(kobo/sec), the tariff is said to be expensive.

Figure 4 shows the input membership function of the network coverage. Poor, average and strong are used defining the network coverage.

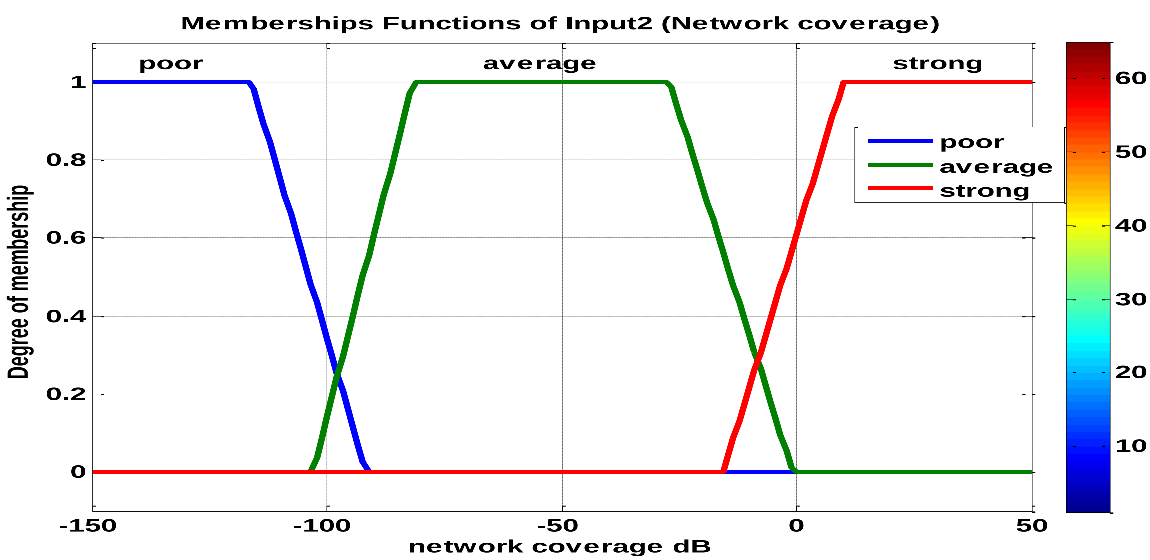

Figure 4: Input membership function 2 (network coverage)

From Figure 4, it was seen that the degree of membership function for the network coverage are equal to 1, but the network coverage in decibel (dB) varies. When the network falls within -90 to -150 dB, the network coverage is said to be poor. When it falls within 0 to -110dB, the network coverage is said to be average. When it falls within -20 to 50dB, network coverage is said to be strong.

Figure 5 shows the input membership function of the customer's services. Unsatisfaction, Medium and Satisfactory are used defining the customer's services.

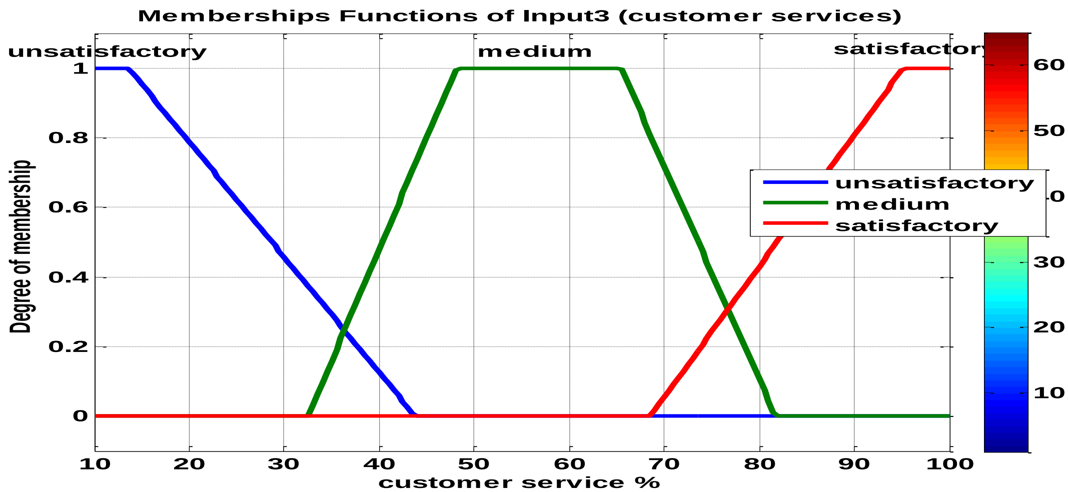

Figure 5: Input membership function 3 (customer service)

From Figure 5, it was seen that the degree of membership function for the customer service are equal to 1, but the service rendered varies in percentage. When the service ranged between 10 to 45%, the customer's service is said to be unsatisfactory. When it varies between 33 to 82%, the customer's service is said to be medium. When it varies between 69 to 100%, the customer's service is said to be satisfactory.

If all the conditions as seen in Figures 3 to 5 are satisfied, then it gives the best MNP. If any one condition is low, or medium, then the result gives a moderate MNP. If any one condition is satisfied, but the remaining is low or medium, then it gives the result as a bad network.

Figure 6 shows the output of the Fuzzy Cost function. The MNP is divided into a set of k_i variables. The output parameter MNP gives information of decision. In this, the MNP ranges from minimum 0% to maximum 100%. The whole range is distributed in five levels very low, low, medium, high, and very high.

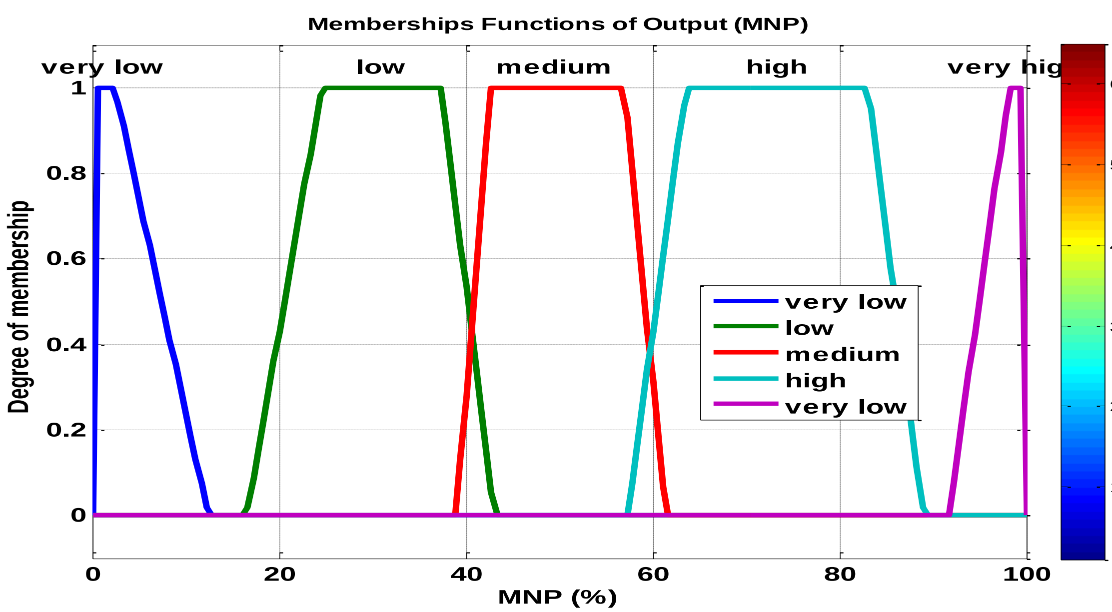

Figure 6: Output membership function of the MNP fuzzy inference system

From Figure 6, it was seen that the degree of membership for the output membership function of the MNP fuzzy inference system are the same at 1, but the output MNP in percentage (%) varies.

