Consultancy Services to Undertake a Cost-Benefit Analysis of the Introduction of Mobile Number Portability in Rwanda

Cost Benefit Analysis Report
Redacted Version

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Executive Summary

In order to establish market conditions that provide maximum flexibility, and hence choice, customers should be able to switch between mobile operators in order to take advantage of attractive service offerings. A major drawback to switching mobile operators at present in Rwanda is that customers must change their mobile telephone numbers if they change service provider.

RURA engaged InterConnect Communications Ltd (InterConnect) for Consultancy Services to carry out a Cost-Benefit Analysis of the introduction of Mobile Number Portability in Rwanda as well as to document the tangible evidence of the expected benefits and their comparison to the related costs to determine whether the introduction of MNP would provide a benefit for Rwanda at this time.

For the purposes of this report InterConnect obtained and analysed information provided by RURA and questionnaire returns from, and meetings with, the three Rwandan mobile operators. Subsequently, an Industry MNP Workshop meeting was held in Kigali on the 9th of July 2014 which provided a further opportunity for the Rwandan Mobile operators, and other interested entities, to provide feedback, views and information.

The requirement for this type of study is supported by Article 45 (Chapter X. ‘Numbering’ of Law No 44/2001) which includes the following clause:

‘The Regulatory Board must investigate the possibility of number portability use in Rwanda or elsewhere and submit a yearly report to the Minister having Telecommunications in his/her attributions.’

In 2009 RURA issued a consultation paper in accordance with their responsibilities as stated above. The three mobile operators operating in Rwanda at that time all provided responses to that consultation. In February 2011 RURA made the decision to postpone the introduction of MNP stating that MNP would not be considered again until the national penetration rate for mobile services was above 60%. Recent RURA quarterly statistics reports have shown that the mobile penetration rate is above 60% and growing so this criterion has now been met.

This RURA data also shows that there has been some movement in market share with MTN reducing from 53% in the fourth quarter 2013 to 51.5% in the first quarter 2014 and both TIGO and AIRTEL increasing their market share by 0.5% and 1% respectively. However, these movements are relatively small and the overall effect is that the market is static with no operator making substantial gains at the expense of any other operator. They also show that the MTN revenue share of the market is even more dominant than the ‘customer share’ would indicate, with MTN controlling 2/3rds of the available revenue, and underlines the ability for operators with majority market share to set their on-net / off-net prices to their advantage as discussed in section 2.4 and 8.7 of this report.

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However, all the operators expressed some concerns regarding the implementation. Examples of these concerns are costs, multi SIM use, customers not ‘wedded’ to their number, low ARPU’s, tariff transparency, etc.

InterConnect concludes, from the information provided and by using extensive benchmark data, that an annual port rate of between 0.8% and 1.1% is a reasonable expectation in the early years. As network quality improves (including the move to LTE and 4G) and the penetration rates increase this figure may rise to between 1.1% and 1.4%. InterConnects experience indicates that it would be unusual for it exceed 1.6%. Currently this equates to approximately 34,226 – 47,061
customer ports per annum in the early years rising to 47,061 – 59,896 ports per annum based on current penetration rates.

In Section 6 of the report InterConnect uses benchmark information to provide an estimate of the likely implementation costs in Rwanda where we conclude that it will be of the order of US$10.5m plus the resource commitment that RURA and the operators will have to make.

In addition, there will be the on-going ‘per-port’ cost that we estimate to be in the region of US$3 - $6 per ported number. If Rwanda achieves a 1% port rate in the first year this will add another US$129k – US$257K and, assuming the same penetration rate and port rate, will continue as an annual cost. That is equal to approximately 3.1 times the monthly ARPU of the average ported number. However, if the actual ARPU per ACTIVE pre-paid SIM is higher than MNP becomes economically more attractive.

Other key issues from the data gathering:

- RURA and the mobile operators are rightly worried that the costs may be excessive for the benefits and may divert operator’s funds from other infrastructure investment.
- Frequently, Multi-SIM use is cited as evidence that there is no demand for number portability. But MNP is about customers retaining the number that people contact them on (their primary number), not the number they use to make outgoing calls or texts.
- Rwandan call charges for on-net and off-net calls differ for all operators; this favours operators with a large market share as they offer the prospect of a larger proportion of on-net calls. MNP may cause a competitive response by reducing this differential.
- Only MTN stated that MNP should not be a consumer right in Rwanda. The other operators stated that it should be a consumer right, albeit with qualifications.

Given all of the above, InterConnect firmly believes that RURA need to make a definite decision on MNP because of their previous statement (made in 2011) that they will implement MNP as soon as the headline penetration rate reaches 60%. This condition was met in 2013. To delay again now risks the assumption that RURA will always find ‘another reason’ to delay this important competitive step. A positive decision also removes uncertainty for operators and consumers alike, providing a categorical message that RURA is interested in enhancing competition for the good of all consumers in Rwanda.

There are also the additional issues as highlighted in various parts of this report, which are:

- That MNP is a consumer rights and competition issue – not a cost issue
- That market share is not changing, and will not change unless some action is taken
- That revenue share favours the largest operator – Confidential text removed
- Multi SIM use will increase
- Prices will remain high

But it should be noted that making the decision to implement MNP has not been easy for any country/regulator and yet, to date, approximately 80 countries have decided to implement. Regulators have always taken the position that consumer rights, the freedom to make choices and increased competition has dominated the argument in favour of implementation. Therefore, InterConnect concludes there are no fundamental reasons not to implement MNP and that RURA should consider stating that they will implement at their earliest opportunity.
1 Mobile Number Portability

1.1 Introduction

In a competitive environment, operators and service providers will compete in all manner of ways in order to attract customers, increase market share and ultimately increase revenues and profit. The typical areas in which mobile service providers will (and do compete) are:

- Pricing plans
- Products/Services
- Coverage
- Quality.

In reality, the situation is far more complex than is suggested by the above four bullets and mobile operators are renowned for introducing particular features into their service offers. These include such features as: the exclusive provision of a particular handset; a number of ‘free’ call minutes included in a particular bundle; an amount of ‘free’ data downloads in a bundle; ‘free’ on-net calls for certain periods of the day; or a number of ‘free’ SMS messages in a bundle. The offers can be complex and are all designed with the aim of attracting new customers (whether they be entirely new customers, first time mobile users, or customers switching from another competing, operator) and retaining existing customers.

This is entirely consistent with the principles of a competitive sector. It is widely acknowledged that some of the benefits of competition are:

- Downward pressure on prices
- New and innovative products and services
- Improved quality
- Greater choice of services and operators for users and consumers.

Thus, in a competitive market, users are (or should be) free to take service from any operator and, if the user so chooses, to switch between operators in order to secure a better deal. In practical terms, a number of factors can prevent or deter a user from switching between suppliers. These include:

- Contractual penalties or contract durations (post-paid customers only)
- SIM locked handsets
- Customer inertia
- Exclusive non-transferable products
- The user’s telephone number.

It is this last point that number portability addresses. It is recognised that some customers will not change operator if the user has to use a new telephone number. This is particularly true in the case of business users, where the business has to offset the benefits derived from taking service from a new operator with the cost of printing new stationary and business cards and of informing all customers and contacts of the new telephone number.

It therefore follows that any system that allows a customer to retain their telephone number when switching between operators will be of interest to the customers. Mobile Number Portability (MNP) is such a system. It affords the following benefits to customers and operators:
1) Lower costs and inconvenience incurred by customers who change from one Mobile Network Operator (MNO) or Mobile Virtual network Operator (MVNO) to another;

2) Potentially faster product implementation and a greater range of services available through increased competition; and

3) Greater ability of customers to change their provider based on price, quality and service.

In order to establish market conditions that provide maximum flexibility, and hence choice, customers should be able to switch between mobile operators in order to take advantage of attractive service offerings. A major drawback to switching mobile operators at present in Rwanda is that customers must change their mobile telephone numbers if they change service provider.

From RURA’s perspective, number portability should enhance competition among the operators, create downward pressure on prices, increase infrastructure investment and facilitate participation of new entrants into the sector.

For operators, it presents opportunities to acquire customers and generate higher Average Revenue Per User (ARPU) through new services. While there are understandable concerns about the costs of implementation and the risks of greater churn, number portability can promote growth in customers and revenue for operators that deliver high quality, innovative marketing, service features, and pricing models.

In some countries, especially smaller countries, the benefits and costs of implementing number portability should be considered carefully. The MNP technical options employed in large markets may be too costly for small countries. In addition, they can be overtaken by technological changes that may change how we think about numbering and customer switching. It is therefore imperative that regulators consider carefully both the questions ‘MNP or not?’ and also ‘how?’

Mobile number portability has now been launched, or is being implemented, in many countries using a variety of technical and administration solutions. At this time (June 2014) approximately 80 countries have implemented, with many more being added all the time, including Nigeria, Moldova, Qatar, UAE, Costa Rica and Kuwait who launched in 2013 and Azerbaijan, Tanzania, China1, and Russia launching or expected to launch by the end of 2014.

Whilst it is true that the implementation and on-going management presents challenges and costs for the regulator and operators in each country, launching MNP in countries with a low customer base in international terms (Table 19 - Examples of small jurisdictions launching MNP refers2) and/or low forecasted porting rates face particular challenges in achieving a viable implementation.

1.2 International Best Practice

In parts of this report we refer to ‘International Best Practice’ for MNP, and in our meeting with them, AIRTEL stated that they are in favour of MNP being implemented in Rwanda but wanted to see RURA adopting ‘international best practice’ examples. Therefore, in order to aid understanding, and as a reference point for RURA, we regard the following principles as international best practice adopted by most countries;

- Recipient lead ‘one-stop shop’ process;
- Porting in one day or less;

---

1 China is a huge country with many regions, each with their own set of licensed operators; consequently, they are deploying MNP on a region by region basis.

2 Table 17 provides examples of countries with small populations or a ‘low customer base’ that have successfully launched MNP.
1.3 Report Objective

The Rwanda Utilities Regulatory Authority (RURA) has engaged InterConnect Communications Ltd (InterConnect) for Consultancy Services to carry out a Cost-Benefit Analysis (CBA) of the introduction of Mobile Number Portability in Rwanda as well as to document the tangible evidence of the expected benefits and their comparison to the related costs. In case the benefits outweigh the costs, the consultancy is also expected to advise on the implementation process of mobile number portability. In case the costs outweigh the benefits, the consultancy is also expected to advise on alternative ways to increase competition on the mobile market.

Based on experience in other international markets, MNP may help to increase competition among the operators and enhance effective competition, service accessibility and poor service quality in rural and remote areas of the country. Consequently RURA requested this report in order to determine whether the introduction of MNP would provide a benefit for Rwanda at this time.

The main objective of the assignment is to provide RURA with a comprehensive Cost-Benefit Analysis (CBA) of the introduction of Mobile Number Portability in Rwanda including assessment of related costs and analysis of its impact on the following:

(a) Business operations of the existing operators.
(b) Competition within the mobile cellular market.
(c) Consumer choice of operators.
(d) Overall economic activities.

During the inception visit, Les Oliver and RURA established the following objectives for the review of Number Portability:

- To provide RURA with an understanding of Number Portability, its costs and benefits in the context of Rwanda. This will include:
  - A review of the regulatory regime and market
  - An indication of market demand and need
  - The benefits
- Identify and detail the MNP technical options, taking into account the market conditions and international best practice

These objectives have been addressed by:

- Providing an operator questionnaire to gain specific market data from operators
• Reviewing the responses to the Questionnaire
• Meetings with RURA to understand their rationale for conducting this exercise at this time
• Meetings with the operators to gain insight on their views of a number portability implementation project
• Analysis of the information obtained and international best practice.

1.4 Structure of the Report

This report is structured as follows:

Section 0 describes a general introduction to Number Portability and the reasons for the report.
Section 2 describes the current market situation in Rwanda focusing on the operator feedback to the Operator Questionnaire and includes the Legal Framework in Rwanda.
Section 3 addresses a variety of number portability related issues than can influence the success, or otherwise, of number portability, including future trends.
Section 4 identifies the MNP implementation development areas including a centralised service and the operator specific developments.
Section 5 identifies the Implementation Costs and provides an overview of where operators will expect to incur costs.
Section 6 uses Benchmark data to identify the likely cost for an MNP implementation in Rwanda.
Section 7 provides an overview of fixed to fixed NP and service NP and their applicability to the situation in Rwanda.
Section 8 provides InterConnect’s overall conclusion regarding number portability in Rwanda.

0 considers the options for porting administration, providing detail of the various options and the preferred choice for RURA consideration.

Appendix B describes the technical routing options available to RURA and provides a preferred choice for consideration.
Appendix C describes the categories of costs to be recovered.
Appendix D details the cost recovery principles RURA should use in any MNP implementation in order to ensure costs are fair and equal.
Appendix E describes the actual allocation of cost that RURA should adopt if it proceeds with MNP.
Appendix F summarises the prices and tariff Benchmark data.
Appendix G summarises the MNP Country information Benchmark data.
Appendix H is a glossary of the number portability terms used in this report.

3 Notes of the RURA and Operators meetings are contained in the project Inception Report.
2 The Mobile Market in Rwanda

2.1 Introduction

For the purposes of this report we have obtained and analysed the information provided by RURA and the questionnaire returns from and meetings with the three Rwandan mobile operators MTN, TIGO and AIRTEL. In terms of the analysis of the mobile market in Rwanda for the purposes of MNP, the data collected is sufficiently accurate. It also ensured that all the operators had an opportunity to state their views on the possible implementation of MNP, as per the minutes of meetings provided in the project Inception Report (Version 2.0).

Subsequently, an Industry MNP Workshop meeting was held in Kigali on the 9th of July 2014 which provided a further opportunity for the Rwandan Mobile operators, and other interested entities, to provide feedback, views and information based on the draft report, as presented to the Workshop, and discussions held within the Workshop.

In conducting this type of exercise more positive responses can be expected from those who believe that MNP implementation in Rwanda will improve the competitive position in their favour, or at least will not harm their competitive position. Those who believe that MNP is not appropriate at this time will be less positive about its possible effects.

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However, all operators expressed some concerns in relation to the implementation. These concerns included costs, multi SIM use, limited customer attachment to their number, low ARPU’s, tariff transparency, etc. These issues are considered in this report.

However, regardless of a particular operator’s position on MNP, the information provided afford an insight into the market that would otherwise not be available (at worst) or very difficult and / or time consuming to obtain (at best)⁴. This enables a reasoned report with better quality conclusions and recommendations than would otherwise have been possible. Table 1 below provides an overview of the feedback provided by RURA and by the current mobile operators.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Market share (customers)⁵</th>
<th>Market share (revenue)</th>
<th>Pre-paid/post-paid %</th>
<th>Churn Rate per month</th>
<th>ARPU per month⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-paid</td>
<td>Post-paid</td>
<td>Pre-paid</td>
<td>Post-paid</td>
</tr>
<tr>
<td>MTN</td>
<td>57%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>99% - 1%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>TIGO</td>
<td>32.78%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>99% - 1%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>AIRTEL</td>
<td>16%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>99% - 1%</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 1 - A Summary of the Rwandan Market

⁴ If the information had not been provided by the operators then it would have had to have been obtained through time consumer market research. However, some of the information is commercially sensitive and therefore would not have been available even through extensive market research.

⁵ This column totals 105.78%. Perhaps a more accurate figure is provided by RURA in their statistical information which gives the following – MTN = 51.57%, TIGO = 33.58% and AIRTEL = 14.85% which adds up to 100%.

⁶ RWF = Rwandan Franc
2.2 Legal Framework in Rwanda

In the EU, number portability is an absolute legal requirement (as a customer right) so EU regulators must comply. Regulators outside the EU can decide whether NP is an appropriate initiative given their particular circumstances. They can then enforce that decision through the powers invested in them by law, statute or other appropriate governmental action. The NP details are usually proscribed in Licence Conditions, General Conditions of Service, ministerial decrees or policy statements, regulatory decisions or regulations. Operators within that jurisdiction are then obliged to provide NP as a condition of providing telecommunications service.

In Rwanda, the Rwanda Utilities Regulatory Agency (RURA) was originally established by the law No. 39/2001 of 13th September 2001 as an independent national authority to administer different sectors offering public utility services, promote transparency, protect free competition and provide inclusive service, as well as protect users’ rights. This law was repealed by the Law No 09/2013 of 1st March 2013 establishing RURA and determining its mission, powers, organization and functioning.

In accordance with the law no. 44/2001 of 30th November 2001 governing Telecommunications, Rwanda Utilities Regulatory Agency (RURA) has the mandate to regulate among other things the telecommunications sector, enhance and deploy services in compliance with the most advanced technology to meet user’s needs at the most suitable prices. It is also charged with the responsibility of protecting consumer interests and facilitating competitive private sector participation in these sectors.

In particular, Article 45 (Chapter X. ‘Numbering’ of Law No 44/2001) includes the following clause:

The Regulatory Board must investigate the possibility of number portability use in Rwanda or elsewhere and submit a yearly report to the Minister having Telecommunications in his/her attributions.

This mandate is vested in RURA’s Regulatory Board. Specifically, the general regulatory framework for telecommunications numbering, including Number Portability, is provided by Article 9 of the Presidential Degree No. 4/01 of 15th March 2004 which states:

Article 9: Number portability

The Board shall look into the possibility of introducing Number Portability within the Republic and in other countries, and shall communicate a feasibility report thereon each year to the Minister.

Prior to the introduction of Number Portability, the Board shall consult with users and take account of their opinions when the decision is made as to whether or not to encourage or require public network Operators, to introduce Number Portability.

The Board shall issue guidelines for the introduction of number portability within the Republic and in other countries.