When the MNP output ranges from 0 to 20%, the MNP output is said to be VERY LOW. When it falls between 18 to 42%, the MNP output is said to be LOW. When it ranges between 39 to 62%, the MNP output is said to be MEDIUM. When it varies between 58 to 90%, the MNP output is said to be HIGH, and when it ranges between 91 to 100%, the MNP output is said to be VERY HIGH.

The Rule viewer diagram is shown in Figure 7.

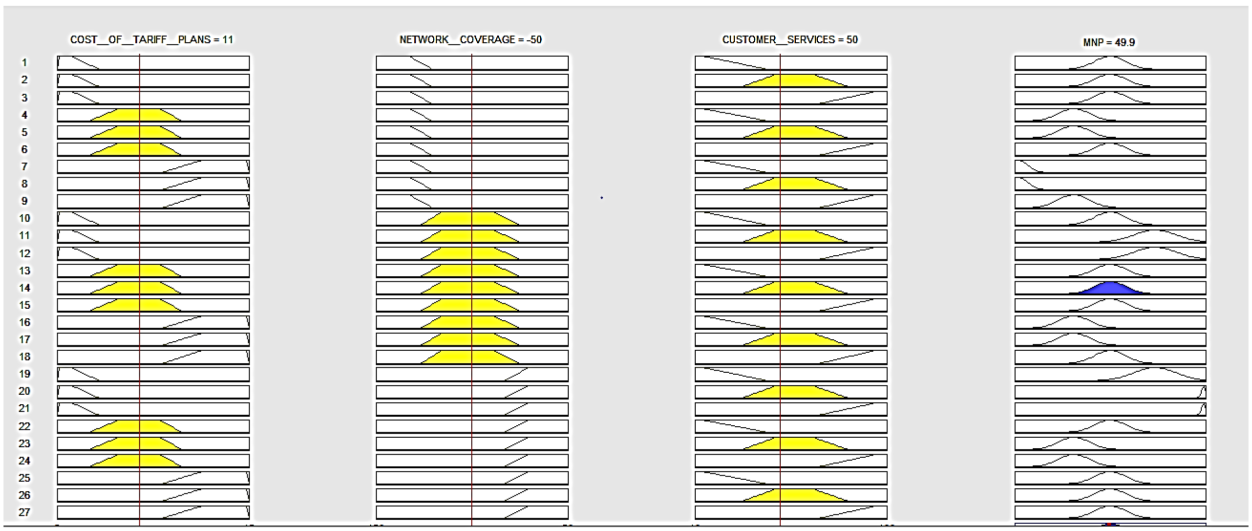

Figure 7: Rule viewer showing input and output membership function with adjustable lines

From the rule viewer diagram in Figure 7, by adjusting the red lines of to the moderate conditions of each input membership function, that cost of tariff 11k/s between a cheap value of 8 kobo/s and an expensive value of 15kobo/s, network coverage of -50 decibels between a weak value of -150db and a strong value of 50db, and customer services of 50%, between an unsatisfactory value of 0% and a satisfactory value of 100%. By adjusting these lines, the MNP read a moderate value of 49.9% between the 0% of very low portability decision and 100% of very high portability.

By adjusting the lines to 8.02 kobo/s, 50db, 100% customer service satisfaction for tariff plan, network coverage and customer satisfaction respectively as shown in Figure 8.

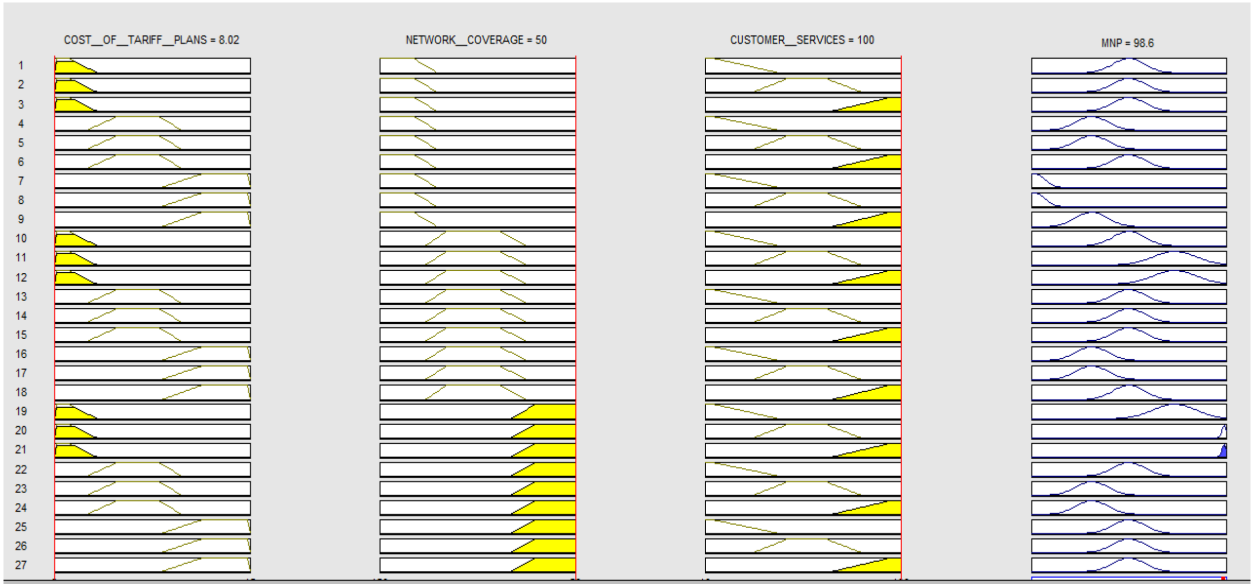

Figure 8: Rule viewer with lines at extremes to show high MNP value

From Figure 8, the values indicate chaep tariff plan, strong network coverage and customer service satisfaction respectively. The MNP value rises to 98.6% indicating a very high mobile number portability. This value indicates that the user trying to port from a donor network A to a receiver network B should port.

Figure 9 shows the membership functions of the rule viewer when cost of tariff plan is adjusted to 14.9 kobo/sec, network coverage -147dB and customer service satisfaction at 0%.

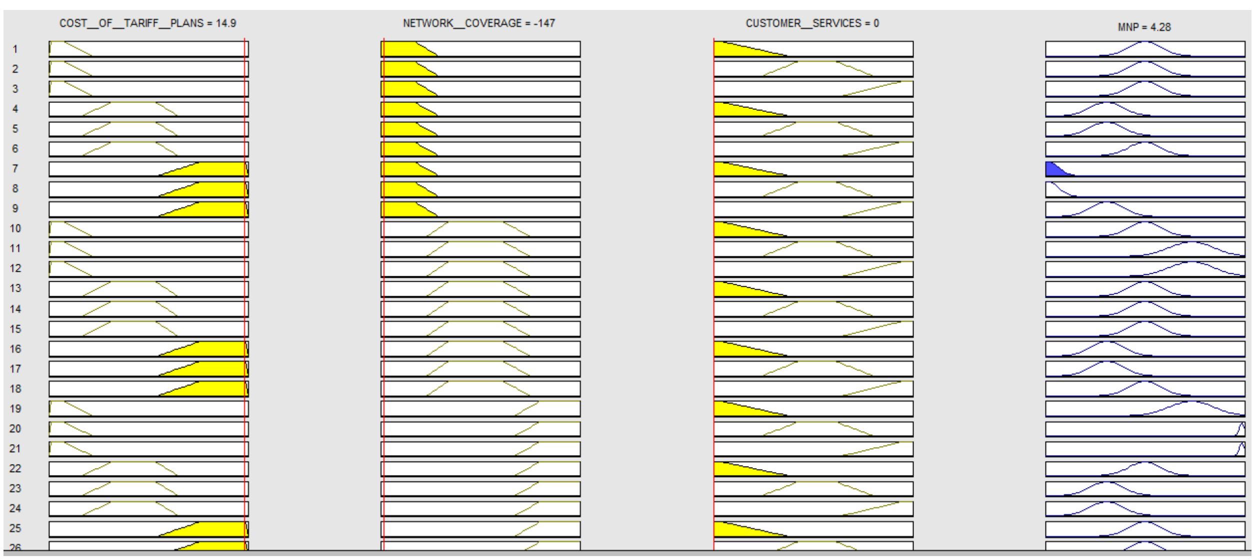

Figure 9: rule viewer with lines at extremes to show a low MNP value

As seen in Figure 9, the MNP value drops to 4.28% indicating a very low MNP value. This value indicates that the user trying to port from a donor network A to a receiver network B should not port.

Figure 10 shows the optimization of the Fuzzy inference system showing only two (2) input functions and the MNP output function.

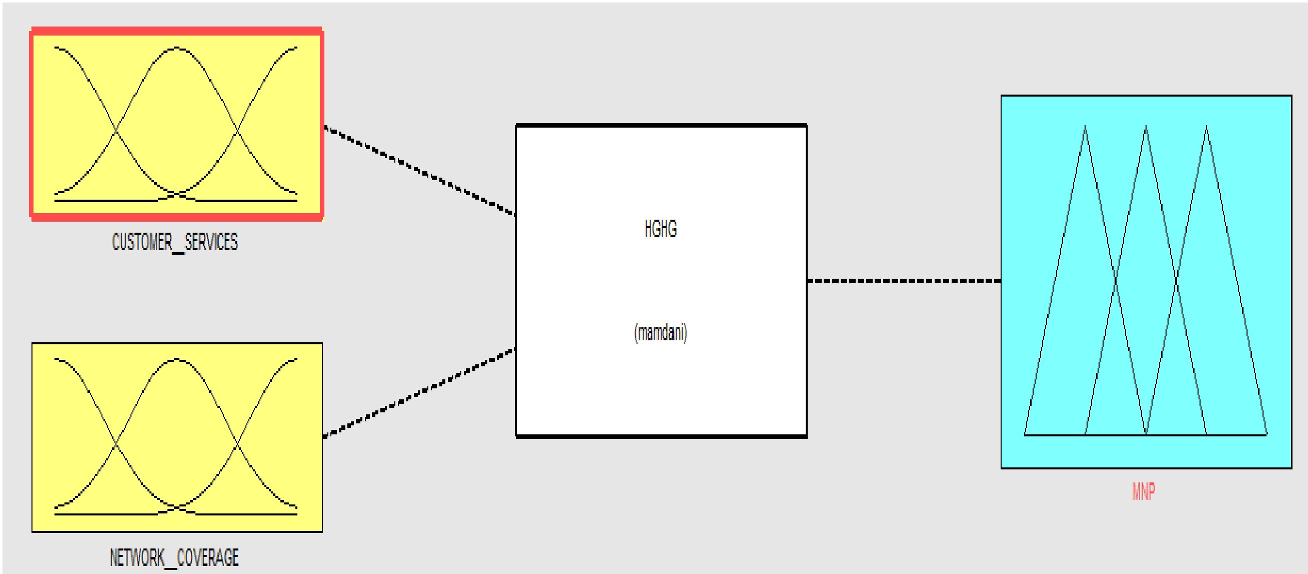

Figure 10: fuzzy inference system showing only 2 input functions and the MNP output function.

As shown in Figure 10, the customer's service and network coverage are the inputs of the Fuzzy inference system, while the MNP is the output of the function.

Figure 11 shows the membership functions of the Fuzzy optimized customer services.