In 2009 RURA issued a consultation paper in accordance with their responsibilities as stated above. The three mobile operators operating in Rwanda at that time all provided responses to that consultation. In February 2011 RURA, having carefully considered the feedback provided by the mobile operators and the situation with the Rwandan Market at that time (as well as other factors), made the decision to postpone the introduction of MNP. This decision stated that MNP would not be considered again until the national penetration rate for mobile services was above 60%. In January 2011 the penetration rate stood at 35%.

RURA continues to issue market statistics on a quarterly basis and recently those quarterly statistics reports have shown that the mobile penetration rate is above 60% and, apart from a slight
downturn due to national SIM registration in the last quarter of 2013, is continuing to rise at approximately 2% per quarter. So this criterion has now been met as shown below.

<table>
<thead>
<tr>
<th>RURA Quarterly Report</th>
<th>Penetration Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 2012</td>
<td>53.10%</td>
</tr>
<tr>
<td>March 2013</td>
<td>57.30%</td>
</tr>
<tr>
<td>June 2013</td>
<td>60.90%</td>
</tr>
<tr>
<td>September 2013</td>
<td>63.70%</td>
</tr>
<tr>
<td>December 2013</td>
<td>63%</td>
</tr>
<tr>
<td>March 2014</td>
<td>65%</td>
</tr>
</tbody>
</table>

Consequently, in order to comply with Article 9 of the Presidential Degree No. 4/01 of 15th March 2004, and in reaction to the recorded mobile penetration rate, the Rwanda Utilities Regulatory Authority (RURA) has engaged InterConnect Communications Ltd (InterConnect) for Consultancy Services to ‘Undertake a Cost-Benefit Analysis of the Introduction of Mobile Number Portability in Rwanda’, to fulfill the Republic of Rwanda’s current and growing future demand for a fully competitive telecommunications market. In preparation for the production of the Analysis InterConnect issued a Questionnaire to the three mobile operators currently operating in Rwanda in order to obtain their views on various aspects of the mobile market and on the implementation of number portability. This information gathering was supported by a visit to RURA in Kigali during which meetings were held with the three mobile operators.

The information requested from the operators, along with the meetings held with the operators prior to the production of this report and any discussions RURA undertakes on the conclusions of this report, forms the required dialogue to determine whether it would be technically, commercially, and legally appropriate to require operators to introduce number portability in Rwanda at this time. The information provided by the operators is reviewed and analysed in this report.

Finally, if, at the conclusion of this process, RURA decide to implement number portability in Rwanda, the mobile operators already have a clause in their operating license which requires them to co-operate in the implementation project as follows:

14.4 The Licensee shall co-operate with other Public Telecommunications Network Operators, in such manner as the Regulatory Agency may direct, in the specification and development of Number Portability to allow flexibility of service without a change of number. Subsequent implementation of Number Portability is to be subject to operational practicability and commercial viability.
2.3 Analysis of the Market Responses to the Questionnaire

The three mobile operators have generally provided accurate data but have not provided information to all the questions asked in the questionnaire. However, more information was made available during the Inception Visit to the RURA offices in Kigali, in our meetings with the operators there, and during the MNP Workshop held in Kigali on July 9th 2014. This has been correlated with RURA supplied data to provide an accurate analysis.

All three operators acknowledged that the national penetration rates are now over 60% which was the RURA stated trigger for further number portability consideration.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
<th>RURA Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>What is the national penetration rate from your perspective?</td>
<td>Mobile: 63%</td>
<td>63.5%</td>
<td>64% for voice – 13% for data</td>
<td>65% (March 2014)</td>
</tr>
</tbody>
</table>

Table 2 - Mobile Penetration Rate

The following information was provided by RURA and the operators during our data gathering:

<table>
<thead>
<tr>
<th>Telecom Statistics at March 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
</tr>
<tr>
<td>GSM Customers</td>
</tr>
<tr>
<td>Landlines</td>
</tr>
<tr>
<td>Mobile Penetration</td>
</tr>
</tbody>
</table>

Table 3 - RURA: Operator Statistics

Taking the population figure of 10.7 million (Dec 2013) and the in service number, for GSM of 6.84m (March 2014) gives a mobile penetration rate of 63.74%. In their responses to the Questionnaire, MTN provided a mobile penetration rate of 63%; TIGO stated 63.5% and AIRTEL gave a figure of 64%. The penetration rates provided can all be regarded as accurate given the slightly differing times and the data used and are all within the range 63% - 65%.

However, due to the effect of Multi SIM use in Rwanda (see Section 2.4), a more realistic ‘in-service’ rate (the number of people with at least one service) is approximately 4.278m.

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⁷ RURA had been using the 2012 projections (10,537,222 by December 2013) provided by the National Institute of Statistics of Rwanda while the new projections published in March 2014 (provided by the Institute) indicates 10,724,429 by December 2013. Using the latest figures provided produces a penetration rate of 63.74% as stated.
The ITU-D statistics\(^6\) show that the Rwandan mobile penetration rate was as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rwanda</td>
<td>6.40</td>
<td>12.94</td>
<td>23.07</td>
<td>32.75</td>
<td>39.90</td>
<td>49.67</td>
</tr>
</tbody>
</table>

The information provided by the operators and ITU-D do not provide a consistent pattern of growth, especially in the last four years of statistics (2009 – 2012), as they present different views on the overall penetration rates and the year-on-year growth rates. It is therefore difficult to draw firm conclusions on the growth rate from these figures.

The most useful (and accurate) statistics are provided by RURA who produce a quarterly report, with monthly updates on mobile customer numbers and national penetration rates, as shown below and in Section 2.2 (Figure 1).

Mobile growth is evident in most countries of the world and this analysis assumes it is present in Rwanda at 2% per annum.

The responses given for market share are:

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>What is your overall market share for each of these services?</td>
<td></td>
<td></td>
<td>16%</td>
</tr>
<tr>
<td>2a</td>
<td>In terms of subscribers?</td>
<td>Mobile : 57%</td>
<td>32.78%</td>
<td>16%</td>
</tr>
<tr>
<td>2b</td>
<td>In terms of revenues?</td>
<td>RURA should have this information</td>
<td>26%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Table 7 - Mobile Market Share in Rwanda

In their quarterly report ‘Statistics and Tariff Information in Telecom Sector as of March 2014’ RURA have assessed the market share as shown in Figure 3:
This data shows that there has been some movement in market share with MTN reducing from 53% in the fourth quarter 2013 to 51.5% in the first quarter 2014 and both TIGO and AIRTEL increasing their market share by 0.5% and 1% respectively. However, these movements are relatively small and the overall effect is that the market is static with no operator making substantial gains at the expense of any other operator.

Confidential Text Removed

The data provided by the operators on the pre-paid / post-paid split provides comparatively consistent information.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>What is your current mobile prepaid / post-pay split?</td>
<td>Mobile prepaid : 99%</td>
<td>1% Post-paid vs 99% pre-paid</td>
<td>99/1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mobile post-paid : 1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Is that moving in one direction or another – i.e. is prepaid increasing whilst post-pay is decreasing – or vice versa?</td>
<td>Both are increasing</td>
<td>It moves in one direction; Post-paid is increasing</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 8 - Pre-paid / Post-paid Market Split

The overall 99% to 1% of pre-paid / post-paid split is in line with many sub-Saharan countries, with Ghana, Nigeria, Kenya and Botswana all reporting approximately 99% pre-paid and South Africa reporting approximately 81%. This high level of pre-pay is significant for NP as we discuss later in this report. The impact of inactive SIMs on this percentage is considered in section 2.4.

The only study known to have specifically looked at this issue is a 2008 study ‘Mobile number portability around the World (2008)’ produced by the TMG

That study provided included an analysis of the relationship between churn rates and port rates for 43 countries, all with different levels of pre-paid to post-paid split. Based on that data:

- The average churn rates are fairly closely aligned at 22.18% (> 50% post-paid) and 26% (< 50% post-paid);
- Where there are more than 50% post-paid (23 countries), the average percentage of customers who keep their number when they churn is 36.07%
- Where there are less than 50% post-paid (20 countries), the average percentage of customers who keep their number when they churn is 8.56%

Given the current pre-paid rate in Rwanda, these figures would indicate that port rates are likely to be lower than a comparable country that has a much lower percentage of pre-paid customers. This analysis considers this when calculating for possible annual port rates in Rwanda.

*The Telecommunications Management Group, Inc.*
The questionnaire also asked about churn rates and the turnover of numbers. This is important when added to the information above. The churn rates that were provided are comparable given that the TMG report shows that an average churn rate in the 43 countries with MNP is approximately 25%.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>What churn rate have you experienced i.e. the number of subscribers leaving each month as opposed to the number joining - over the last 12 months?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>6a</td>
<td>Fixed-line?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>6b</td>
<td>Mobile Prepaid?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>6c</td>
<td>Mobile Post-pay?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 9 - Mobile Churn Rates in Rwanda

Confidential Text Removed

However, we have considered the impact and the positive effect on annual port volumes in section 2.6.

In terms of NP, customers tend to maintain a primary number; the number they give to their friends, family and colleagues even when they carry multiple SIMs. People do not tend to give several numbers out, so the primary number is important to them, more important than the other numbers they have. Therefore, the primary number is the one they would want to keep if they wanted to change operator. The operator feedback received did not provide information on this specifically in Rwanda, but there is no reason to believe the situation in Rwanda is different for other countries with high pre-paid rates.

The other dimension to factor into this analysis is that Rwanda, with its 99% pre-paid rate, will have a significant percentage of high value, and business customers are pre-paid customers using the pre-paid service. Such customers are more likely to want retain their number if they changed operator for the reasons stated earlier.

In conclusion, in countries with NP where there are a higher percentage of pre-paid customers, the customers are 25% as likely to keep their number when they churn as customers in countries with a higher level of post-paid customers. This is a ‘market effect’ that is included in our consideration of possible annual port rates in Rwanda, in section 2.6, and is not a failure of NP to stimulate churn or generate competition.

2.4 Multi SIM Use

In their MNP Questionnaire responses, MTN stated that they have no information on the level of multi SIM use in Rwanda. The other two operators provided information as follows;

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
</table>

12
22. Do you have any figures on multi SIM or multi handset use – subscribers who carry more than one SIM/Handset? | 46% (later corrected to 64%) | 1.6 SIMs per person

| Table 10 - Multi SIM use in Rwanda |

Subsequently, in the meetings held during the first visit to Rwanda, the three operators offered the following additional information:

AIRTEL confirmed their response of 1.6% multi SIM use. This figure is based on their own limited market research and experience of their own customer base. **Confidential Text Removed**

TIGO stated in their questionnaire response that there is 46% multi SIM use in Rwanda. This figure is based on their interconnect rates, the interconnect traffic they monitor. However, they will check their data and the method of collection and get back to RURA with more detailed information. TIGO later corrected this figure to 64% based on a survey of their customer base. InterConnect has used 64% in its calculations on projected annual port volumes and resultant costs.

MTN – in their response to Q22 of the questionnaire MTN had provided no answer so were asked if they have any figures which they would like to include. MTN stated that their estimate for multi SIM use was 40% for MTN customers and 80% for other operator’s customers e.g. 40% of MTN customers have another service with another operator, whilst 80% of TIGO and AIRTEL customers have another service with another operator. This is based on their interactions with their own customers and the use of multi-SIM handsets. **Confidential Text Removed**

We know that multi SIM use is common in sub-Saharan countries, as it is in other parts of the world where pre-paid rates are very high, and multi SIM use can have a significant impact on the penetration rates in Rwanda and therefore any calculation of ‘annual portability rates’. Using the available statistics we need to calculate a realistic penetration rate.

- The total population is 10.725m
- Active SIMs is 6.836m
- That provides a penetration rate of 63.74%\(^{10}\)

If, however, many customers carry more than one SIM as stated by the mobile operators in their responses to the questionnaire and during our meetings, then we should calculate the total number of people who actually have service with at least one operator based on the following assumptions:

**AIRTEL** – if the average person carries 1.6 SIMs then that reduces the number of people with service to 4,272,483 which is a 40% penetration rate, as follows:

\(^{10}\) This figure complies with ITU definition 271 as provided in ‘Definitions of World Telecommunication/ICT Indicators, March 2010’. Definition 271 refers to ‘Mobile cellular telephone subscriptions (post-paid + prepaid)’, and states it ‘Refers to the subscriptions to a public mobile telephone service and provides access to Public Switched Telephone Network (PSTN) using cellular technology, including number of pre-paid SIM cards active during the past three months. This includes both analogue and digital cellular systems (IMT-2000 (Third Generation, 3G) and 4G subscriptions, but excludes mobile broadband subscriptions via data cards or USB modems. Subscriptions to public mobile data services, private trunked mobile radio, telepoint or radio paging, and telemetry services should also be excluded. This should include all mobile cellular subscriptions that offer voice communications’.
TIGO – 36% of customers carry one SIM
64% of customers carry (at least) two SIMs

MTN – For MTN we followed the process shown below.

For every one customer, there is 1.4 or 1.8 SIMs (if only one additional SIM) depending on the operator. Divide the Subscriptions by 1.4 or 1.8 takes you to number of customers, from there you get the number of multi-SIM and totals.

Therefore, the percentage figures provided by them for all three operators reduce the number of people with service to 4,356,576 which is a 40.62% penetration rate.

None of these figures are entirely accurate but they are within an acceptable range. Taking an average of the three figures results in an ‘in-service’ rate of approximately 4,265,778. It should be noted that, from the Questionnaire responses and meetings, there is no evidence of the current use of MSISDNs for Machine to Machine (M2M) services. The possibility of M2M services becoming popular in Rwanda, as they are in many countries, is a factor that should be considered as part of multi-SIM use and is included in section 3.2 of this report.
Frequently, Multi-SIM use is cited as evidence that there is no demand for number portability and therefore it should not be implemented, although there was limited mention of this by the Rwandan operators. However, MTN stated that ‘Entry level prices are so cheap that customers will not be inclined to go through the process of porting their number, but will simply take on another service. Especially as multi-SIM handsets are increasingly available.’

The logic for this argument is that a customer with SIMs from more than one operator does not need NP to use the operator of their choice. They can already make and receive calls on more than one network. But MNP is about customers retaining the number that people contact them on (their primary number), not the number (or SIM card) they use to make outgoing calls / texts or to take advantage of any special offers or promotions.

In regard to special promotions or offers, those SIMs are disposable, by definition, at the end of the promotion whilst the number given out to business contacts / colleagues, friends and family members is not. It can also be the case that the multi-SIM situation is a direct result of recharge bonuses. On-net calls in Rwanda are already cheaper than off-net calls and this situation can be enhanced by the introduction of various re-charge bonus schemes which makes on-net calls even cheaper.

Nobody chooses to carry multiple handsets or carry multi-SIMs around because they want multiple SIMS. They typically do it for one or more of the following reasons:

- To overcome inadequacies in network coverage / quality;
- To ensure they obtain lower rates through special offers;
- To ensure that calls to friends and family are kept ‘on-net’ to get lower call charges;
- To differentiate between business and personal calls.

Consumers will always look for ways to reduce their expenditure including spend on mobile usage. Frequently this means they actively seek deals that provide more free call minutes, free SMSs or data usage. This is how competition works and the more the competition the more the choice and promotions for customers. NP is one of the ways to increase competition and thus encourage price reductions, rather than the reductions being a reason to avoid NP.

Whilst network coverage was not raised as a particular issue by operators or RURA, it is clear from the operator’s responses that there may be an issue for (potential) customers in terms of network quality. This issue is covered in more detail in section 2.5 of this report that observes that operators in fully competitive markets will do everything they can to gain and retain customers once NP is available, including investment in their network infrastructure to improve quality and (if necessary) coverage. Any limitation in network quality, especially in rural areas, will explain some of the multi SIM use evident in Rwanda.

The Tariff table provided below demonstrates that Rwandan call charges for on-net and off-net calls differ for all operators, and by an increasing margin.

<table>
<thead>
<tr>
<th></th>
<th>On-Net</th>
<th>Off-Net</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peak</td>
<td>Off Peak</td>
</tr>
<tr>
<td>MTN</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>
Table 14 - On-net – off/net price differentials at peak and off-peak

These different on-net / off-net prices reinforce one of the reasons for a regulator to introduce MNP, to stimulate market forces to reduce these differentials. However, as already stated, on-net calls can be cheaper (sometimes substantially cheaper) because of the use of special / promotion packages and recharge bonuses. Increased competition created by MNP may encourage further innovation in price reductions.

Any special / promotional packages and recharge bonuses are available to customers of an operator. If MNP is introduced, it is important that they should be offered in a non-discriminatory manner to customers with ported numbers and those with non-ported numbers. This must continue post launch of an MNP service regardless of whether the customer has ported their number or not and this should be clear in the MNP ‘rules’.

Mobile termination rates are a factor in managing customer prices, and the information provided by the operators in their questionnaire responses confirms that the mobile termination rates are equal for all mobile operators in Rwanda. Table 15 compares this with the rates in some other Sub-Saharan African countries. It can be seen that the Rwandan mobile termination rates are on the high side compared with some other countries in this table, but are being reduced year on year as part of RURA policy.

<table>
<thead>
<tr>
<th>Countries</th>
<th>Operators</th>
<th>Termination rates $US</th>
<th>Prepaid</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Gambia</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Kenya</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Ghana</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Uganda</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Namibia</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Zambia</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Rwanda</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Botswana</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>South Africa</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 15 - Mobile Termination Rates

It is worth noting that the rates given for Ghana and Kenya are frequently quoted as being among the lowest in sub-Saharan Africa, yet we can see from the table that both Tanzania and The Gambia have lower termination rates. However, Figure 4 and Figure 5 show the
termination rates in a number of OECD countries\textsuperscript{11}. This shows that the Rwandan mobile termination rates are much lower than the OECD average of just over 6 cent ($US).