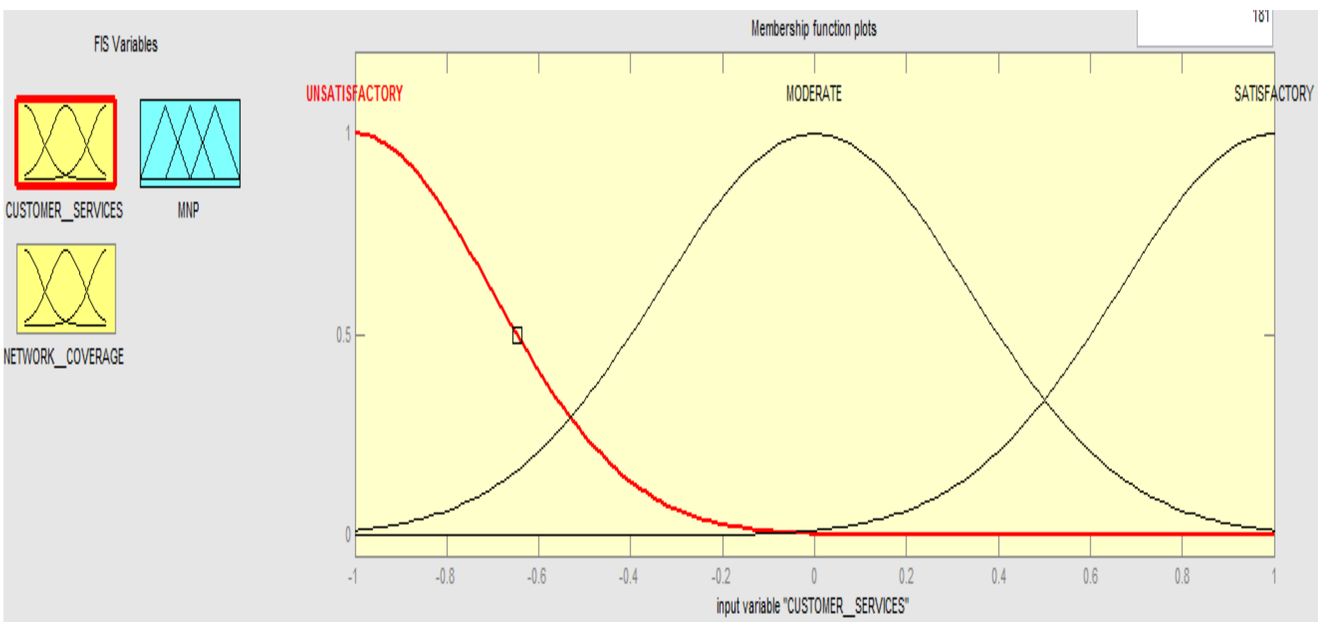

Figure 11: Plot showing membership functions of customer services

From Figure 11, it was seen that customer's service, network coverage and MNP are the Fuzzy Inference System. The input variable is the customer service. The membership function of the customer's service was graded into three parts, namely: unsatisfactory, Moderate, and Satisfactory.

Figure 12 shows the plot of membership functions of the network coverage.

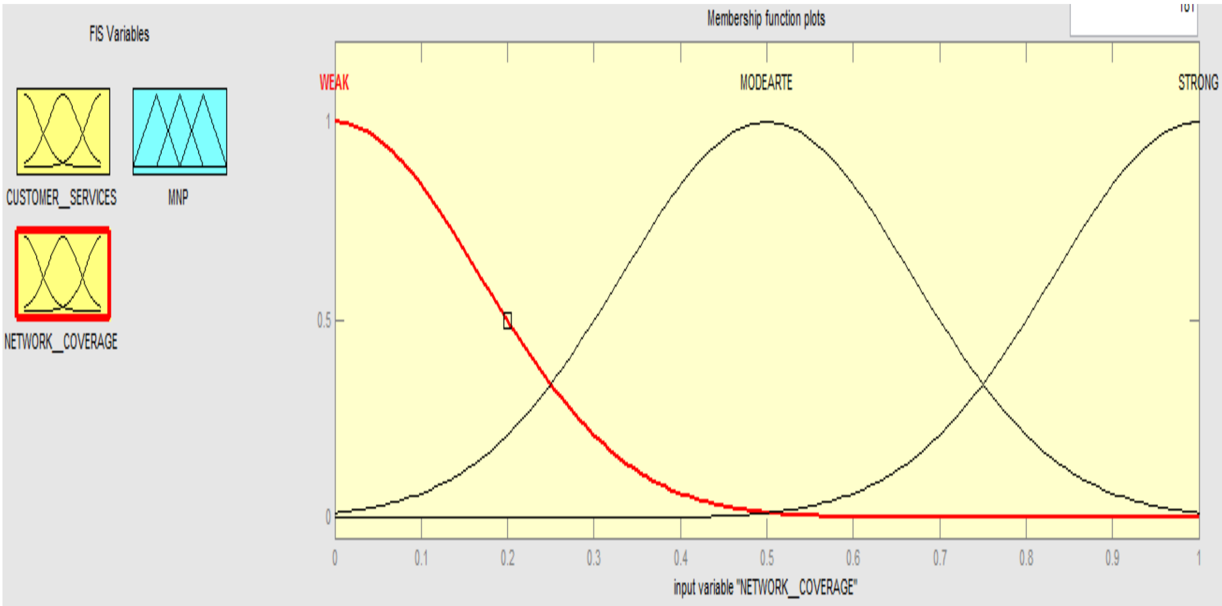

Figure 12: Plot showing membership functions of network coverage

From Figure 12, it was shown that the customer's service, Network coverage and MNP are the FIS variables. The input variable is the network coverage. The plot shown that the network coverage was divided into three parts namely: weak, moderate and strong.

Figure 13 shows the plot of the membership functions of the MNP.

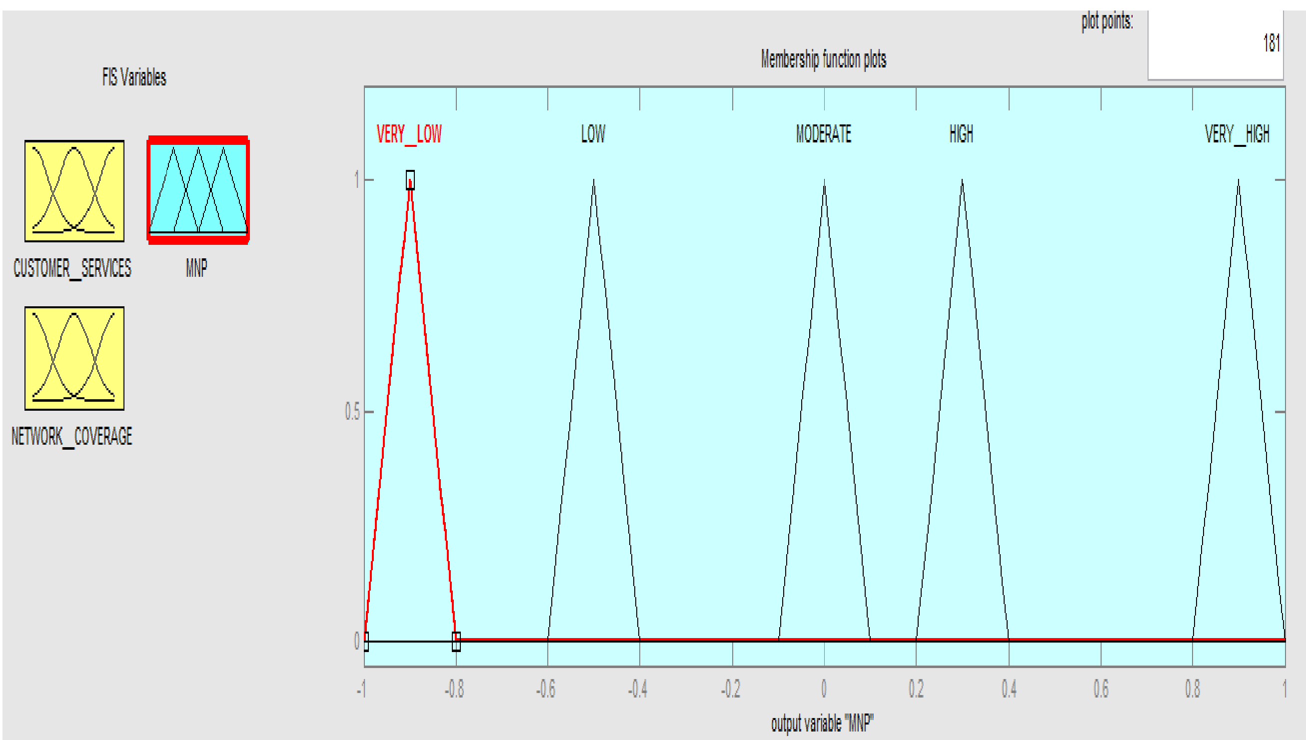

Figure 13: Plot showing membership functions of MNP

From figure 13, it was seen that the customer's service, network coverage and MNP are the FIS variables. Customer's service, network coverage are the inputs to the FIS, while the MNP is the output from the system.