![Figure 4 - Average and High Termination Rates](image)

![Figure 5 - Termination Rates in the OECD on 5 May 2011 (US$)](image)

Consequently, it can be expected that countries with a high or very high pre-paid percentages and high multi SIM use would expect MNP, over time, to result in post-paid percentages to increase and multi SIM use to decline. This will result from reducing termination rates with consequential reductions in customer call charges and the on-net / off-net price differential to flatten.

The existence of any special promotions, if they continue post MNP launch, will continue to encourage people to take on a pre-paid service for just as long as the offer lasts, no matter

\textsuperscript{11} 'Developments in Mobile Termination’ an OECD Digital Economy Paper (No 193) issued in 2012, the data was collected for the regulated peak hour per minute fixed-mobile interconnection rate of the largest mobile network. The termination rates for other networks were not recorded, nor were off-peak and weekend rates.
how short the offer duration. However, to repeat earlier comments, these promotions are for outgoing calls, SMSs and data usage and do not relate to the customer’s primary number. NP enables the customer to keep their primary number, whilst benefitting from the promotions for outgoing calls. Thus multi SIM use is likely to continue whilst the promotions continue and thus inflate the apparent penetration rates.

Operators will have to work harder to gain and retain customers once NP is available. The experience in other countries is that operators increase their investment in their infrastructure (network, customer care and other services) and reduce prices in reaction to this pressure. This is because:

1. Pre MNP, operators, especially dominant operators, can maintain higher prices’ and lower levels of customer care because they know that customers who want to switch operators have to factor in the cost and effort of doing so. This makes customers much less likely to switch

and

2. The MNP experience is that, while good offers, lower price’, handset giveaways, etc. encourage customers to switch, it is the network quality / coverage and good customer care services that make them want to stay.

Therefore, RURA must consider the effect of MNP on their wider market issues than just on-net / off-net price differential and termination rates. These include:

- Will MNP increase operator investment in their networks?
- Will MNP increase operator investment in customer care services and product offerings?
- Will MNP increase the likelihood of more mobile operators entering the Rwandan market to increase competition?

### 2.5 Network coverage

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All three operators confirm that coverage of rural areas is not 100% either in geographic or technical terms. This lack of rural network coverage and/or quality is an issue that has to be recognised and, if introduced, MNP is likely to support an improvement in the area of network infrastructure.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thinking about your network coverage:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.a</td>
<td>Do you cover the whole country?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>1.b</td>
<td>If you have particular weak coverage areas, where are those?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>1.c</td>
<td>Can you provide a network coverage map or plan?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>
2. What switches and HLR equipment are you using?

2.a When were they installed

3. How many switch vendors do you use – who are they?

4. Could your switches perform onward routing for a ported out number without significant upgrade – onward routing requires the addition of a prefix indicating the serving network?

5. Could your switches perform All Call Query (ACQ) routing on calls originating on your network without significant upgrade – ACQ requires a look up in a database to determine the serving network of the called number?

6. Is your SMSC capable of delivering SMSs to imported or exported numbers without a significant upgrade?

<table>
<thead>
<tr>
<th>2G</th>
<th>2.5G</th>
<th>3G</th>
<th>3.5G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic coverage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTN Rwanda Ltd</td>
<td>99.08</td>
<td>99.08</td>
<td>54.67</td>
</tr>
<tr>
<td>TIGO Rwanda Ltd</td>
<td>87.9</td>
<td>87.9</td>
<td>8.89</td>
</tr>
<tr>
<td>AIRTEL Rwanda Ltd</td>
<td>72.60</td>
<td>72.60</td>
<td>6.29</td>
</tr>
<tr>
<td>Population coverage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTN Rwanda Ltd</td>
<td>99.90</td>
<td>99.90</td>
<td>71.14</td>
</tr>
<tr>
<td>TIGO Rwanda Ltd</td>
<td>99.53</td>
<td>99.53</td>
<td>46.53</td>
</tr>
<tr>
<td>AIRTEL Rwanda Ltd</td>
<td>90.30</td>
<td>90.30</td>
<td>12.40</td>
</tr>
</tbody>
</table>

Table 16 - Operator Questionnaire – MNP Network Questions

As with the mobile penetration and growth rates (see section 2.3) RURA provide an accurate picture of the operator’s network coverage for both geographic and population measures across a range of mobile technologies.

This shows that over 99% of the population have mobile service at 2.5G from two operators with over 90% of the population enjoying 2.5G coverage from all three operators. This is important to understand in terms of the freedom of choice that NP provides. In order to exercise choice people must have choices they can make. Also important is the level of literacy in the country as a whole, with over 70% of the population (15 years and over) literate. This figure again helps to understand the number of people who are able to take advantage of choices offered to them.

The significant rural population (80% of the total population) is a slight concern, as the rural areas are generally those that suffer most from the lack of universal network coverage or a good quality network. Some of the operator’s responses to the questionnaire confirmed this view. The customers (or potential customers) in rural areas will have a different set of
requirements from their mobile operators than those in urban areas who generally enjoy wider choices.

![Figure 6 – Five-year age/sex distribution of the resident population in rural and urban areas](image)

Confidential Text Removed

In addition, no operator made the direct connection between MNP implementation costs and infrastructure investment. However, all three operators stated their concern about the overall cost of the implementation without stating if any other form of investment would suffer as a consequence.

MNP does carry significant implementation costs for operators, see section 5. However, in every jurisdiction where we have any experience or have had any feedback, ex-incumbent operators or operators with SMP, or simply operators who do not wish to see MNP implemented, will argue that the cost of MNP implementation diverts funds away from network investment and thus shouldn’t be implemented. However, we have not identified any evidence to support this view.

In fact, InterConnect has had the opposite point-of-view stated to us in more than one jurisdiction – that the lack of MNP, or confirmed dates for the delivery of MNP, hinders decisions on investment in network infrastructure due to the uncompetitive nature of the particular market.

In summary, there is no evidence (apart from empirical) to support claims that implementing MNP increases network investment. However, what is true is that MNP (over time) increases the competitive nature of the market and therefore operators improve network quality / coverage as well as improving their customer care operations along with their prices and package offerings. People with direct experience of MNP (regulators, operators, vendors, and consultants,) constantly and consistently state that ‘it may be a price or a package that makes a customer switch, but it is the network quality / coverage and customer care quality that makes them stay’.

Whilst it is not possible to offer a list of benchmark data to support the argument on network investment either positively or negatively, operators in competitive markets will make
continuous efforts to gain and retain customers post MNP implementation, including investments in their network infrastructure.

2.6 Beneficiaries of MNP

When considering its options, RURA should take account of the evidence that the benefits of NP are wider than a customer retaining their number when switching operator. These benefits have been highlighted in several reports on NP, including “Mobile Number Portability in Europe” (Stefan Buehler, Ralf Dewenter & Justus Haucap - July 2005) which encapsulates the benefits in a very straightforward manner:

‘With switching costs, customers that actually switch (and thus give up their number) incur a utility loss. Also, switching costs induce some consumers to stick to a provider which is not their preferred choice. Introducing MNP benefits both types of consumers:

1A Consumers who switch even in the absence of MNP can retain their number (benefit 1A)

1B Consumers who switch only with MNP are more likely to obtain services from their preferred operator (benefit1B).

2 While MNP thus benefits consumers that actually switch, there are also benefits to non-switching consumers resulting from more intense competition among providers of mobile telecommunications services (benefit 2).

3 Furthermore, introducing MNP benefits consumers who place calls to ported numbers (benefit 3). Without MNP, these consumers have to update their address books, may be unable to call a particular user, etc.

4 Finally, introducing MNP benefits mobile customers because of the reallocation of property rights (benefit 4). The fact that MNP reallocates property rights in telephone number is especially important for so-called vanity numbers. If customers advertise their telephone number, this increases the number’s value and may be seen as a specific investment into the number’s value. Hence, a telephone number’s value is to some extent endogenous.

5 The incomplete contracts literature suggests that underinvestment results if the customer making the investment does not hold the property right in the number.

6 Hence, the reallocation of property rights strengthens the customers’ investment incentive.

This thickening of consumers’ property rights benefits all consumers – whether they actually port their number or not. The option to port one’s number is decisive here, and this option is given to every telephone user with MNP.’
So it is clear that the introduction of MNP benefits all customers who make or receive calls which are a significant portion of the citizens of Rwanda.

2.7 Port Rates

2.7.1 The Rwandan Market Size

RURA and the operators expressed concern about the overall cost of implementation of MNP in Rwanda. This is a relevant point and the overall potential costs, which are substantial, should be considered carefully by RURA before they make any final decision to implement or not.

Market size is often an issue raised by operators who believe that ‘their country’ is not ready for number portability, stating that, given the population and the penetration rate their market is not ready for MNP. However, taking the Rwandan population figure of 10.7million (Dec 2013) and the in service number, for GSM of 6.84m (March 2014) the Rwandan market is already bigger than many other jurisdictions that have launched MNP, as Table 19 shows.
### Table 19 - Examples of small jurisdictions launching MNP

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>(approximate) Population</th>
<th>Date of launch (MNP unless stated)</th>
<th>Solution chosen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyprus</td>
<td>800,000</td>
<td>2004</td>
<td>Distributed. Direct routing</td>
</tr>
<tr>
<td>Iceland</td>
<td>320,000</td>
<td>2005</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>500,000</td>
<td>2005</td>
<td>Centralised. F-M = indirect routing M-M = direct routing.</td>
</tr>
<tr>
<td>Malta</td>
<td>415,000</td>
<td>2006</td>
<td>Distributed. Direct routing</td>
</tr>
<tr>
<td>Channel Islands</td>
<td>150,000</td>
<td>2008</td>
<td>Centralised. F-M = indirect routing M-M = direct routing.</td>
</tr>
<tr>
<td>Isle of Man</td>
<td>80,000</td>
<td>2009</td>
<td>Centralised. F-M = indirect routing M-M = direct routing.</td>
</tr>
<tr>
<td>Bahrain</td>
<td>1,300,000</td>
<td>2011</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>54,000</td>
<td>2012</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>30,000</td>
<td>2012</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td>Qatar</td>
<td>2,100,000</td>
<td>2013</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2,700,000</td>
<td>2013</td>
<td>Centralised. Direct routing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F-M = Fixed to mobile calls; M-M = Mobile to mobile calls</td>
</tr>
</tbody>
</table>

#### 2.7.2 Port rate drivers

If MNP is implemented in Rwanda, one successful measure might be to achieve above what is commonly regarded (by the participants) as the expected annual port rate, whilst achieving port rates below expectations could be regarded as less than successful. But port rates depend on numerous factors. A low port rate, taken in isolation, cannot be used to signify a lack of success without taking into account other factors evident in Rwanda.

For instance, if customers are moving from operator to operator desperately looking for reasonable network quality and/or coverage, is that regarded as success? And if customers stay with an operator because that operator is continually improving their network and/or customer service or prices/packages, is that regarded as failure?
The factors that drive number portability vary from country to country and no two countries are exactly alike in this regard. Some of these factors are:

- Regulatory Environment
- ARPU
- Competitive Environment: (number of network operators, distribution of market share)
- Network Coverage
- Handset Subsidies
- Corporate versus Consumer use
- Pre-paid versus Post-paid
- Mobile Penetration
- Smart phone penetration
- Quality of service
- Cultural factors
- Price Elasticity
- Churn
- Value Added Service (especially mobile money)
- Price to port
- Ease of Process
- Contract duration
- Public awareness and public perception
- Rivalry amongst competing operators
- Service offerings
- Threat of new entrants
- Operator customer retention campaigns
- Handset subsidies and incentives

Many of these factors are discussed in this report, but some (such as cultural factors) will only be understood by the populace (including RURA).

Table 20 shows that there is no correlation between the various factors quoted and the port rate. This it is impossible to take one factor and use it to predict the likely port rate for an individual country and therefore use port rate as the measure of success or failure.
Saudi Arabia, for instance, seems to have all the ingredients for a port rate of about 2-3% when compared to Malaysia and Ghana, the two countries that are the closest in terms of populations. All three have an over 100% penetration rate and range from 78% to >99% pre-paid rate. However, Saudi Arabia has an annual port rate of 0.07%, whilst Ghana has a port rate of 1.6% and Malaysia a port rate of 3.4%. Ghana has a very simple porting process with no porting charges to the porting customer; it is also one of the fastest processes in the world so that customers are often ported in minutes. Confidential Text Removed

In Kenya, the service was launched before the operators were fully ready so there were some early porting problems for customers. This created a bad reputation for the service that has taken time to overcome. It also has a large mobile money service dominated by a single operator, so if customers moved from that operator they lost their mobile money service, resulting in many customers returning to this operator (who, incidentally, is also the dominant operator). Finally, it has reported a large number of dual SIM handsets in use as a recent article on Kenya (July 2014) states:

Kenya is lagging behind South Africa and Nigeria in mobile number portability (MNP) as just 362 in-ports were recorded in the East African nation from January to March 2014.

---

12 2013 data.
MNP -- which allows subscribers to change networks while retaining the same number -- was launched in Kenya in April 2011. But the prevalence of dual-SIM handsets has meant that MNP adoption rates have been low in Kenya, and a quarterly statistics report released by the Communications Authority of Kenya (CA) on Monday\(^1\) illustrates how MNP remains sluggish in the country. “Mobile Number Portability has shown mixed trends over time,” says the CA.

“During the period under review, the number of in-ports increased by 31.2% to stand at 362 in-ports up from 276 in-ports recorded in the previous quarter. “Conversely, relative to the same period of the previous year, a decline of 26.1% was recorded,” notes the CA.’

South Africa’s Number Portability Company (NPC) -- which is jointly owned by Cell C, MTN, Neotel, Telkom and Vodacom, and which offers mobile and geographic porting services -- posts regular statistics that point to a much higher MNP adoption rate in SA compared to Kenya. Regulations drafted by the Independent Communications Authority of South Africa (ICASA) kicked into gear in 2006 to spur on MNP among telecom providers in SA, and the NPC notes that the average mobile ports per month since 2006 have hovered around 24,939. “Since November 2006 to end June 2014 + 2,269,488 Mobile numbers have been successfully ported including port back and port on numbers,” says the NPC on its website.

Section 2.3 of this report explained that pre-paid customers are less inclined to keep their number if / when they churn (although MNP does not have a lasting effect on churn rates). However, Ghana has a pre-paid rate above 99% and their port rate since launch is around 1.6%, high for the sub-Saharan Africa region where other countries experiencing port rates of less than 1%. Conversely Saudi Arabia has a 19% post-paid percentage but their annual port rate is very low by international standards at 0.07%.

Through more than 15 years of technological maturity and implementation, MNP has seen both success and failures. In many cases, high porting rates has been the success. Hong Kong, South Korea and Australia are cited among the most successful implementations of MNP; however, they are vastly different markets to Rwanda. On the other hand, MNP in Ireland, India, Pakistan, Finland, Malta, UK and the Netherlands have fared less well, for many reasons, including high porting charges, long-winded applications, lengthy porting times and handset subsidies.

As previously discussed in this report, high annual port rates in themselves are not a good measure of the success or failure of MNP in a particular country. Nonetheless, one of the critical factors that do influence this measure of success or failure is the way the MNP process is implemented. RURA should note that, from experience in other countries including the above examples of poor implementations, we can outline some of the implementation conditions needed for a successful launch, which are:

- Low (or free) porting charges to customers
- Simple porting processes
- Short porting time scales
- No financially burdensome contractual ‘lock-ins’
- Recipient lead ‘one-stop-shop’ process
- Customer education

\(^1\) Report refers to the January – March 2014 period and was released by the Communications Authority of Kenya on Monday June 30\(^{th}\) 2014 and reported in a press release in July 2014.
These elements have been highlighted in a recent study ‘Mobile Number Portability in Developing Countries: Its successes and failures. Case Study- West African Sub-Region – November 2012’. This study stated the following:

Previous studies (Taylor & Baker, 1994; Keaveney & Parthasarathy, 2001) have found a link between service quality and satisfaction, between satisfaction and customer loyalty, and between customer loyalty and retention. Other studies (Jones et al., 2001; Bruner & Kumar, 2005) show that when a switching barrier exists, customers tend not to switch even when they are not satisfied with the service. Given these empirically demonstrated relationships, it is worthwhile to test switching intention under the MNP policy by analysing the effects of customer satisfaction and switching barriers on switching intention.

From the discussions thus far, the research framework is developed based on the following propositions:

i. Knowledge of the MNP Technology and usefulness
   (P1): Perceived usefulness of MNP has a positive effect on intention to use
   (P2): Perceived Ease of Use of MNP has a positive effect on intention to use
   (P3): Subscriber education and awareness has a positive effect on intention to use

ii. Forming an attitude towards its use
   (P4): Low Porting Fee has a positive effect on intention to use
   (P5): Short Porting duration has a positive effect on intention to use
   (P6): Low levels of subscriber lock-ins has a positive effect on intention to use

Ultimately, a strong and positive intention to use (the MNP service) has led to an actual adoption and usage decision.

Figure 7 – Research Framework

There are a good number of previous studies that have investigated the relationship between customer satisfaction and customer loyalty (Kim et al., 2004, Dick and Basu, 1994
and Reichheld, 1996); the relationship between customer satisfaction and call quality (Keaveney, 1995, Soderlund, 1998 and Gerpott et al., 2001); switching demand and MNP (Lee et al., 2004). However, the relationship between these factors and customers’ switching intention has not been discovered yet.

The propositions above are based on the relations among the factors. It must be noted that considering MNP is yet to be introduced in the Ghanaian mobile market\textsuperscript{14}, a more accurate forecasting can enable a better technology policy analysis and more effective industry response. Thus, the results of this study will contribute to the body of work surrounding MNP and explore viable alternatives to reducing switching barriers, increase churn rates and stimulate competition among MNOs – which are the core benefits of the service.

This study has provided a clear linkage between the implementation conditions needed for a successful launch, as highlighted above, and the intention to use the service which leads to the decision to actually use the service.