The output membership function is divided into five (5) groups namely: Very Low, Low, Moderate, High, and Very High. When the output ranges between -1 to -0.8, the MNP is said to be Very Low. When the output ranges between -0.6 to -0.4, the MNP is said to be Low. When the output ranges between -0.1 to 0.1, the MNP is said to be Moderate. When the output falls between 0.2 to 0.4, the MNP is said to be High, while when it ranges between 0.8 to 1, the MNP is said to be Very-High.

Figures 14 and 15 shows the 3D relationship amongst the functions.

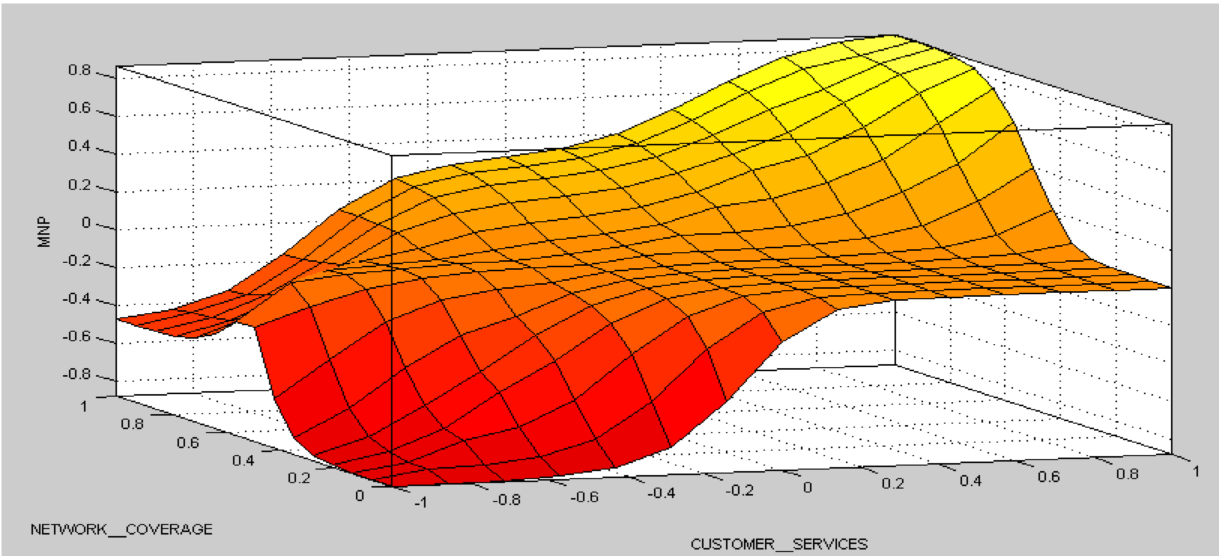

Figure 14: 3D plot showing relationship among the functions

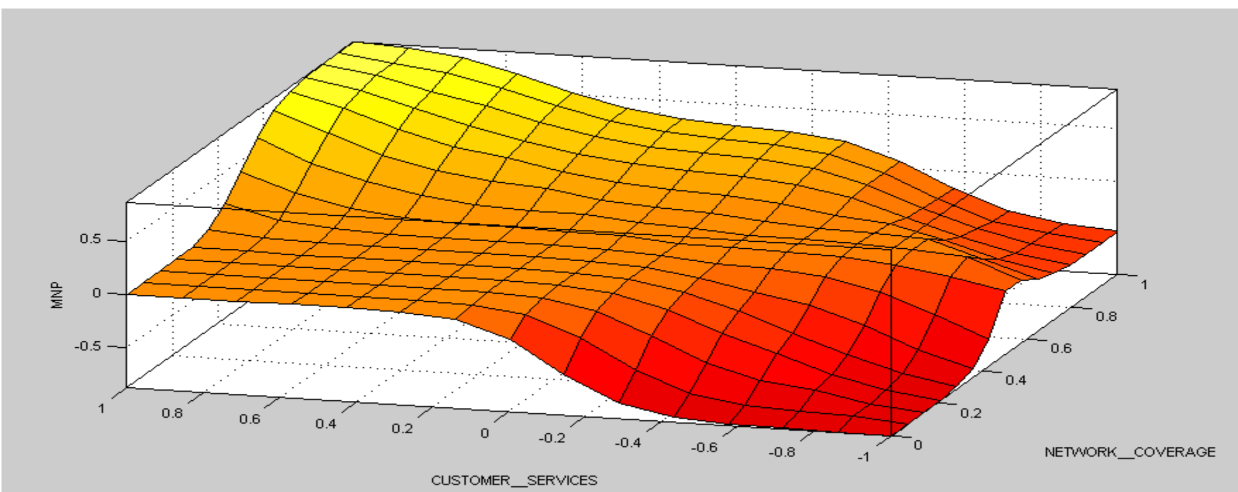

Figure 15: 3D plot showing relationship among the functions

The result of the MNP decision approach of the customer's service and network coverage is shown in Figure 16.

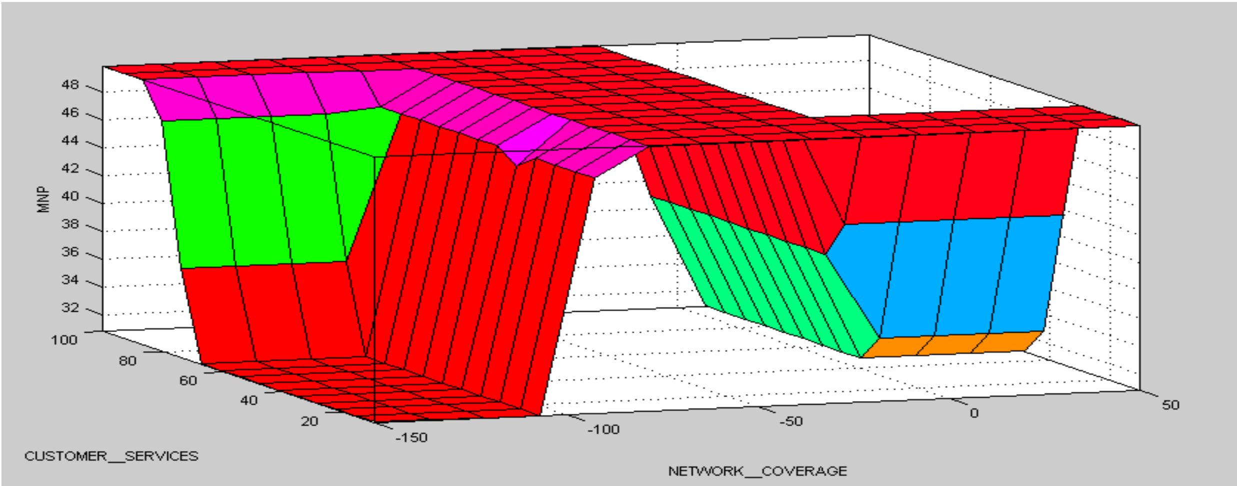

Figure 16: Decision approach of the customer's service and network coverage

As seen in Figure 16, both the network coverage and customer's services were plotted against the MNP.