2.7.3 Rwandan Population Demographic

In assessing the potential annual porting volumes one of the interesting demographics\textsuperscript{15} to study concerns the 16-40 age group. This age group are more likely to be interested in and embrace new technology and to have the money to invest in it, including in their mobile service. They are also more likely to take an active interest in promotions and new products being offered, and are therefore more inclined to want to try the latest product or take advantage of the latest offer or promotion.

People younger than 16 may be even more inclined to take an interest in and embrace new technology but will not necessarily have the money to invest in it, being more dependent on their parents or guardians for their upkeep. Correspondingly, people older than 40 will have their own money to invest but are slower to embrace new technology or ideas (as a group). The general view is that as people get older they tend to use technology less, or are more modest in their use.

It follows then that the 16-40 age group are more likely to perceive MNP as a product that they can use to obtain the latest product / package / offer etc.

According to the NISR\textsuperscript{16} statistics (from the 2012 census) the population of Rwanda was 10,515,973, and SIM Registration Statistics from NIDA (National Identification Authority) as by 17\textsuperscript{th} July 2014 shows that:

- Total number of SIMs registered to date = 9,326,590
- Total number of people with SIM cards (registered to date) = 3,348,742\textsuperscript{17}

\textsuperscript{14} Although this study was published post the launch of MNP in Ghana in July 2012, the research was clearly undertaken prior to the launch.

\textsuperscript{15} Demographics are the quantifiable statistics of a given population. Demographics are also used to identify the study of quantifiable subsets within a given population which characterise that population at a specific point in time.

\textsuperscript{16} NISR “National Institute of Statistics of Rwanda”.

\textsuperscript{17} This figure contradicts the estimation done in section 2.4 where the number of unique subscribers was estimated to be 4.2M. However the difference can occur due to the fact that people (or other dependents) under 16 register their SIM cards through another person (often parents or guardians).
- Total number of SIMs registered (to date) to people between 16-40 years old= 4,012,184
- Total number of people with SIM cards registered (to date) between 16-40 years old= 2,685,724

All of these ‘SIM Registration’ statistics, as provided by NIDA, exclude the number of SIMs de-registered to date i.e. if a customer registers a SIM with MTN then, at a later date, ceases that service and registers a SIM with TIGO then that person will be on the database with two SIMs even though one is no longer active.

So the number of SIMs registered by total number or by number of people must be treated with some caution. However, taking that into account, we can address the percentages rather than the numbers and gain some insight into the market share enjoyed by the 16-40 year age group.

The total number of people with SIM cards (registered to date) of 3,348,742 is 31.85% of the total population (as supplied by NIDA) and is, we think, a low figure. The penetration rate calculated from the multi SIM use estimates provided by the three operators gives us an (average) penetration rate of approximately 40% (see section 2.4 for detail). Given this, the number of 16-40 year olds with SIMs equates to over 80% of the total number of people with SIMs. This may be a little on the high side so we shall assume a more realistic figure of 70%.

To see how this may affect the annual port rates we must compare this against some other Sub-Saharan African countries with MNP.

<table>
<thead>
<tr>
<th>Countries</th>
<th>Total Population</th>
<th>Total Population 16-40</th>
<th>Percentage population 16-40</th>
<th>Annual Port Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>25m</td>
<td>9.9m</td>
<td>39.6%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Kenya</td>
<td>41m</td>
<td>18.16m</td>
<td>44.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>176m</td>
<td>68m</td>
<td>38.6%</td>
<td>0.15%</td>
</tr>
<tr>
<td>Rwanda</td>
<td>10,515,973</td>
<td>4,239,897</td>
<td>40.32%</td>
<td>1% (estimated)</td>
</tr>
<tr>
<td>South Africa</td>
<td>50m</td>
<td>21.15m</td>
<td>42.3%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Table 21 - Percentage of people in 16-40 age group in sub-Saharan African countries with MNP

Accordingly, in terms of the overall population, the Rwanda percentage of people in the 16-40 age group is in line with the other Sub-Saharan countries that already have MNP. Nevertheless, we do not know the total number of those people with SIM cards in each of those countries, which may be higher or lower than Rwanda, but we do believe that a percentage of 70-80% of people with SIMs belonging to the 16-40 age group is very high and is unlikely to be exceeded in any of these other countries. We therefore believe that this will have a positive effect on annual porting rates in Rwanda.

### 2.7.4 Potential Rwandan Port Rates

Given this background, we have taken a view on what would be a reasonable expectation for port rates in Rwanda. Our view is influenced by these Rwandan factors:

- Is competitive (with 3 operators)
• Has a ‘headline’ penetration rate of (approximately) 65%
• Has a more realistic customer ‘in-service’ number of 4.265M (a penetration rate of approximately 40%) when multi SIM use is factored in
• 70-80% of all registered SIMs belong to people in the 16-40 age group (70-80% is the percentage when considering individuals not the total number of SIM cards registered (refer to section 2.7.3))
• Has a very high pre-paid rate of approximately 99%
• Has a low cost base for customer entry to market
• Has a growing mobile money market
• Has a high level of multi SIM use and a comparable churn rate

We conclude that an annual port rate of between 0.8% and 1.1% is a reasonable expectation in the early years. As network quality improves (including the move to 4G) and the penetration rates increase this figure may rise to between 1.1% and 1.4%. Our experience indicates that it would be unusual for it exceed 1.6%. Currently this equates to approximately 34,126 to 46,924 customer ports per annum in the early years rising to 46,924 to 59,721 ports per annum based on current penetration rates.

We simplify this estimate to a baseline figure of 1.0% of customers for calculations later in this report. This is approximately two thirds of the port rate achieved in Ghana (1.6% pa) which has higher termination rates, but like Rwanda has significant multi SIM use\(^{18}\) and double the number of networks (3 in Rwanda / 6 in Ghana). 1.0% of the current 6.836m active SIMs in Rwanda equates to approximately 1.6% of our estimated 4.265m "actual" customers which is close to the Ghanaian experience in terms of annual porting rates.

Given the pre-paid / post-paid split of 99% / 1% we anticipate that 10% of the ported numbers will be post-paid and 90% pre-paid as post-paid customers are more inclined to port their number as discussed in Section 2.3.

\(^{18}\) Confidential Text Removed
**3 Various Portability Considerations**

**3.1 Value added services (including M-Banking and M-Money)**

M-Banking is the ability of a customer to access and carry out transactions with their bank account from their mobile device. In some cases services providers make exclusive arrangements with individual banks that the services are only available from their networks. As such, operators can use the facility to discourage customers from moving to another operator.

M-Money is a service offered by some operators whereby a customer can deposit funds with their operator and then use their mobile device to make payments. Such a service is often seen in countries without extensive bank or ATM networks.

The responses provided during the data gathering for this analysis show that M-Money services have a significant take up in Rwanda.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Do you provide a mobile banking (M-Banking or M-Money) service?</td>
<td>Yes, Mobile Money</td>
<td>Yes</td>
<td>Yes Airtel Money</td>
</tr>
<tr>
<td>10a</td>
<td>If the answer to the above is yes, how many subscribers use this service?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>11</td>
<td>Do you provide Blackberry services, how many subscribers have Blackberry accounts?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>12</td>
<td>Do you offer any other high value type services?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>12a</td>
<td>Are these available by subscribers of other networks?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>12b</td>
<td>How many numbers do you have in-service with customers for these services?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

**Table 22 - Use of M-Banking and M-Money**

Mobile money services are in place in many countries, and are especially popular in Africa. This is due to the relative ease of access to mobile services and the lack of penetration of traditional banking services. There are 56.9 Million users of Mobile Money services in Sub Saharan Africa with almost 70% of mobile customers in the region using MM services the highest penetration in the world.\(^1\)

\(^1\) i.e. the cost of the call or the SMS text to the customer includes a payment for the goods or services accessed
In Rwanda all three operators offer competing mobile money services, accessed over USSD and available to all registered customers. These services have become an essential part of day to day life for many customers across all demographics.

MNP introduces a number of challenges into the Mobile Money space. In Africa the mobile operators have almost exclusively been the power behind the deployment of Mobile Money services. The operators have seen the MM services as another kind of Value Added Service (VAS) and in fact a particularly “sticky” one. The branding of the services, MTN Money, Tigo Money/Pesa and AIRTEL Money make it clear that these services are tied to an operator. In fact in Kenya it is made clear that if your port is from Safaricom to say Orange you will lose access to mpesa the dominant MM service in the country, this is made clear in their POS material due to the high number of port backs experienced when new ported in customers discover they have no access to mpesa.

The core driver for MNP delivery to increase competition and improve quality is quite severely impacted by the bonding of MM service to operators. This is most prevalent where one operator is a dominant MM supplier such as in Kenya.

3.1.1 What is the Impact for NP?

A customer porting will lose access to his MM service from the time that the port is completed. If no process to release the balance is in place the money held in the MM wallet will be in effect orphaned and the customer may be unable to access the funds without considerable inconvenience. This scenario is clearly unacceptable and would result in major disruption to the customer and a disproportionate effect on the porting process as hundreds of requests to roll back were processed.

In an environment where the MM service is firmly attached to the operator, particularly if one MM service is dominant MNP will be adversely affected. MNP may not prove to be as effective in meeting its goals of delivering competition and quality uplift.

3.1.2 What can be done?

1. Rule set. This must consider MM from day one; there are a number of options;

   a. The customer must be advised by the recipient operator to cash out his MM with the donor service prior to the port request. This is simple but may have limited effect. It also introduces a “win back” opportunity to the donor operator.

   b. An automatic “cash out” can be generated as part of the MNP process with the “cash out” code sent to the customer. This limited the ability of the donor to “win back” but does introduce a fraud vector.

   c. In conjunction with point 2 below a transfer of balance from MM of the donor to the MM of the recipient could be mandated in the rule set this is limited by the ability of the operators to interconnect their MM services via a payment gateway. This has a much lower fraud risk and poses the lowest barrier to true portability.
2. Interconnection – The regulators can mandate interconnection of the MM services. This would offer both ability of balances to be ported as part of the MNP process and provide stimulus to the MM market as the utility of the service would be expanded.

3. Porting of MM service, this is the optimal scenario where the MM service is “unlinked” from the operator and any MM service can be used with any operator. There are technical difficulties with this but it is a desirable long term goal. This would have major impact and involve considerable work with the relevant banking regulator.

3.1.3 Who else is impacted other than the customer and operator?

MM services are now the premier VAS services for most operators in Africa in terms of revenue; SMS is declining day by day eroded by over the top (OTT) services they are keen to grow the revenue and will resist any initiative to allow customers to use one service to reach all potential payees. Interconnection of MM services for this reason will be resisted by dominant operators. There is an ongoing requirement for the sector regulators to review the current position regarding interconnection in the MM services currently deployed. Failure to address this feature in the longer term will limit the effectiveness of MNP in delivering improvements in competition, choice and quality.

3.2 Machine-to-Machine

One of the growing uses of mobile numbers (MSISDNs) is in machine to machine (M2M) services. M2M normally refers to the increasing proliferation of mobile SIM cards in ever smaller cellular radio modules, being used in everyday objects to enable the 'Internet of Things', a connected world where machines communicate, report status information or manage themselves to a certain degree. Examples of M2M deployments may be:

- Smart metering for utility supplies billing
- Cars which can report their location to centralised fleet management systems, report when they have been involved in an accident or update their satellite navigation systems automatically
- Vending machines which report to central depots when they are low on stock and need a fresh delivery
- Webcams or remote CCTV
- Home automation (where no fixed broadband exists)
- Running shoes which report the user’s progress to central
- Road signs, traffic cameras, bus stops and other potentially off-fixed-network transport related objects which benefit from connectivity to be able to offer real-time information or tracking

Some countries issue numbers from their current range of mobile numbers for these types of services. In that case these numbers are no different from numbers being allocated for ‘normal’ mobile service use and, therefore, are portable under their existing regulations.

However, because of the predicted volume of numbers that will be required (3-5 per head of population is predicted by some industry commentators), and because these numbers are effectively unknown (not used by callers); some countries have issued ‘special’ numbers for this service. Some regulators have taken a spare number range and increased the number...
length; some to the maximum permitted, and allocated these numbers as for machine to machine services only.

3.2.1 Impact on NP

If the numbers are allocated from the existing mobile number ranges then they will be portable under the same regulations. However, if special, longer digit length, numbers are allocated then they will not be portable in the normal way.

However, in order to allow for competition in this market, provision should be made for a provider of machine to machine services to ‘bulk port’ their numbers from one network to another. This will allow the providers of machine to machine services to negotiate a ‘better deal’ either from their existing network provider or from another network provider.

3.3 High Value and Blackberry Services

High Value and Blackberry services can also limit MNP service take-up if the customers are tied into long term contracts or contracts where the customer has to pay a penalty (effectively the cost of the handset) for early termination. In most jurisdictions, an existing contract is not a reason to reject a port request, but the donor operator is entitled to recover early termination charges i.e. if a customer is six months into a twelve month contract then the donor cannot reject the port request but can invoice the customer for the remaining six months of the contract.

3.3.1 Impact on NP

RURA must be aware of any similar types of contract penalties and/or long term contracts and make provisions for them in the Business Rules if it is to implement MNP.

3.4 Handset Locking

The responses in relation to handset locking (see Table 23) are a concern in that some operators provide handsets to their own customers that are locked. This is an issue if MNP is introduced.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Are your mobile handsets locked/unlocked or both? Please specify the percentage.</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>17a</td>
<td>For prepaid services?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>17b</td>
<td>For post-pay services?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 23 - Handset Locking

Confidential Text Removed

When a customer ‘ports’ from one operator to another the new (recipient) operator has to provide the customer with a new SIM card (so that they are using the IMSI of the recipient
operator) as part of the process. However, if handsets are locked then the customer also requires a new handset.

To ensure that this does not become a barrier and prevent customers befitting from MNP, RURA need to include an ‘unlocking’ clause as part of the porting process. In many cases, Operators will argue that they have subsidised the handset and that they must protect their investment. In the cases of the (limited number) post-pay customers this is not an issue as permissible termination payments address the issue, see Section 3.5. RURA will need to include in the ‘Business Rules’ permissible methods for operators to recover pre-pay handset subsidies, or prevent the subsidies from being made²⁰.

RURA should also be aware that the data gathering for this report will have raised operators’ awareness of the possibility of MNP being introduced. There is therefore a risk that they may increase handset subsidies or other ‘lock-in’ activities before RURA’s regulations are promulgated and thereby hinder the introduction of MNP.

### 3.5 Contract Periods

The responses in relation to contract periods do provide some cause for concern.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Thinking about mobile post-pay 'contract' subscribers:</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>18a</td>
<td>What is your typical contract period?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>18b</td>
<td>What is your maximum/ minimum contract period?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>18c</td>
<td>What special enhancements do you use to attract subscribers to a longer period (e.g. special handsets, on-net discounts, enhanced calling plans, something else)?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 24 - Post Pay Contract Periods

This is vital information that will affect any MNP implementation. Whilst most MNP implementations do not allow a donor operator to reject a (post-paid) port order request because the customer is still in contract, that same donor operator is allowed to invoice the customer for ‘early termination charges’ on the existing contract. If the ‘normal’ contract period is 24 months rather than 12 or 18 months then those charges will be higher and may provide a barrier for the customer to port their number. However, post-pay customers account for just 1% of the overall customer base so this is not a serious issue.

The issue of contract periods is much wider than MNP, but the ‘Business Rules’ must include acceptable practices for contract periods and early termination charges. These aspects of the Business Rules must be aligned with other relevant RURA regulations and legal requirements on these topics.

²⁰ This is a topic with wider regulatory implications than MNP and is outside the scope of this report.
As we noted above RURA should be aware that, due to this report, the profile of MNP will be raised with the mobile operators with the result that they may start considering changes in their practices. If this manifests itself in long or onerous contract periods/conditions then RURA may have to take early action to support MNP and the customers’ ability to switch.

3.6 A simple validation process

Often the design for a Number Portability process starts with a requirement to establish a simple and efficient process, but, on occasion, this requirement has not been met, since participants in the project find it necessary to collect all sorts of customer validation information to be captured on the porting request. Experience shows that the more information that is collected and subject to validation the larger the fail rate of the requests. If porting requests fail (i.e. they do not reached approval) then porting will not take place. The porting request validation process thus becomes a barrier to MNP success.

The CEPT\(^{21}\) Electronic Communications Committee (ECC) recently published a Recommendation Paper on Number Portability – Best Practice, which provides in its list of recommendations the following:

‘5) That the NP process should be as short and efficient as possible.’

And goes on to state in sub section 5, ii;

‘The validation phase in the portability process (e.g. customer data verification by the donor operator) shall be as short and efficient as possible based on clear and stable parameters and the validation should be automated as much as possible;’

It also provides in recommendation No 7: ‘that the recipient operator should authenticate the porting request in an efficient manner, e.g. by collecting a written identification and/or authorisation (Short Message Service [SMS], e-mail or request on secured customer interface could be sufficient) from the customer before the porting is initiated………..’

An often stated blueprint for a sufficient set of information that leads to an efficient process is as follows (pre-pay as well as post-pay):

- MSISDN to be ported
- SIM card number belonging to the subscription
- ID-number (Residential customer) or Company Registration Number (Business Customer)

The ID-number may be a passport number, or a social security number, or a civil ID number. Preferably, it should be an ID-number that does not change over time (i.e. a civil ID number or social security number) as Passport numbers can change once the passport is out of date and renewed.

The SIM number provides inherent security since only the user of the SIM card and the donor operator that provided the SIM card have this information (referred to as ICCID according to the ITU-T recommendation E.118). Third parties, not even the recipient, are able to retrieve this information without the customer’s consent. Usually the ICCID is ink-

\(^{21}\) The European Conference of Postal and Telecommunications Administrations (www.cept.org)
printed on the SIM card. The ICCID is a unique identifier and it also identifies the current serving network.

Ultimately, it has to be accepted that no process is guaranteed to prevent misuse of the system. However, Rwanda should not look to copy countries that have attempted to make their system infallible by bringing in more and more validation requirements because what these countries have achieved is a process which customers find impossible to use.

The result is that MNP has failed to provide any improvement in the competitiveness of the market and has therefore been a waste of money and resource. RURA need to accept that there will always be a very small level of fraud and deal with that, without inconveniencing the majority of customers who will be trying to port their numbers honestly and appropriately.

3.7 SIM Registration

The questions in relation to records held on mobile pre-paid customers prompted the following responses.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Do you have records on your mobile prepaid subscribers?</td>
<td>Yes</td>
<td>Yes</td>
<td>yes</td>
</tr>
<tr>
<td>21a</td>
<td>If yes, what records do you have on your prepaid subscribers?</td>
<td>ID number, Names, location, age</td>
<td>Demographic, ID or Passport</td>
<td>Customer information</td>
</tr>
<tr>
<td>21b</td>
<td>Do you have SIM registration?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 25 - Records held on pre-paid customers

All the operators confirmed in our meetings, and in their questionnaire responses, that the process of SIM registration was undertaken in the last quarter 2013.

Presuming a successful completion of the registration process then, dependant on how SIM registration is conducted\(^{22}\); the SIM registration data is one way to verify customers who wish to port their number(s). Hence, it can be used to the advantage of the customer process. However, it would need to be addressed carefully in any inter-operator porting process as it can also be used to its disadvantage. If the customer SIM registration information is only held by the serving operator and the data quality is poor, donor operators can use the possible data mismatches to reject ports unnecessarily.

SIM registration is not the only customer validation method, although operators sometimes argue that it is a pre-condition for MNP in the knowledge that the process will take some time to complete, thereby delaying the implementation of MNP. Potentially the delay may be years as was the case in Nigeria where MNP was delayed for the completion of SIM registration, which took two years.

However, many countries have MNP without SIM registration. These countries put the responsibility firmly on the recipient operator to validate the customer, adopting processes

\(^{22}\) Whether there is a central database of information or whether operators only hold information on their own customers.
which oblige the recipient operator satisfy themselves that the customer is who they claim to be and has the right to the number they wish to port. If, subsequently, the port is found to be fraudulent, then the recipient must ensure that the customer is restored to the donor operator, with the recipient operator bearing the cost of that restore. As the recipient bears the cost of porting numbers (in most countries), they effectively incur a second cost without any incoming revenue for just ‘restore to donor’ activities resulting from fraudulent ports.

Other countries’ processes require the recipient to ask questions about usage of the number, (who did you last call? when did you last top-up your account? etc.), that the donor can then verify against their records. However, this can lead to false order rejections, where the customer’s recollection of events does not exactly match the donor’s records. Other countries attempted to combat possible fraud by using processes that are so complicated in that customers have found them impossible to use. Confidential Text Removed

3.8 Slamming

‘Slamming’ is the practice where the customer’s service provider (or network operator) is changed without their consent, denying the customer the right to choose who provides their service. Slamming’ is a way of mis-selling by malicious or fraudulent companies that regulators and operator should address. Customer awareness and education, legal measures, monitoring and enforcement are the key components for an anti-slamming policy.

Internationally, ‘slamming’ occurs mainly in fixed networks, with very little in mobile networks. In fixed networks, ‘slamming’ may manifest itself as follows:

- A fixed operator may take over a line from an incumbent operator. This may be done by misleading the customer on what is to happen;
- Customers that have a (pre)selected carrier are routed via other carriers, without their consent. This is also a matter of misleading of the customer;

‘Slamming’ is not necessarily linked to Number Portability, as the above examples are non-porting cases, e.g. in the USA most of the ‘slamming’ occurs with ‘interstate long distance telephone service’. Dishonest retailers can find ways, whatever the validation process, to abuse the porting system, so monitoring and enforcement are always important.

Some countries (e.g. UK and India), have adopted a donor lead process in an attempt to prevent ‘slamming’. This is less customer-friendly and can depress port volumes as the customer must contact the donor operator to obtain an authorisation code number before they can proceed with the port request. Donor operators can then try to persuade the customer from porting. Spain and Ireland have similar processes but a neutral third party issues the authorisation code denying the donor operator the opportunity to try to convince the customer not to port their number (retention activity). However the customer still has to contact two parties, the recipient operator and the third party.

The relative absence of mobile ‘slamming’ is due to the need for the customers to insert a new SIM in their handset. Thus, the customer knows that a change is occurring. There are no known examples of countries reporting high rates of mobile slamming, not even in countries that have simple validation processes including those without ‘physical visits’. Therefore, there is no evidence to justify onerous precautions against ‘Slamming’ for MNP.

Best practice is that customers should be informed that a porting request was received and that the recipient operator is initiating the process. This ensures that the customer knows a
porting request has been made and the status of the request. If the customer did not make the porting request the ‘slamming’ can be countered.

A standard method of informing the customer, suitable for Rwanda, is for the porting process to include the sending and receiving of SMS messages between the customer and a centralised order handling system. This has been adopted in Nigeria, Ghana, Kuwait, Qatar and other countries. For example the MNP Business Rules and Port Order Processes Documents in Nigeria specify that:

*The customer is requested to text the word "PORT" to a "free phone" short code number from their existing account (NB: This must be possible even if there is no credit left on a pre-paid phone.) The SMS is sent to the central order handling system by the SMSC of the donor operator using the SMPP protocol over the Internet.’*

and later states:

*During the initial central order handling system order validation phase the central order handling system will send one of two defined SMSs to the customer advising that either a) SMS 2 (Pass) their porting request has been accepted and is being processed or b) SMS 1 (Fail) their order has been rejected and advising the customer to contact the recipient operator’*

In summary, a process intended to prevent all instances of fraud is unlikely to succeed and will be so complicated and onerous for customers to use that it will actually prevent ports taking place and so will be self-defeating. The objective of MNP is to allow as many customers who wish to port their numbers legitimately to do so as easily and as quickly as possible.

RURA should follow the advice given in the ECC Paper21 and keep the process as short and simple as possible. This can be achieved by the use of SMS confirmation messages as described above.

### 3.9 Security Issues

In their feedback to the MNP questionnaire, and during the meetings, none of the operators identified state security issues as a concern. However, it has been a problem in at least one country recently. *Confidential Text Removed*

The issue is the ability of Security Services being able to identify the location and use of numbers (lawful interception). To achieve this Security Services have to be able to identify the mobile operator using a particular number at any given time. Without number portability, this is straightforward, as the initial digit(s) of a number will identify the relevant network even when the fourth or subsequent digit must be examined. Once number portability is available this is not the case and Security Services need an alternative method to identify the operator using a particular number at a particular time.

This is an implementation issue. During any implementation period, RURA will need to liaise with the appropriate Security Services to ensure that their needs are included in the porting processes and procedures. In a very limited number of countries this has led to a national security agency being involved in the actual processes. In jurisdictions where this has become an issue, it has usually been the case that the regulator did not involve appropriate security agency in the implementation decisions.
Normally access to a central database of ported numbers is sufficient to satisfy the needs of the security agency(ies).

### 3.10 Debt Management

All Operators are legitimately concerned to mitigate the risk of bad debts. Frequently they adopt a process that includes service suspension to encourage customers to settle outstanding invoices. The introduction of competition and additional operators can reduce the effectiveness of these measures as an indebted customer can transfer their service to an alternative operator. In countries with credit reference agencies, as Rwanda has, such customer behaviour is very limited as their bad debt is visible to the proposed new operator. Without these agencies, the potential for bad debts increases, although it is still limited because such a customer can only change their operator a limited number of times as previous operators will know of the debt and are likely to refuse to provide service.

**Confidential Text Removed** TIGO also explained that a Credit Reference Bureau exists in Rwanda which means that companies can research a customer’s credit history to ensure they have a good/acceptable record before a company decides if they are a suitable customer. Customers with an unacceptable record can be refused service. As described above, this minimises instances as their bad debt is visible to the proposed new operator.

**Confidential Text Removed**

An objective of NP is to simplify the process of customers moving from one operator to another. Frequently, operators fear that a consequence of this process will increase the risk of bad debts as post-pay customer change operators. InterConnect is not aware of any evidence, from any country that MNP increases the actual post-pay bad debt levels, compared to a competitive environment without portability.

Consequently, most MNP implementations adopt the principle that MNP is simply a service that allows a post-pay customer to cease service with one operator and take-up service with another. The fact that they are keeping the same number is not material to the ‘cease and provide’ process. Consequently, number portability does not increase or reduce the bad debt risk already present when customers change operator. Therefore, a porting customer should be treated in exactly the same way as a ceasing customer. Should that customer leave an unpaid invoice (bill) behind, the donor operator must use their existing debt procedures that they have established for pursuing ceasing customers who do not pay their final invoice.

For mobile numbers, this risk applies to post-pay (contract) customers and pre-pay customers with ‘airtime’ loans. Rwanda has a very low proportion (1%) of post-pay customers so that risk is very slight, especially as post-pay customers create a traceable credit history which can be checked via a credit reference agency. However, for pre-pay customers, it is not known how much is owed by any particular customer at any given time. Each operator will know their overall average debt exposure, but individual customer loans will fluctuate from time to time.

Consequently, if RURA decide to implement MNP then two courses of action are open to them in dealing with pre-pay customers with ‘airtime’ loans:

1. Not allow operators to loan ‘airtime’ money to customers – to treat customers purely as pre-pay customers or
2. To introduce a process (within the overall port order process) which allows operators to recover the 'airtime' loan at the time of porting.

### 3.11 Tariff Transparency

Telecommunications operators often use two call tariffs for customer outbound calls, one tariff for traffic (calls/data) between customers on its own network (on-net) and another tariff for traffic (calls/data) between one of its customers and another customer on another operators network (off-net). With number portability, a caller will no longer be able to use the dialled number to determine whether the contacted person is on the caller’s network or to the network of another operator.

Therefore, as numbers are ported from one operator to another, a method may need to be put in place to ensure that the call tariffs are still transparent to the calling customer i.e. if the calling customer is to be subject to a higher charge because the ported number is now classed as 'off-net', then the calling customer needs to be alerted to that fact and given the option to abort the call, without charge. If this is not the case then the unexpected higher call charges could become a barrier to use of the service.

In their responses to the questionnaire the operators provided the following information:

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Do you charge your customers more to call customers of other networks ('off-net') than you do to call customers on your own network ('on-net')? If so, what is the ratio of the charges for 'off-net' / 'on-net' call charges?</td>
<td>YES 60:45</td>
<td>Yes; it costs 2.4 times more to call off-net than on-net</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 26 - On-net / off-net price differentials

Further examination of this deferential provides the following data:

<table>
<thead>
<tr>
<th></th>
<th>On-Net</th>
<th>Off-Net</th>
<th>On-Net</th>
<th>Off-Net</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peak</td>
<td>Off Peak</td>
<td>Peak</td>
<td>Off Peak</td>
</tr>
<tr>
<td>MTN</td>
<td>45</td>
<td>45</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>TIGO</td>
<td>25</td>
<td>25</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>AIRTEL</td>
<td>20</td>
<td>20</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 27 - On-net / off-net price differentials at peak and off-peak

The Tariff table provided above demonstrates that Rwandan call charges for on-net and off-net calls differ for all operators, and by an increasing margin.

If RURA implements NP, then InterConnect believes that tariff transparency measures may be required as there is a significant price variation, although MNP may cause a competitive response by reducing the differential. To avoid the ‘bill shock’, a number of countries have introduced one of the following tariff transparency measures:
- A tone injected at the start of a call to a ported customer
- A voice message at the start of a call to a ported customer
- Different ringtones
- A text enquiry (by the calling customer) asking where a particular number resides
- An enquiry to an operator’s web site asking where a particular number resides.

None of these methods is particularly elegant, and the voice message is particularly annoying to customers (and is therefore rarely used), but they do allow a degree of advance warning for customers who do not want to receive unexpectedly high call charges.

The Questionnaire responses did confirm that termination rates are equal for all mobile operators.

The overall pricing regime means that it is not appropriate at this time for RURA to consider full portability between fixed and mobile services (Service Portability). Many countries have considered this but only the USA is known to have implemented it to date, because they have equal termination rates between fixed and mobile services. In the UK, Ofcom have allowed service portability for some years but no operator has offered it to customers because of the different termination rates (mobile termination rates are much higher than fixed). This is also true in many other countries.

### 3.12 Consumer Rights

Confidential Text Removed Table 28 summarises the responses.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>In some parts of the world, keeping your number when you change operator is a consumer right – should that be the case in Rwanda?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 28 - Number Portability as a Consumer Right

In our meetings with the operators TIGO stated that in their view “that porting should be a ‘consumer right’ but behind that right there should be rules of conduct”. AIRTEL stated that it should be a consumer right. However, MTN stated the following;

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In a number of countries and for the 28 EU countries in particular, the consumer right to retain their number when changing operator is the overriding reason for number portability, and takes precedence over all other issues.

In the EU, NP is an absolute legal requirement. EU Universal Service and Users’ Rights Directive (2002/22/EC), Article 30 (effective since July 2003) states that Member States shall ensure that all customers of publicly available telephone services, including mobile services, who so request, can retain their number(s) independently of the undertaking providing the service:

- In the case of geographic numbers, at a specific location;
In the case of non-geographic numbers, at any location.

In 2009 the EU updated some Article 30 clauses as follows:

1. **Member states shall ensure that customers with numbers from the national numbering plan who so request can retain their number(s) independently of the undertaking providing the service in accordance with the provisions of Part C of Annex 1.**

2. **National regulatory authorities shall ensure that pricing between operators and/or service providers related to the provision of number portability is cost-orientated, and that direct charges to customers, if any, do not act as a disincentive for customers against changing service provider.**

3. **National regulatory authorities shall not impose retail tariffs for the porting of numbers in a manner that would distort competition, such as by setting specific or common retail tariffs.**

4. **Porting of numbers and their subsequent activation shall be carried out within the shortest possible time. In any case, customers who have concluded an agreement to port a number to a new undertaking shall have that number activated within one working day.**

### 3.13 Number Repatriation

There is an issue around the subject of ported numbers that become spare because the customer has ceased service for whatever reason. Under these circumstances, it is usual to have it built into the MNP Business Rules that the number is returned to the Range Holder operator i.e. the operator that has been allocated the number range that the ported number belongs to.

There may be rules in place about quarantine periods, clauses designed to cater for customers who may change their mind and want their number reinstated, but the underlying principle is that an imported number that becomes spare is not available to the recipient operator for re-issue to a new customer. It must be returned to the range holder operator, who, after a set period, can return the number to their pool and make it available for re-issue to a new customer.

*Confidential Text Removed*

The fact that an NRA charges Fees for numbers raises the issue of compensation for numbers exported to other operators (although interestingly there is never an issue raised about paying more for numbers imported). However, unless the NRA has a very dynamic number management system it is not possible to reconcile numbers on a weekly or monthly basis, and it is an overhead to do the reconciliation on an annual basis – the cost outweighs the benefit. Most NRAs take the view that operators will gain numbers as well lose numbers and it is not viable to reconcile the small differences which must be regarded as ‘the cost of doing business’.

### 3.14 Number usage

The questions in relation to the usage of numbers can also have a bearing on whether MNP is implemented or not. If number exhaustion was shown to be imminent then RURA would need to consider what steps to take to increase the resource prior to the introduction of
MNP. Changes to a National Number Plan are always complicated and costly, and if MNP is already in place the complications (and possibly the costs) are increased.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>What is your current allocation of mobile numbers?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>5a</td>
<td>How fast is this being exhausted?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>5b</td>
<td>When do you believe you will need to apply for more numbers?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 29 - Number allocations and usage

The operator response to these questions and the discussions held during the meetings in Kigali make it clear that they do not believe there is any mobile number resource issue. However, MNP has been shown to assist in number conservation where that is an important national factor.

3.15 Current arrangements for switching customers

The responses in relation to the help given to customers who wish to churn currently without MNP but keeping their number are interesting. All three operators will offer a customer the matching number from their own range so only the leading digits are changed (see Table 30). These measures obviously assist a customer who wishes to port their number; however, this does not alter the underlying difficulty of socialising a number change to family, friends and colleagues, as the initial digits that must be dialled have changed. It also has a negative impact on the number of numbers available for allocation to new customers.

Despite comments from at least one operator doubting the customer demand for Number Portability, the fact that this service is provided by all operators demonstrates that (at least some) customers do value their numbers and want to retain them when they change operator. Collectively and individually, the operators are acknowledging that retaining a number when switching is a recognised customer requirement and one that should be encouraged.

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Do you do anything to assist a customer who wishes to join you but does not want to change their number?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>26a</td>
<td>Do you try to provide a matching number?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>26b</td>
<td>Do you provide any contract waiver for post-paid customers?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>26c</td>
<td>Do you provide a rebate for pre-paid customers?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 30 - Numbers for Switching Customers
3.16 Future Trends

The future of number portability is ambiguous and many commentators have expressed opinions on MNP implementations and their future.

‘In many countries worldwide, and EU countries in general, the demand for number portability is increasing although consumers are generally unaware of its costs

The popularity of number portability varies among Member States. In Malta, Belgium, Denmark, Spain, Ireland, Finland, the Netherlands and Italy more than 5% of subscriptions were migrated using number portability. During the same period, the ratio was below 1% in Bulgaria, Germany, Hungary, Portugal and Romania. At the EU level there was a slight increase from 2.9% to 3.4% between 2010 and 2011.’