Figure 17 shows the plot of MNP against network coverage.

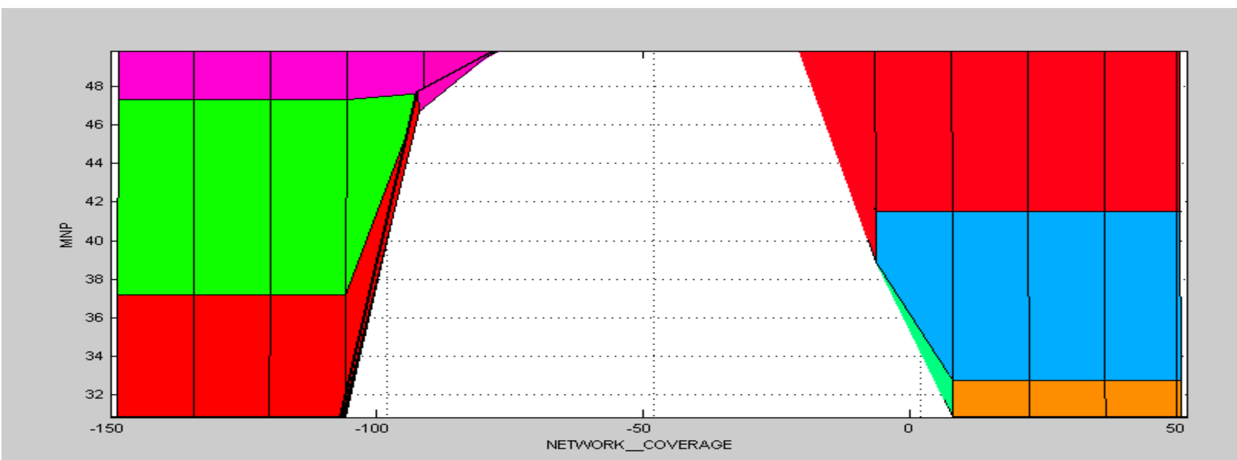

Figure 17: Plot of MNP against network coverage

On consideration of network coverage as shown in Figure 17 the user decides to port or not depending on the network strength. Between -150db to -90db, the user MNP decision is yes port. This is shown by the plot covered region, between -90db to 10db the MNP decision is uncertain as the user has to consider other factors, also from 10db to 50db which indicates strong network coverage, the MNP decision is no port as shown by the plot covered region.

Figure 18 shows the plot of MNP against customer's service.

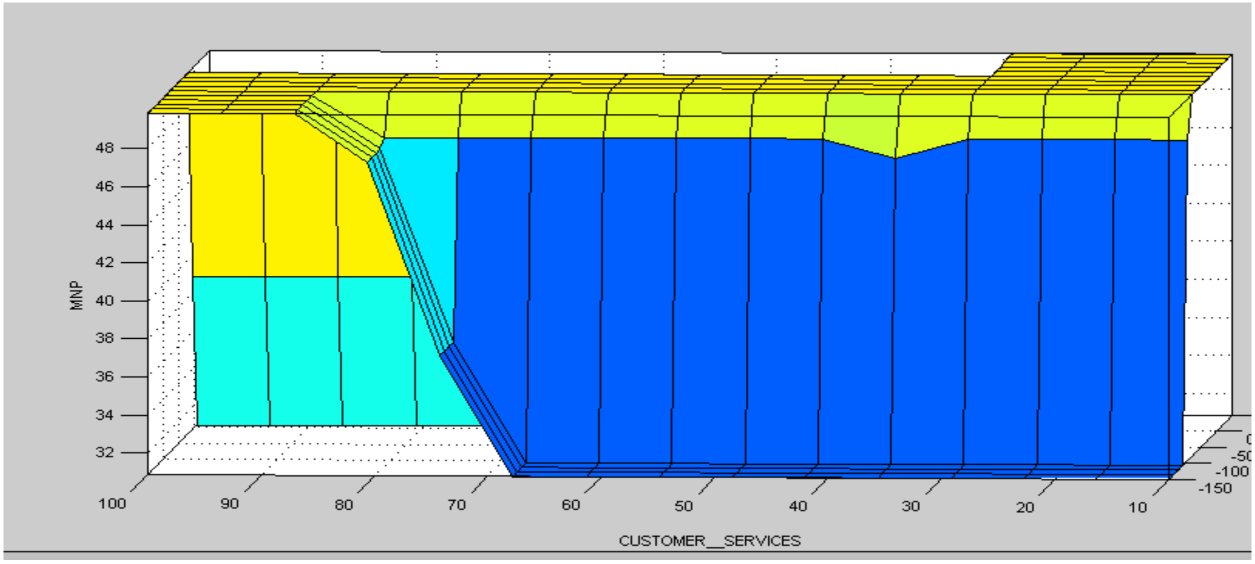

Figure 18: Plot of MNP against customer services

As shown in figure 4.5, the user ports to the test network after considering its customer services. From a rating of 10% to 65%, the user does not consider porting until the user gets about 65% and above customer efficiency information about the network in which he is about to port into, from 85% to 100%, the user gets a very high MNP and will decide to port to the test network.

On consideration of customer services and cost of tariff plan of the test network by the user, the following plots were obtained. Figure 19 shows the plot of MNP against customer's services and cost of the tariff plan.