![Mobile number portability transactions as a % of total subscriptions, 2011 (Jan-Sept) - 2012 (Jan-Sept)](image)

Source: Communications Committee

Figure 8 - MNP transactions as a % of total subscriptions 2011-2012

‘Most regulators regard portability as a user right, yet assessments of portability continue to be based on its effects on prices and competition’

The underlying reason is that operators, especially ex-incumbents and/or those with SMP, who traditionally are less enthusiastic about NP, demand that the regulator ‘prove’ that the consumer will enjoy a cost benefit from the initiative. This has led many regulators to conduct such studies. To date, none has shown a direct cost benefit to consumers, which is probably why some operators insist the regulator carries out such a study.

One of the most recent examples is the Adam Smith International ‘Regulatory Impact Assessment of Mobile Number Portability’ which was carried out in 2012 on behalf of the Botswana Regulator BTA. This was an extensive study that included a very detailed cost benefit analysis which showed that (currently) MNP would carry no cost benefit for the consumers of Botswana.

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Within the EU, this has been addressed by enshrining consumer rights into EU law which overcomes the 'cost benefit' argument. It is no longer an issue just of cost, although cost is always a factor that must be considered.

‘Improvements in regulations, such as lower termination rates, should make a market more ready for number portability’

Regulators have a responsibility to ensure that their market place is as competitive as possible. Enforcing lower termination rates is one of the ways that the regulator can achieve this; however, actions taken by a regulator should be seen as cumulative in their effect.

Lowering termination rates should not be considered ‘instead of MNP’ but in parallel. Initiatives such as MNP and lower termination rates are not mutually exclusive but will increase the effect of each other within a competitive market.

‘The costs of implementing number portability are falling as next generation network technology can support it easily and many modern systems have the support of portability included’

This reinforces the notion that MNP should be implemented in parallel with other competitive measures.

However, the mobile number portability experience of other countries needs to be considered in terms of the conditions that exist in Rwanda including:

- A high percentage of customers are prepaid;
- Low to medium Average Revenue Per user (ARPU);
- Customers tend to have prepaid services with multiple operators with resultant comparable churn rates
- Projected low porting rates;
- Infrastructure roll-out into rural and/or remote areas.

In the past, this combination of factors has led countries to the conclusion that introducing MNP is not viable, with the predicted costs outweighing the corresponding benefits as discussed above.

However, there are an increasing number of countries successfully implementing MNP despite a projection of low porting rates and / or with small populations (by international standards). These countries have had to be realistic about the immediate cost effectiveness of the solution adopted and consider the wider benefits and range of options available.

Over the past few years, MNP has been viewed as essential for competition. However, the benefits of number portability are changing over time:

- Greater availability of the Internet makes informing others and finding numbers much easier - so changing number becomes less of a problem;
- Operators can send SMS messages to all the numbers on the SIM card to tell the customer’s contacts about the change of number;
- People are becoming less dependent on telephony/ text for communication and more on email, instant messaging, social networking;
• Competition is making networks more efficient and coverage better, so the remaining scope for continuing improvements is reducing;

• Other barriers to changing operator such as Smartphone/Blackberry services, mobile money and exclusive value added services are increasing;

• There is less use of pre-printed stationery as many companies print letters and invoices with letterheads from colour printers and the templates can be changed easily.

3.17 4G and LTE Technologies

4G and LTE technologies are defined as follows:

'4G, short for fourth generation, is the fourth generation of mobile telecommunications technology, succeeding 3G and preceding 5G. A 4G system, in addition to the usual voice and other services of 3G, provides mobile ultra-broadband Internet access, for example to laptops with USB wireless modems, to smartphones, and to other mobile devices. Conceivable applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

In March 2008, the International Telecommunications Union-Radio communications sector (ITU-R) specified a set of requirements for 4G standards, named the International Mobile Telecommunications Advanced (IMT-Advanced) specification, setting peak speed requirements for 4G service at 300 megabits per second (Mbit/s) for high mobility communication (such as from trains and cars) and 1 gigabit per second (Gbit/s) for low mobility communication (such as pedestrians and stationary users).

Since the first-release versions of Mobile WiMAX and LTE support much less than 1 Gbit/s peak bit rate, they are not fully IMT-Advanced compliant, but are often branded 4G by service providers. On December 6, 2010, ITU-R recognized that these two technologies, as well as other beyond-3G technologies that do not fulfill the IMT-Advanced requirements, could nevertheless be considered "4G", provided they represent forerunners to IMT-Advanced compliant versions and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed".

Mobile WiMAX Release 2 (also known as WirelessMAN-Advanced or IEEE 802.16m') and LTE Advanced (LTE-A) are IMT-Advanced compliant backwards compatible versions of the above two systems, standardized during the spring 2011,[citation needed] and promising speeds in the order of 1 Gbit/s. Services are expected in 2013.

As opposed to earlier generations, a 4G system does not support traditional circuit-switched telephony service, but all-Internet Protocol (IP) based communication such as IP telephony. The spread spectrum radio technology used in 3G systems, is abandoned in all 4G candidate systems and replaced by OFDMA multi-carrier transmission and other frequency-domain equalization (FDE) schemes, making it possible to transfer very high bit rates despite extensive multi-path radio propagation (echoes). The peak bit rate is further improved by smart antenna arrays for multiple-input multiple-output (MIMO) communications.

The term "generation" used to name successive evolutions of radio networks in general is arbitrary. There are several interpretations, and no official definition has been made despite
the consensus behind ITU-R's labels. From ITU-R's point of view, 4G is equivalent to IMT-Advanced which has specific performance requirements as explained above. According to operators, a generation of network refers to the deployment of a new non-backward-compatible technology. The end user expects the next generation of network to provide better performance and connectivity than the previous generation. Meanwhile, GSM, UMTS and LTE networks coexist; and end-users will only receive the benefit of the new generation architecture when they simultaneously: use an access device compatible with the new infrastructure, are within range of the new infrastructure, and pay the provider for access to that new infrastructure.'

Impact on MNP

InterConnect has recommended that a 'centralised automated solution, which includes a central reference database updated automatically from the order handling function of the centralised solution, and used for direct routing, is the correct one for Rwanda' see Appendix B. One of the reasons this is suitable as a future proof solution is the fact that it is designed to be 'technology neutral' so that, as new generations of mobile technology are developed, the centralised system will remain viable. As stated elsewhere in this CBA, mobile number portability is concerned with the numbers customer’s use, not the underlying technology which different operators may adopt.

This view is supported by the various ETSI/3GPP technical documents which are available to download, and have particular relevance to MNP – ETSI TS 122 066, ETSI TS 123 066, 3GPP TS 23.140, 3GPP TS 23.066 and in particular (to LTE) 3GPP TS 23.002 which states the following:

4a.6.1 IN-based solution: Number Portability Database (NPDB)

The Number Portability Database (NPDB) is the central element of the IN based solution for Mobile Number Portability (MNP). MNP is the ability for a mobile customer to change the GSM subscription network within a portability cluster (e.g. a country) whilst retaining his/her original MSISDN or MSISDNs.

The NPDB stores the table of correspondence between MSISDNs and Subscription networks. Upon request of the (gateway or visited) MSC, the NPDB retrieves from the MSISDN the Routing Number pointing out the Subscription network.

6a.6.1.1 NPDB to MSC interface

Upon receiving an ISUP IAM, the (gateway or visited) MSC send a database query to the NPDB as a result of analysis of the received MSISDN. The MSISDN is included in the query to the NPDB. The NPDB determines whether the MSISDN is ported or not. If not, it responds back to the MSC to continue the normal call setup procedure for MT calls (optionally providing the Routing Number).

If it is ported, the NPDB responds back to the MSC with a Routing Number pointing out the Subscription network.

4G or LTE, whilst providing the customer with an enhanced suite of products, does nothing to suggest that this development (or series of developments) will in any way change the fundamental use of mobile numbers. It may prompt higher usage and higher penetration over time, due to increased competition and lower prices, but this is part of a general growth
pattern. There may also be the need for enhanced ‘handset’ development due to the availability of an improved suite of products.

None of these will affect the Mobile Number Portability product as currently envisaged.

However, mobile operators may request specific number ranges be allocated for the launch of 4G or LTE data services to differentiate between the new services and the old. This in itself is not an issue for this mobile number portability CBA; however, RURA needs to ensure that portability is allowed between the services, so that customers can take advantage of the technical advances whilst retaining their existing number.

3.18 MNP for MVNO Operators

One of the ways that MNP can improve the competitive environment in Rwanda is by encouraging more operators to begin service thereby increasing choice for customers, and one of the common ways for this to happen is by RURA facilitating the introduction of Virtual Network Operators in the Mobile sector (MVNOs).

The existence of MVNOs will have an impact on the MNP implementation depending on how the MVNOs are facilitated (at a wholesale basis) by mobile network operators. In general there are two models that may be applied:

1. The MVNO has numbering resources (MSISDN ranges) allocated directly by RURA, and has the status of ‘operator’. In the MNP process the MVNO is then to be identified and involved as a potential donor and recipient network operator, like any of the current mobile network operators'. Such parties, assuming they have implemented their own core network infrastructure are often referred to as 'full MVNO';

2. The MVNO does not have numbering resources allocated by RURA, but makes use of numbering resources of the Host Mobile Network that the MVNO has the wholesale agreement with. Such MVNOs act as a reseller or a service provider of the MNO network service. The porting process for such cases will be managed by the Host network that will execute number porting (either as a donor network operator or as a recipient network operator) on behalf of the service provider or reseller. The reseller/service provider will be referred to e.g. as ‘recipient service provider’ or ‘donor service provider’.

In countries where mobile wholesale services are very common, all roles involved in the MNP process will be specified in the Porting request procedure i.e. Recipient Service Provider, Recipient Network Operator, Donor Network Operator, Donor Service Provider.

As guidance for MNP implementation for MVNOs the following next steps apply:

a) Define MVNO models for Rwanda, and analyse ‘ownership’ and ‘allocation rules’ for numbering resources in these models;

b) Prepare (or Update) MNP process description and specification, MNP Business Rules etc. to support MVNO mobile number porting,
c) Define central System requirements for MVNOs Mobile Number Porting and design, test and implementation in central system

MVNO/Wholesale MNP requirements should be taken into account in the initial phase of delivery of the Central MNP system.
4 NP Implementation

A regulatory obligation to implement number portability inevitably requires operators to develop their networks and processes. The extent of these developments is related to the form of number portability that is being implemented, but nonetheless they will be significant.

The section on Cost Recovery Principles (Appendix D) states that it is usual practice for each operator to bear its own costs of establishing number portability on its network (as this meets the regulatory principles of cost minimisation and promoting effective competition).

This section details the likely development areas within a mobile operator that are required in order to support MNP. These include internal network and process changes as well as contributions to the implementation of external organisations or systems, such as a Central Reference Database and a Number Portability Clearing house, as well as the links and processes between the operator and such entities.

The specific operator costs of establishment will vary depending on the type of MNP implemented and the following sections of this report detail the different development areas relevant for each type of implementation. This section considers three different types of implementation. InterConnect believes that it is very probable that a central reference database would be used in Rwanda in any future implementation of MNP because it is international best practice.

4.1 Per Operator System Set–up

Individual mobile operators need to establish their own internal capability to offer MNP to customers in advance of the service being taken even if, at first, there are only a small number of porting customers. This applies if the mobile operator is not intending to recruit customers using number portability – portability may be required in the other direction. In fact the ‘obligation’ is usually focused on an operator allowing a customer to leave them (export), rather than forcing an operator to import a customer.

This will mean significant developments to their network hardware and software (including the installation of new equipment such as databases), as well as modifications to existing processes (new customer provisions or ceases as a result of porting), and the development of new processes (such as inter operator processes, or processes between them and a clearinghouse). These developments are described in more detail in the sections below.

4.2 Operator Network Development Areas

The actual development areas of each operator will be specific to their current network structure. Likely areas include, but are not limited, to:

Existing switches may need modification in order to route calls to ported numbers according to the chosen solution. Such modifications may involve software and/or hardware upgrades to manage links to routing databases.

If a central reference database solution is used for All Call Query (ACQ) routing, each operator will require an internal database, which may already exist as of existing switches, e.g. HLRs. This database will need to be set up in the operator’s network, with links to switches in order for calls to route efficiently. This implementation is shown in Figure 9 below and may comprise of:
- additional hardware and software for the database and its gateway to the central database
- links to network elements, such as switches
- links to the central reference database

Figure 9 - Network Gateways will be required in each operator’s domain

- Physical links will need to be deployed to or between specific order handling systems for NP. These may be separate internal systems if the order handling is being affected manually or links to the clearing house if one is being used.
- The modification of NP may cause different patterns of traffic within and between operators as customers move between them. Traffic forecasts are used to plan network capacity rollout and therefore traffic on the network will need to be re-forecast in the light of the number of ported customers. Network capacity rearrangements may be required.
- The amendment of NP brings with it the opportunity to develop new reciprocal inter-operator services for number portability (including ‘automated’ timed and dated porting, and multiple line porting) to support the requirements of the recipient operator through an order handling hub. As a result, documentation of number portability service establishment should be considered in order for new operators to provide services to their customers as effectively as possible. In some countries, an end-to-end process manual has been developed by the operators to manage number portability between them via the hub.

If the call routing solution chosen uses a combined centralised reference database, a decision needs to be taken as to whether details of all ported numbers are downloaded by all operators. This will have cost implications – there is a trade-off between the size of the operators’ internal routing database, and more cost effective routing options (see Appendix B).
4.3 Operator Process and System Development Areas

Mobile operators will need to develop new processes to manage number portability. Some of these processes will currently exist and only require to be modified to accommodate MNP. Other processes will be entirely new and need complete development. Figure 10 below provides a representation of the typical process requirements.

![Business processes impacted by MNP](image)

The introduction of MNP impacts a wide range of established business processes and introduces new processes.

Issues to be considered in the development of MNP procedures from existing processes include, but are not limited to:

- Handling of porting requests through existing customer channels (by phone to customer help desk, in operator retail outlets, and online)
- Customer verification in order to check an authorised porting request
- Handling of requests from another operator to port a customer out
- Bulk porting for business customers
- Subsequent porting.

If customer care is seen as a distinct process, the customer care system may include fault reporting as well as order handling. Number portability will need to be included in this system.

Operational Support Systems (OSS) and Business Support Systems (BSS) may require modifications to recognise the difference between the original operator and current (or ported) operator and to include details of the network location of the new numbers.

The introduction of MNP requires an assessment of current operational and business systems. Issues that operators will need to consider are:

- Are existing OSS and BSS systems able to accommodate any additional information which needs to be recorded as part of the porting process? If not, what modifications
are necessary, how long will they take, who will make the changes and how much will that cost?

- Is new OSS or BSS required as a result of the introduction of MNP? If so, what is the specification of the new system(s), who will provide them, how long will it take for them to become operational and how much will they cost?

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<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Are the following systems capable of handling imported numbers, numbers from a number range allocated to another service provider imported on to your network?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>1.a</td>
<td>Customer support system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>1.b</td>
<td>Retail billing system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>1.c</td>
<td>Prepaid credit management system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>2</td>
<td>Are the following systems capable of handling exported numbers, numbers from a number range allocated to you but exported to another network?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>2.a</td>
<td>Customer support system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>2.b</td>
<td>Retail billing system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>2.c</td>
<td>Prepaid credit management system?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>3</td>
<td>Are the following systems capable of handling MNP orders (import and export)?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>3.a</td>
<td>Customer Services Centre Systems?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>3.b</td>
<td>Shops Systems?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>3.c</td>
<td>Dealer Systems?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>4</td>
<td>Do you allow ‘Remote SIM Swap’?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>5</td>
<td>Are there any other CSS/BSS systems that you believe will be affected – what are they?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 31 - Operator Support System readiness
Whilst the set up costs of portability are not recoverable from other operators, some parts of any new systems may be used for on-going MNP administration, the costs of which may be recoverable from recipient operators. The distinction between the developments required to set-up the capability and that required for its on-going administration is important. Regulators must take care that the total cost of such OSS or BSS replacement is not completely charged for as part of any cost recovery for administration of MNP if the systems can also be used for the support of other services within the operator.

The billing system will need to be modified to include inter operator charges for number portability services and management of any new charges to customers of fees for porting.

An operator’s number management system will need to be modified to recognise that individual numbers or blocks have been ported out or ported into their network.

In the maintenance area, technical procedures for porting need to be included in fault reporting and restoration procedures, including links to either internal or centralised databases, the distributed routing database, and existing systems which have been modified for porting.

Information and links to directory services need to be considered with the introduction of MNP.

MNP brings with it the need for inter operator procedures which are new and need to be developed completely. Distinct contacts need to be maintained between operators to manage issues such as administrative and operational issues and management of portability activation, deactivation or modification. If a manual order handling approach is implemented then bilateral agreements will need to be negotiated between operators for their management of MNP.

The development of new processes requires time and effort by an operator and includes the following steps:

- An assessment of what the process should achieve
- What steps are required to complete the process
- What systems are needed to effect the process – do they exist or need to be developed?
- Who should be performing the process? What are they also doing which may be affected by the introduction of new processes for number portability?

Once the process is developed

- What training is required?
- Testing should be carried out.

Therefore, in effect, there is a process to go through in order to develop a process and this takes time, effort and money for the process and system development, and for staff training.

If a new clearinghouse solution is to be set up for the MNP implementation then the process development would need to be established with no help from existing processes or experience which may take longer to implement.
4.4 Development Areas for a Centralised Database

International best practice is clearly to use a central reference database and Rwanda should adopt this approach if MNP is mandated. Such a MNP centralised database will require developments including, but are not limited to:

- Specification of the database and its interfaces with operators
- Tender and contractual processes to obtain the database
- Establishment of the database and its links to those operators using it
- Testing of the database and it’s downloads to operator’s distributed databases.
- Pre-population of numbering information if necessary according to the chosen solution
- Developments for disaster recovery as appropriate.