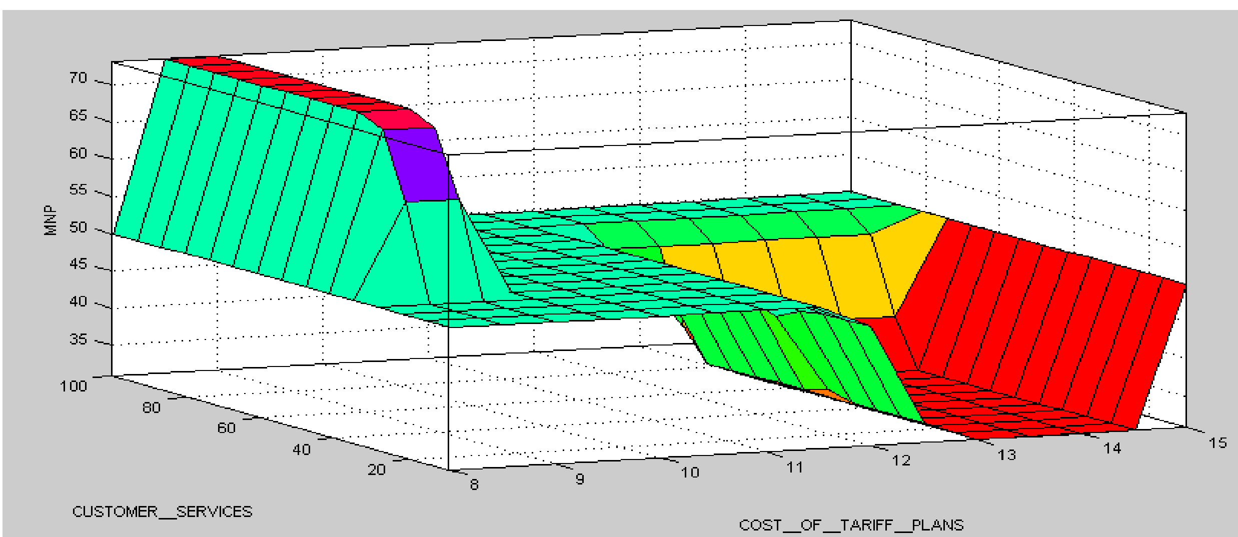

Figure 19: Plot of MNP against customer services and cost of tariff plan

In Figure 19, the plot shows an upper and lower contour indicating the decision of the user deciding to port.

Figure 20 shows the plot of MNP against customer's service.

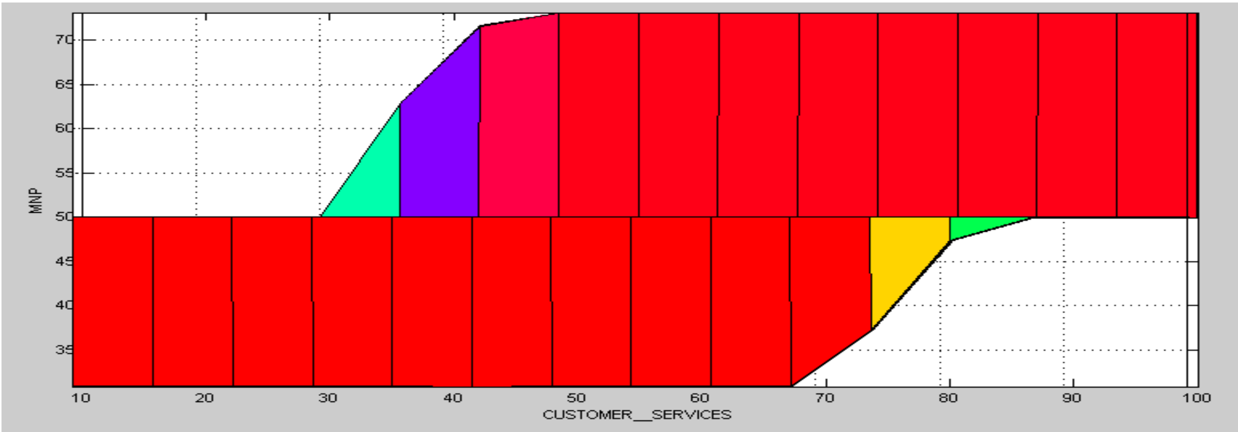

Figure 20: Plot of MNP against customer services

When the customer's service was considered as shown in Figure 20, a look at one side of the plot plots the MNP against the customer services. From 10% to 30% shows an unsatisfactory customer service, the shaded region indicates a low MNP from 0 to 50%, a customer service rating from 30% to 70% shows both the highs and lows of the MNP shaded, this explains a moderate MNP and so no decision. A customer satisfaction from 70% to 100% showed in the upper region shaded. This explained a high MNP decision which is better than 60% achieved in Nosiri *et al.* (2020) as seen in the literature.

Figure 21 shows the plot of MNP against cost of tariff plan.

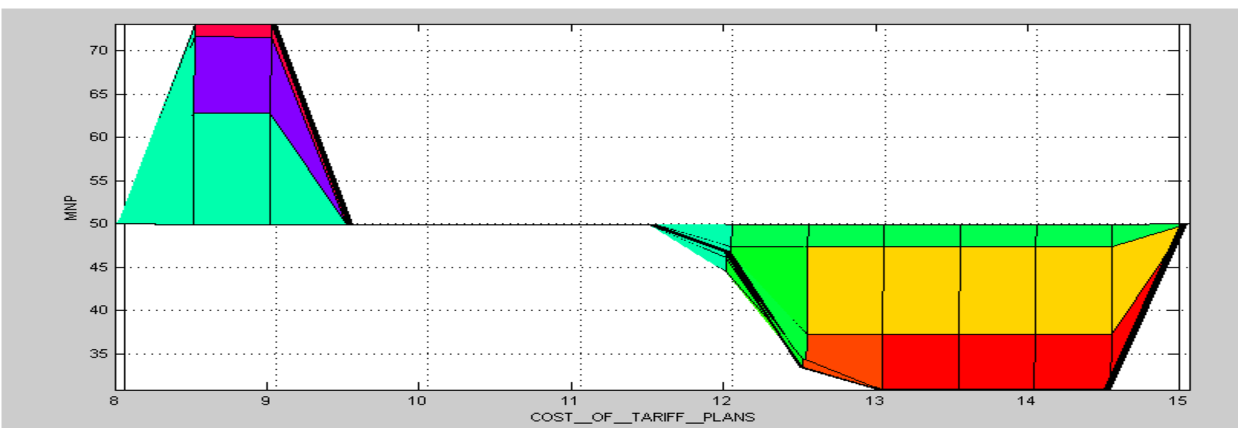

Figure 21: plot of MNP against cost of tariff plan

As seen from Figure 21, a cheap tariff plan between 8 to 10 kobo/s indicates a high MNP decision allowing the user to port to the test network. Around 10 to 11 kobo/s, the tariff plan is expensive and the MNP decision is low, therefore the user decides not to port to the test network.

When a user considers network coverage and cost of tariff plan, MNP decisions are usually difficult to make. Because strength of network coverage does not determine the cost of the tariff plan to be used, that is in the case of WLAN network in Nigeria.

Figure 22 gives a relationship amongst the MNO, network coverage and cost of tariff plan.