4.5 Development Areas for a Number Portability Clearinghouse

A centralised clearinghouse solution is also international best practice, frequently combined with the centralised reference database. RURA should adopt this best practice and the following development areas will be required:

- Specification of the clearinghouse and its interfaces with operators
- Tender and contractual procurement process to obtain the clearinghouse
- Identification and negotiation of the processes required to be provided by the clearinghouse
- Establishment of the clearinghouse, the processes and its links to operators and the centralised database
- Testing of the clearinghouse and its processes in conjunction with the associated order handling systems and links with fixed operators and service providers
- Appropriate developments for disaster recovery.

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24 The Number Portability Clearinghouse (NPC) concept is fully described in Appendix A of this Study.
5 Implementation Costs

This section of the report details the cost areas related to the development areas described in Section 4.2. Actual cost figures will depend on the nature of the implementation of MNP and the structure of the operator’s networks and systems as well as the nature of any centralised reference database and/or clearinghouse solution.

The recent study (written by Adam Smith International) ‘Regulatory Impact Assessment of Mobile Number Portability’ completed for the Botswana Regulator (BTA) concluded that: ‘The Regulatory Impact Assessment shows that the benefits of mobile number portability, with all operators required to export and import numbers, are most unlikely to outweigh the costs and so there is no economic justification for requiring mobile number portability. An alternative requirement on the larger operators to port on request as a competition measure also does not show a net benefit at present although it performs better.’

Actually, our experience is that no purely cost based study of this type has ever shown an economic justification for MNP. As with other similar regulated services such as LLU and CPS, the costs will outweigh the demonstrable financial benefits.

However, in their report on ‘The Impact of Mobile Number Portability on Price, Competition and Consumer Welfare’25 (May 2013), the authors state the following:

‘MNP in Europe has been mandated by the European Commission and enacted in each country as an exogenous shock. In fact, we perform a number of tests showing that the introduction of MNP is unrelated to local market conditions. Using quarterly data from 47 mobile carriers in 15 European countries between 1999 and 2006, we show that MNP intensified competition leading to an increase in consumer surplus. On average, the introduction of MNP decreased price by 7.9%. Policies that require faster and cheaper MNP were also more effective in this respect. Furthermore, market followers seem to have decreased price more than incumbents did when MNP was introduced. MNP also increased competition by reducing the incumbent’s market power and by tightening the range of prices practiced. We measure changes in consumer surplus by estimating the price elasticity of demand. Our results suggest that, on average, MNP increased consumer welfare by 2.86 euros per person. Our study shows that MNP is an effective policy to reduce price and increase consumer surplus and that the European experience can be used as an example of a best practice by other countries that plan to introduce MNP in the near future.’

By looking at MNP retrospectively we can see that, apart from the expected consequences of introducing MNP (increased competition, decreased prices, and reducing incumbent’s market power) we also see that ‘MNP increased consumer welfare by 2.86 euros per person’.

This benefit is, of course, not quantifiable in advance. In addition, the report quoted above looks at a geographic region (the EU) rather than an individual country as most other studies have done, including the Adam Smith study also quoted above. It therefore provides a new insight into the financial impact that MNP can deliver over time.

5.1 Operator Set-up Costs

Operators will incur capital and operating costs from the development areas identified in Section 4.2. These costs are fixed and do not depend on the number of ports which occur once the system is set up. On-switch routing solutions (such as onward routing) are generally less costly to implement than off switch solutions (such as All Call Query). Conversely, on-going costs for porting using on switch solutions tend to be higher than those for off-switch solutions see Appendix B.

For the purposes of this report, off switch solutions have been considered as they have more efficient call routing26. Capital cost items for such an implementation may include:

- Switch hardware and software upgrades
- Distributed database hardware and software
- New OSS and BSS systems
- Equipment for physical links between:
  - An operator’s own network elements and its distributed database
  - An operator’s distributed database and the centralised reference database
  - An operator’s OSS and BSS and the clearinghouse, as appropriate

Operating costs for NP include:

- Modifications to OSS and BSS as required
- Staff time spent negotiating, developing, documenting and testing new porting processes:
  - Where manual processes are used, bilaterally between operators
  - Where a clearinghouse is used, between the operator systems and the clearinghouse
  - Including technical standards and processes such as the agreement of protocols for message passing, agreement of test plans for establishing that MNP interfaces are working and so on.
- Training staff on all new processes
- Producing documentation informing customers about portability
- Sending appropriate staff to industry working groups during the set up phase of portability

These costs have to be met by the operators’ existing revenues and the time found during ‘business as usual’ activities.

There is a crude (and very approximate) trade-off between set-up costs (and implementation time) and on-going direct (administration and routing) costs, which varies with the

26 This solution delivers efficiencies for all functionality – SMS, data and voice. However, there are issues for international incoming calls and SMS/data. This is why the implementation needs to include fixed line operators and international gateway operators.
implementation approach adopted. Very broadly, the administration and routing techniques that are fastest and cheapest to implement incur the greatest costs per port or per call in the medium to long term. For instance, “call forwarding” is probably the easiest and quickest routing solution to implement, thus it has low set-up costs. However, it is one of the most inefficient routing solutions per call and therefore has the highest routing costs.

The relationship between set-up and on-going costs has been further examined by Stefan Buehler, Ralf Dewenter & Justus Haucap\(^\text{27}\). They state:

“Comparing the direct costs of the various technical solutions, we note that on-switch solutions are characterised by comparatively low fixed set-up costs and high variable costs. In contrast, IN (intelligent network) solutions have relatively high fixed set-up costs, whereas their variable costs are low. Hence, IN solutions are cost-efficient if the expected number of portings is relatively high, whereas less advanced solutions (such as call forwarding) are efficient as long as the number of portings is low. The stylised average cost function for these two technologies, on-switch (ONS) and off-switch (IN), are depicted below, as is the threshold number of portings after which an IN solution becomes more efficient than an on-switch solution.”

![Figure 11 - Direct Costs of NP using ONS or IN Technology](image)

The administrative costs and the routing costs can collectively be considered as direct on-going costs as they costs are incurred each time a user requests a port (administration costs) and each time the operator routes a call to a ported number (delivery costs).

\(^{27}\) ‘Mobile Number Portability in Europe’ July 2005
5.2 Centralised Reference Database Implementation Costs

The centralised reference database costs include, but are not limited to:

- Cost of time spent specifying the database and its interfaces with operators
- The cost of the tender and contractual processes to obtain the database
- The cost of establishing the database and its links to operators
- Time spent testing the database and its downloads in conjunction with the associated order handling processes and links with fixed operators and service providers
- The cost of pre-population of numbering information if necessary according to the chosen solution
- The cost of developments for disaster recovery as appropriate.

5.3 Number Portability Clearinghouse Implementation Costs

The portability clearinghouse costs include, but are not limited to:

- The cost of the time spent specifying the clearinghouse and its interfaces with operators
- The cost of the tender and contractual procurement process to obtain the clearinghouse
- The cost of the time spent in the identification and negotiation of the processes required to be provided by the clearinghouse
- The cost of establishing the clearinghouse, the processes and setting up its links to operators and the centralised database
- Time spent testing the clearinghouse and its processes in conjunction with the associated order handling systems and links with fixed operators and service providers
- Time spent developing and testing any modifications to disaster recovery arrangements.

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28 Links with any fixed operators and/or international gateway operators are necessary because, even though we are focused on MNP, calls to/from fixed networks and international calls will need to be routed correctly dependent on the routing ‘rules’ established during MNP implementation.
6 Implementation Costs for Rwanda

In the section on Cost Recovery Principles (Appendix D of this document), InterConnect states that:

‘Based on the benchmark data provided, operators should bear their own system set-up costs. In fact, in almost all countries (where information is available), the NRA has stated that operators will bear their own cost of system set-up for MNP. This view is consistent with establishing charges that promote effective competition, ensuring that charges are based on cost and encouraging cost minimisation…. this principle should extend to set-up costs where a national clearinghouse and/or centralised database are implemented for the same reasons of competition and non-discrimination.’

If this approach is followed, mobile operators will have to bear all the appropriate costs described in this section of the report, and will not be able to recover them from other operators to whom their customers port. The costs will be recovered indirectly from all their own customers in a similar manner to how costs are usually recovered.

Where a centralised database and a clearinghouse solution are implemented, mobile operators will again have to bear their own costs of participating in the implementation (the costs of sending staff to industry working groups, for example). The costs of large items such as the database or clearinghouse solution will be shared between the operators, but the contractual terms of the agreements may spread the upfront cost in some manner, and include the upfront cost in the on-going porting charges.

6.1 Benchmark Costs

The details of actual costs incurred in the implementation of number portability are rarely in the public domain, due to the commercial confidentiality of the supplier agreements. Therefore, it has only been possible to compile a list of indicative benchmark costs from selected countries for this report.

- Confidential Text Removed
- UK - The UK currently uses an onward routing solution for fixed number portability. It is now in the process of establishing a centralised database solution, but this has yet to be implemented. Over the past few years, studies have been carried out into the costs and benefits of the introduction of a centralised database solution. One such study (completed in 2004), for Ofcom, attempted to estimate the costs associated with an ACQ implementation. Its estimates for capex cost elements are shown below:

<table>
<thead>
<tr>
<th>Capex Cost Estimate</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN Functionality</td>
<td>£5000 per Call Query per second</td>
</tr>
<tr>
<td>Switch Functionality Upgrade</td>
<td>£25,000 per switch</td>
</tr>
<tr>
<td>Switch Processor Upgrade</td>
<td>£100,000 per switch</td>
</tr>
<tr>
<td>Switch Software Upgrade</td>
<td>5% of main capex items</td>
</tr>
<tr>
<td>Rebuilding Data Routing Tables</td>
<td>£10,000 per switch</td>
</tr>
<tr>
<td>Additional Capex Items</td>
<td>30% of main capex items</td>
</tr>
</tbody>
</table>
Internal Systems Development | 8% of main capex items
Interface to Centralised Database | Negligible in comparison with major capex items
Implementation Programme | £10,000 per switch
Process Development | Small – time taken seen as more important
Central Database | Recovered on a per port basis – no upfront cost

Table 32 - Estimates of UK Capex cost elements

These costs are only estimates based on a consultant’s assumptions and the opinions of some UK operators at the time. In addition they were based on TDM (legacy) networks. The estimated total cost required, at that time, for the whole UK industry was approximately £267m (CAPEX costs).

A more recent study conducted by Sagentia, on behalf of Ofcom and included in their consultation on General Condition 18, looked at the costs involved for the same type of upgrade of the NP routing arrangements, but this time assumed the work was completed as the main fixed-line provider (BT) ungraded their network to NGN technology. The overall cost to industry changes dramatically as the table below demonstrates:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Costs Modeled</th>
<th>Traffic</th>
<th>Comment</th>
<th>Capex</th>
<th>Post costs per mm</th>
<th>NPV £m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F-F</td>
<td>M-F</td>
<td>M-M</td>
<td>F-M</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>TDM</td>
<td>Fixed</td>
<td>•</td>
<td></td>
<td>£267m</td>
<td>0.0267</td>
</tr>
<tr>
<td>F2</td>
<td>TDM</td>
<td>Fixed</td>
<td>•</td>
<td></td>
<td>£267m</td>
<td>0.0183</td>
</tr>
<tr>
<td>F3</td>
<td>TDM</td>
<td>Fixed</td>
<td>•</td>
<td>•</td>
<td>Adds fixed - mobile Traffic</td>
<td>£267m</td>
</tr>
<tr>
<td>M1</td>
<td>TDM</td>
<td>Mobile</td>
<td>•</td>
<td>•</td>
<td>Adapt Base model to mobile</td>
<td>£12m</td>
</tr>
<tr>
<td>M2</td>
<td>TDM</td>
<td>Mobile</td>
<td>•</td>
<td>•</td>
<td>Above with Lower DCC</td>
<td>£12m</td>
</tr>
<tr>
<td>M3</td>
<td>TDM</td>
<td>Mobile</td>
<td>•</td>
<td>•</td>
<td>Adds mobile - fixed traffic</td>
<td>£12m</td>
</tr>
<tr>
<td>C1</td>
<td>TDM</td>
<td>Fixed and Mobile</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>Combined</td>
</tr>
<tr>
<td>N1</td>
<td>NGN</td>
<td>Fixed</td>
<td>•</td>
<td>•</td>
<td>NGN variation on base</td>
<td>£61.5m</td>
</tr>
<tr>
<td>N2</td>
<td>NGN</td>
<td>Fixed and Mobile</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>NGN variation on Combined</td>
</tr>
</tbody>
</table>

Table 33 - Estimated CAPEX costs for the UK industry group – Sagentia

This table shows that the CAPEX costs for the UK industry have dropped from £267m to £61.5m for fixed portability only. If mobile portability is added, the costs for the NGN type development become £73.5m, still substantially lower. Sagentia have also included the net present value (NPV) figures for the UK industry, which include the benefits that a central database solution would bring over time. These show that the development has moved from a negative £200m in 2004 to a positive £15.3m for the fixed industry.

It must be remembered that these all the above UK figures are estimates, originating from published consultancy studies commissioned in advance of any tender or implementation process. Actual establishment costs subject to commercial negotiations during any procurement process and the final figures will not be in the public domain.

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Our experience in other more recent number portability implementation programmes suggests that the industry investment costs continue the reductions implied by the above review, for example:

- **Confidential Text Removed**

### Cost Element | CAPEX/ OPEX | Minimum $USD | Maximum $USD
--- | --- | --- | ---
ACQ Routing Infrastructure | Confidential Text Removed | Confidential Text Removed $600k | Confidential Text Removed
Billing System Upgrades | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed
Core Network Upgrades | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed
BTL Sales Acquisition/ Retention subsidies | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed
Ancillary Core Network Upgrades | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed
Marketing development & delivery | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed

**Totals** | Confidential Text Removed | Confidential Text Removed | Confidential Text Removed

Table 34 - Trinidad Costs (MNP & Fixed NP)

**Confidential Text Removed**

Finally, El Salvador's Superintendency of Electricity and Telecommunications (Siget) announced that (May 2014) ‘the launch of number portability has been suspended. Consequently, its implementation could be applied during the mandate of the next government, reports La Prensa Grafica. According to Superintendent Luis Mendez, there is no willingness to invest on the part of operators, and the implementation of number portability requires USD 14 million. He explained that the state does not have the resources to meet the costs of number portability. For their part, Claro and Tigo announced that they were available to start work on the project.’

### 6.2 Estimated Cost Comparison

The cost comparison table below compares costs of recent implementations and applies the same logic to an implementation in Rwanda to develop a view on likely costs (all figures below quoted in $’s refer to US$’s).

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
<th># of operators</th>
<th>Active SIMs</th>
<th>Pre-pay/Post-pay split</th>
<th>Penetration rate</th>
<th>Cost ‘spread’</th>
<th>Average cost per operator</th>
<th>Total cost to industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>45m</td>
<td>4</td>
<td>31.3m</td>
<td>98%/2%</td>
<td>70%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Ghana</td>
<td>26m</td>
<td>6</td>
<td>27m</td>
<td>99%/1%</td>
<td>106%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Panama</td>
<td>3.9m</td>
<td>4</td>
<td>5.3m</td>
<td>89%/11%</td>
<td>136%</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Rwanda</td>
<td>10.7</td>
<td>3</td>
<td>6.84</td>
<td>99%/1%</td>
<td>65%</td>
<td>$3m - $4m</td>
<td>$3.5m</td>
<td>$10.5m</td>
</tr>
</tbody>
</table>
Laurasia Communications Consultants provide the following cost breakdown obtained from operators who have completed MNP implementations. This suggests that approximately 70% of the total cost is spent on modifications to the operators Network infrastructure (routing) and Business Systems (OSS & BSS), with the remaining 30% being spent on various business and sales/marketing functions as shown in Figure 12.

<table>
<thead>
<tr>
<th>Country</th>
<th>Existing</th>
<th>New MNP</th>
<th>% of New</th>
<th>% of Total</th>
<th>Cost Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>4.3m</td>
<td>5.4m</td>
<td>82%/18%</td>
<td>125%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>El Salvador</td>
<td>6.4m</td>
<td>8.5m</td>
<td>87%/13%</td>
<td>134%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>21.4m</td>
<td>24.6m</td>
<td>91%/9%</td>
<td>115%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Honduras</td>
<td>8.2m</td>
<td>8.4m</td>
<td>94%/6%</td>
<td>103%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>10.5m</td>
<td>10.1m</td>
<td>83%/17%</td>
<td>97%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Paraguay</td>
<td>6.9m</td>
<td>7.3m</td>
<td>80%/20%</td>
<td>107%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>58.8k</td>
<td>94.4k</td>
<td>81%/19%</td>
<td>160%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Bahrain</td>
<td>1.3m</td>
<td>2.6m</td>
<td>80%/20%</td>
<td>192%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Qatar</td>
<td>2.2m</td>
<td>3.8m</td>
<td>86%/14%</td>
<td>172%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Hungary</td>
<td>9.9m</td>
<td>11.3m</td>
<td>47%/53%</td>
<td>113%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Pakistan</td>
<td>183.6m</td>
<td>134.8m</td>
<td>97%/3%</td>
<td>73%</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>Chile</td>
<td>17.7m</td>
<td>27.1m</td>
<td>72%/28%</td>
<td>153%</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 35 - Cost comparison Table

Figure 12 – Approximate MNP cost breakdown
In their responses to the questions in relation to ARPUs the operators provided the following information (all figures below quoted in $’s refer to US$’s):

<table>
<thead>
<tr>
<th>#</th>
<th>Question</th>
<th>MTN Response</th>
<th>TIGO Response</th>
<th>AIRTEL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>For mobile services, what is your Average Revenue Per user (ARPU) for:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.a</td>
<td>Prepaid?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
<tr>
<td>7.b</td>
<td>Post-pay?</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
<td>Confidential Text Removed</td>
</tr>
</tbody>
</table>

Table 36 - Monthly ARPU returns

Pre-paid ARPU in Rwanda is between 2,013RWF (MTN) and 1,074RWF (AIRTEL) which is between US$3 and US$1.6. This rate may also be affected by the rate of multi-SIM use, where potentially the second (and the third SIM etc.) are hardly used once any short term ‘offer’ is exhausted. This may also be exacerbated by operators who are slow to disconnect inactive SIMs despite their policy. Therefore, the penetration rate may be lower as already discussed, and ARPU higher.