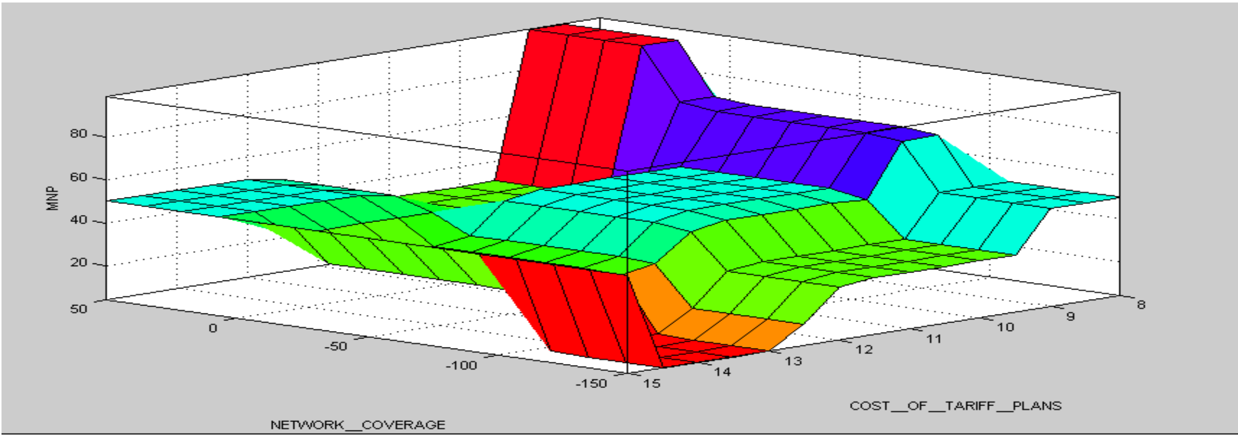

Figure 22: MNP against network coverage and cost of tariff plan

From figure 4.9, it could be seen that the MNP is highest at axis where cost of tariff plan is cheap and network coverage strong.

Figure 23 shows the plot of MNP against network coverage.

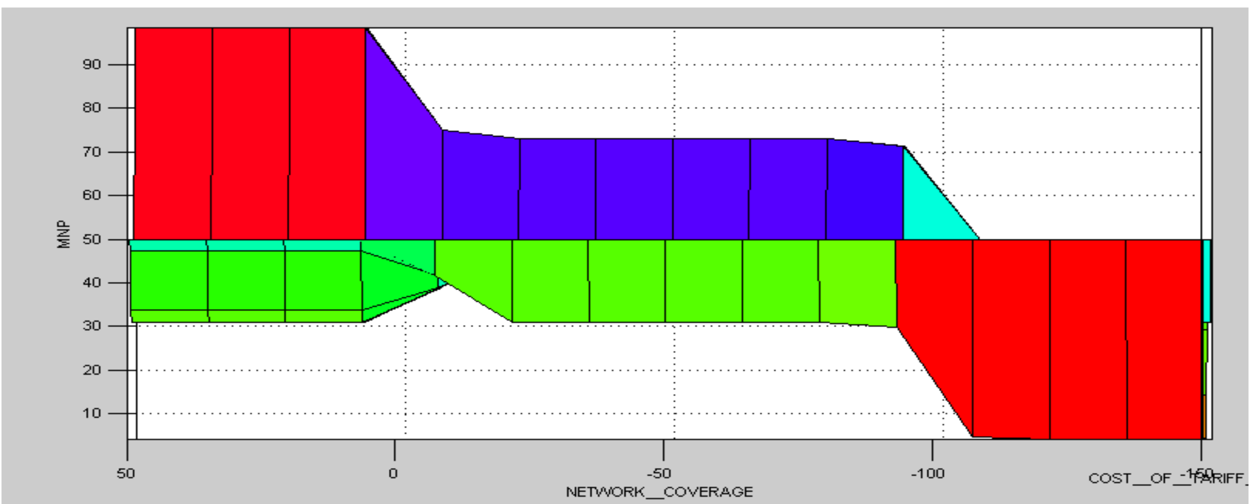

Figure 23: Plot of MNP against network coverage

As seen in Figure 23, from 0 to 50dB indicates very high MNP without consideration of cost of the used tariff. From 0db to -100db, the MNP decision is uncertain as only a cheap cost of tariff plan would determine if the user will port to the test network. Below -100db will mean that the users MNP decision will be low and likewise is not available for portability. This plot explains most mobile number portability carried out in poor networked region in the area of interest.

Figure 24 shows the plot of MNP against cost of tariff plan

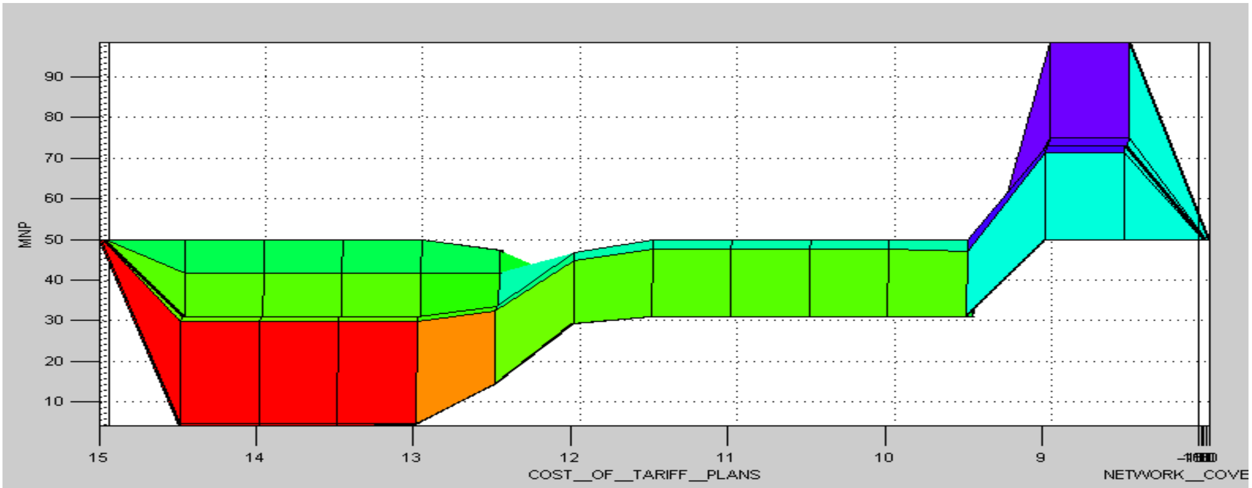

Figure 24: Plot of MNP against network cost of tariff plan

From Figure 24, the reasons why users port to a recipient network are observed. This is as a result of cheap tariff plans, the cost of call, data, and SMS. These factors go a long way to influence the user decision whether to port to the test network or not. A cheap Tariff leads to a high MNP value, while an expensive tariff makes a low MNP decision.

4.0. Conclusion

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 that most subscribers have remained circumspect, opting to remain with their old service providers rather than dare uncharted waters. The research presented an enhanced fuzzy based Mobile Number Portability (MNP) migration platform in Nigeria. The parameters that could determine why customers would switch their operators are tariff plans, call quality factor, customer care services and network coverage parameters. In this research, these four parameters were used for MNP decision using fuzzy logic. On the basis of these four parameters, the decision whether MNP is to be done or not was considered. The tariff plan, call quality factor, customer care services and network coverage were the input parameters and MNP was the output parameter. The results showed that a cheap tariff plan indicates a high MNP decision allowing the user to port to the test network. When the tariff plan is expensive and the MNP decision is low, the user decides not to port to the test network. When a user considers network coverage and cost of tariff plan, MNP decisions are usually difficult to make. This is because strength of network coverage does not determine the cost of the tariff plan to be used, that is in the case of WLAN networks in Nigeria. Therefore, the research concludes that a cheap Tariff leads to a high MNP value, while an expensive tariff makes a low MNP decision.

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