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If we take the US$10.5m implementation costs and the fact that InterConnect is predicting an approximate 1% annual port rate with an approximate 10% to 90% split of post-paid to pre-paid numbers ported (as discussed in section 2.7.4) we can start to assess the average per-port cost to the mobile operators.

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Figure 13 - Average ARPU per ported customer

- 1% annual port rate is 42,658 per annum or 639,870 over a fifteen year period.
- US$10.5 investment with a 15 year ROI
- Cost per port = US$16.40

That is equal to approximately 2.6 times the monthly ARPU of the average ported number.

Add to this the per port costs as estimated in 0 – Porting Administration which is US$3 – US$6 per port, this is approximately 3.1 – 3.6 times the monthly ARPU of the average ported number.

Thus MNP is (economically) a viable option only if there are significant effects (that are difficult to estimate) on the market such as improved competition, higher penetration (through network investment and lower prices), better quality, more services, more ARPU.
etc., as discussed elsewhere in this report. The introduction of other types of NP (fixed to fixed and/or fixed to mobile) will also have an effect on this calculation.
7 Fixed line NP & Service Portability

7.1 Introduction

Although the term Number Portability has universal use, it actually encompasses three distinct types of NP. These NP types are not mutually exclusive. To avoid confusion and facilitate the work in the rest of the report, these types are described here, although the feasibility report will focus on mobile ‘Service Provider’ portability unless it specifically refers to one of the other types.

7.2 Types of Number Portability

7.2.1 Service Provider Number Portability

Mobile number portability is the focus of this report and consequently has been considered at length. We will not repeat that discussion.

Fixed line (geographic) NP allows customers of fixed services to port from operator to operator in much the same way that mobile NP works. The difference is, in most countries that have fixed NP, that the porting is restricted to a rate area, or within the same exchange switch area, however, where the tariffs are equal between local and national calls there is the possibility that fixed services can port to another part of the country (but remain as fixed services as their ‘service type’).

Non-geographic NP refers to the porting of numbers that are rated on a national level i.e. toll-free services, shared cost, shared revenue services and nomadic type services (where applicable). These types of numbers are portable from operator to operator but, like mobile numbers, they are not tied to a location or area.

7.2.2 Location Number Portability

Location portability is restricted to a rate area, or within the same exchange switch area, and only applies to fixed services. Many countries have this service (as an operator option that is not regulated) and customers are allowed to change location within the rate or exchange area and keep their number. This service can be combined with Service Provider Portability.

7.2.3 Service Portability

Service Portability allows a customer to retain their number when they change the service type that they use. Examples include changing from PSTN to ISDN or ADSL services or porting numbers between fixed line geographic services and mobile services.

Since 2004, this type of Number Portability has attracted regulatory attention relating to portability between fixed-line / geographic services and mobile. The USA is believed to be the first country to require Service Portability between fixed and mobile services. Subsequently, the UK has explicitly permitted and / or required the introduction of this level of portability, whilst Italy has rejected it.

Tariff transparency is the reason behind this disparate approach to fixed / mobile portability. In the case of the USA all calls to fixed and mobile telephones and handsets have always been charged the same, so the issue does not arise. In the UK, the regulator has permitted the portability provided that calls are charged on the basis of the number dialled, whereas,
Italy has considered tariff transparency as the key issue that overrides the customer benefits of the portability.

7.3 Number Portability Types

7.3.1 Service Provider Portability

Mobile number portability – as above.

Fixed to fixed portability is already in place in many countries and indeed was the main focus for many early adopters of NP. In recent years, mobile NP has become the primary focus because of the general change in the nature of most markets, that mobile services are more widespread and more important to the economy than fixed services. However, it can still be an important competitive tool for regulators to use.

By definition this requires competition in the fixed services market, which exists in Rwanda at this time. Liquid Telecom and MTN Rwanda Ltd are the fixed line voice service providers as of March 2014. These two operators between them provide fixed service to 45,444 customers (March 2014 figure) up from 44,338 (Dec 2013), so the market is quite small (0.43% Penetration).

InterConnect recommends that RURA only considers fixed to fixed portability after mobile NP is implemented and established, and could consider it as part of a move to an any-any portability implementation sometime in the future.

7.3.2 Location Portability

Both Toll Free and Premium Rate access codes have been issued to all three mobile operators in the ranges 0800 for Toll Free and 0900 for Premium Rate. These codes offer free to caller (Toll Free) services and services that are charged at a higher rate than normal rates.

InterConnect understands that none of these numbers have been brought into service so far. However, consideration of the NP issues for these number types will need to be made by RURA sometime in the future.

7.3.3 Service Portability

Fixed to mobile NP has not become a widespread offering because of the termination rate issue described above.

The real issue for Rwanda is the competitiveness of the market and the effect that fixed to mobile NP will have. Currently it is more important to consider mobile NP as an initial phase before considering other types of NP such as fixed-fixed NP or fixed to mobile NP.

7.4 Considerations for Rwanda

7.4.1 Competition Issues

RURA can decide to deliver MNP first and then add to that other forms of NP over a period. For a customer, that means that they can get used to the idea that they can switch from
mobile operator to mobile operator, and then accept that they can now move from fixed operator to fixed operator before taking the final step of any one to anyone, anywhere.

In European countries, the concept of customer rights means that customers accept the concept even if the operators have yet to deliver the full range of NP services. They take for granted the fact that they can keep their mobile number or fixed number when switching operators: “why has that not been extended to fixed to mobile NP?” is the question.

However, in a country that has yet to take the first step, taking the ultimate step (in NP terms) may be too much.

7.4.2 Numbering Issues

In terms of the possible implementation of mobile NP, no numbering issues are currently envisaged.

In their questionnaire responses all three operators indicated that they have sufficient numbers for the foreseeable future, Confidential Text Removed. They also all have good quarantine procedures in place which, if followed correctly, mean that ceased numbers are returned to their number pools in 6 – 12 months. Finally, all three operators have processes in place to try to allocate an equivalent number to a customer who wishes to move from one operator to another, indicating that number resource is not an issue.

In regards to the National Numbering Plan, all mobile numbers are of the same digit length and fall within the ranges 07X.

7.4.3 Development Costs

It would almost certainly be more cost effective to deliver the full range of NP services in one implementation than to deliver them one at a time. However, RURA could mitigate that cost penalty by initially declaring their intention to deliver all NP services and making sure that everyone involved in each part of the project understand the road map and time lines being followed.

The main cost issue is the centralised service. Most countries engage a third party vendor to deliver one NP service. In recent years, this has generally been MNP. Regulators have often stated that the centralised service must be capable of delivering other NP services, but have been vague about timings, and have insisted that vendors deliver MNP in the most cost effective way. This means that the solution, whilst capable of being developed to manage other portability types, is not equipped on day one to manage them. This serves to dilute the cost effective nature of the original requirement.

From an operator perspective, a centralised solution that is capable of managing all portability types from the outset would mean that costs are shared between all operators that participate in NP. However, RURA will have to manage this carefully if they are to implement NP types one at a time. Again, the operators and the centralised solution vendor will need to understand the project objectives from inception to be able to manage cost effectively.

The operators own development costs will be largely unaffected by the order in which NP services are implemented e.g. MTN fixed will have the same costs if fixed NP is launched at the same time as mobile NP or delayed by a period. Again, as long as any delay is understood at the outset, the spend will just be delayed. However, we believe their
marketing costs will be affected by the products operators chose to participate in e.g. if MTN only have MNP to consider, their marketing costs will be different than if they participate in fixed NP as well as mobile NP.
8 Overall Conclusions

8.1 Cost Benefit

In a recent study produced for another sub-Saharan African country, we find the statement ‘The benefit produced by number portability depends on the number of people porting’. This statement is fundamentally flawed. The goal of introducing MNP is not to port as many numbers as possible but to acknowledge consumer rights and increase consumer choice. This improves competition thereby placing downward pressure on prices, increases investment in the telecoms sector and stimulates innovation.

As stated earlier, no financial benefit analysis of MNP produced in advance of implementation is known to have shown a positive cost benefit to the customers who port their numbers. The parameters are too narrow. To get a true understanding of the value of the benefits you must examine the effects over a period of time after service launch, as the Cho, Fereirray, and Telangz study has done30. Their study of the competitive effects of European countries that have MNP looked at ‘47 carriers in 15 countries over a period of 7 years’. Its conclusions include the following:

“On average, the introduction of MNP decreased price by 7.9%. Policies that require faster and cheaper MNP were also more effective in this respect. Furthermore, market followers seem to have decreased price more than incumbents did when MNP was introduced. MNP also increased competition by reducing the incumbent's market power and by tightening the range of prices practiced.”

It also concludes “Our results suggest that, on average, MNP increased consumer welfare by 2.86 euros per person.” The use of the term ‘consumer’ rather than customer or customer is significant as the benefits of number portability are wider than the immediate porting customers.

8.2 Legal Position

The Rwandan legal position is clear from both the law no. 44/2001 of 30th November 2001 governing Telecommunications, and clause 14.4 of the mobile operator’s licence. RURA has the legal authority to require number portability in Rwanda, and that this is not limited to any particular type of number portability but includes any type that RURA choose to include.

8.3 Data Gathering Conclusions

Confidential Text Removed However, all the operators expressed some concerns regarding the implementation. Examples of these concerns are costs, multi SIM use, customers not ‘wedded’ to their number31, low ARPU’s, tariff transparency, etc.

An annual port rate of between 0.8% and 1.1% is a reasonable expectation in the early years. As network quality improves (including the move to LTE and 4G) and the penetration


31 However it is notable that the service providers are offering products that provide a new number as close to the old number as possible.
rates increase this figure may rise to between 1.1% and 1.4%. Our experience indicates that it would be unusual for it exceed 1.6%. Currently this equates to approximately 34,226 to 47,061 customer ports per annum in the early years rising to 47,061 to 59,896 ports per annum based on current penetration rates.

Other key issues form the data gathering:

- RURA and the mobile operators are rightly worried that the costs may be excessive for the benefits and may divert operator’s funds from other infrastructure investment. Actually, our experience is that no purely cost based study has ever shown an economic justification for MNP. As with other similar regulated services such as LLU and CPS, the costs will always outweigh the demonstrable financial benefits. However, in their report on ‘The Impact of Mobile Number Portability on Price, Competition and Consumer Welfare’ (May 2013), the authors, by looking at MNP retrospectively, have shown that, apart from the expected consequences of introducing MNP (increased competition, decreased prices, and reducing incumbent’s market power) we also see that ‘MNP increased consumer welfare by 2.86 euros per person’. This benefit is, of course, not quantifiable in advance.

- Frequently, Multi-SIM use is cited as evidence that there is no demand for number portability and therefore it should not be implemented, although there was limited mention of this by the Rwandan operators. However, MTN stated that ‘Entry level prices are so cheap that customers will not be inclined to go through the process of porting their number, but will simply take on another service. Especially as multi-SIM handsets are increasingly available.’ The logic for this argument is that a customer with SIMs from more than one operator does not need NP to use the service provider of their choice. They can already make and receive calls on more than one network. But MNP is about customers retaining the number that people contact them on (their primary number), not the number (or SIM card) they use to make outgoing calls or texts.

- Mobile termination rates are also a factor in managing customer prices, and the information provided by the operators in their questionnaire responses confirms that the mobile termination rates are equal for all mobile (GSM) operators.

- SIM registration is not a pre-condition of MNP, however, as the registration project is completed, the SIM registration data can be used to verify pre-paid customers who wish to port their number(s). Hence, it can be used to the advantage of the customer process providing data mismatches are not used to reject ports unnecessarily.

- The questionnaire responses demonstrate that Rwandan call charges for on-net and off-net calls differ for all operators, and by an increasing margin. If RURA implements MNP, then InterConnect believes that tariff transparency measures may be required as there is a significant price variation, although MNP may cause a competitive response by reducing the differential. To avoid the ‘bill shock’, a number of countries have introduced one of a number of tariff transparency measures to alert customers to the price differential.

- Confidential Text Removed
8.4 Cost of the Implementation

The cost of the implementation concerns the mobile operators and RURA alike. In Section 6 we used benchmark information to provide an estimate of the likely implementation costs in Rwanda we conclude that it will be of the order of US$10.5m plus the resource commitment that RURA and the operators will have to make.

We feel that this is a realistic estimate and it is not an insignificant sum.

In addition, there will be the on-going ‘per-port’ cost that we estimate to be in the region of US$3 - $6. If Rwanda achieves a 1% port rate in the first year (based on current penetration rates), this will add another US$129k – US$257K and, assuming the same penetration rate and port rate, will continue as an annual cost.

That is equal to approximately 3.1 times the monthly ARPU of the average ported number. However, if the actual ARPU per ACTIVE pre-paid SIM (i.e. those more likely to be ported) is higher than MNP becomes economically more attractive.

8.5 Other NP Types

Our concern with implementing all forms of NP in Rwanda is the competitive position of the fixed-line market. Whilst there is good competition in the mobile market, with three GSM operators, there is little competition in the fixed line market. This leads to the conclusion that fixed-fixed NP is not a consideration for RURA in the short term until more aggressive competition is experienced.

8.6 MNP Options

We have identified 4 options for RURA: they can be pro-active and move forward with the implementation of MNP (Option 1); they can decide to pause and commence the implementation at some future date (Option 2); they can state that they will begin MNP when certain market conditions are met (Option 3); or they can do nothing (Option 4).

If RURA accept Option 2, they have an opportunity to introduce other measures aimed at improving the competitive position of the mobile market in Rwanda. Such options are major topics in their own right and are beyond the scope of this report but include: encouraging operators to increase their network coverage / quality, enforcing lower termination rates thereby lowering on-net / off-net price differentials and creating competitive innovation such as encouraging virtual network operators (MVNOs).

Option 2 also requires RURA to issue an explicit Regulatory Decision stating that MNP will be introduced on a certain date. This encourages operators to take account of NP when improving / upgrading their network / OSS / BSS, minimising the cost of NP and permit RURA to require action whenever necessary and appropriate.

If RURA accept Option 3 then they should introduce other measures aimed at improving the competitive position of the mobile market in Rwanda, as described in the preceding paragraph. Such measures may also reduce multi SIM use, which will be an advantage to a future MNP implementation.
8.6.1 Option 1

The first option for RURA is to mandate the introduction of MNP, and initiate a project to implement it, on the basis that:

- It will promote further competition
- It will protect the interests of consumers
- It will encourage further investment in network infrastructure
- It may encourage additional operators to enter the market

It is probable that this will also:

- further stimulate mobile activity
- stimulate increased investment in quality of service
- spur innovation on products and services
- over time increase the percentage of post-paid customers and ARPU’s and reduce multi SIM use
- further increase mobile penetration

However, there are some issues for RURA to address and overcome that will follow the decision, and the MNP implementation itself:

- The overall costs are not prohibitive, and certainly not in the ‘tens of Millions’ of (US) dollars per operator. However, it is still significant.
- Projected (initial) annual port rates are just 0.8% to 1.1%; this is a multi-faceted issue that includes the following:
  - Penetration rates are lower than the stated figure (65%) because customers carry multiple SIMs/handsets;
  - Infrastructure upgrades in rural and remote areas has to improve; operators will claim that implementing MNP will hinder that;
  - A very high percentage of customers are pre-paid which will depress annual port rates;
  - Rural populations (80% of the total population) and a 70% literacy rate\textsuperscript{32} will mean that public awareness campaigns will need to be carefully monitored;
  - Security issues will need to be addressed early in the implementation to prevent the problems experienced in some other countries;

Confidential Text Removed The most successful implementations of MNP have been achieved when the regulator takes a strong management lead throughout: setting deadlines, arranging and chairing meetings, monitoring and managing developments and, where necessary or appropriate, punishing operators who fail to make the required progress.

\textsuperscript{32} Figures from the CIA World Fact Book of the literacy rate amongst adults (15 years and over) in Rwanda – 2012.
However, we believe, given the circumstances described above, that all the operators will eventually accept that RURA is determined and will co-operate. This cooperation is necessary, as it will be the responsibility of the operators (collectively) to agree with RURA the solutions necessary for a successful launch.

International experience is that the implementation of MNP is likely to take approximately twelve to eighteen months to achieve in Rwanda, once the formal decision is promulgated, so the earliest launch date of late-2015 is realistic. RURA could launch MNP in 12 months from the date it makes the decision to proceed, but 18 months is a more reasonable minimum timescale. This time scale will allow RURA to assess the competitive situation as the project unfolds, and take whatever action it deems necessary to ensure that, at the time of launch, that the service will benefit customers and consumers.

If the competitive landscape changes, RURA can speed up or slow down the implementation of other forms of NP in relation to the launch of MNP (the date of which should be fixed and not changed unless something extraordinary happens).

To start the project RURA should issue an explicit statement (regulatory decisions) that they will launch MNP in a particular time frame, followed by other forms of NP in a particular time frame. They should publish a ‘road map’ that is clear to the industry and the consumers of Rwanda so that both can have confidence that the project will move forward and has a specific end date. RURA’s approach should consider the following:

- State that MNP will be launched in late 2015 (a formal date must be agreed upon internally and publicised)
- State that other forms of NP, particularly fixed / mobile portability will be launched by a date yet to be decided (a formal date must be agreed upon internally and publicised)
- Draw up Business Rules or a Code of Practice that will manage the operator interactions and set the guidelines on issues such as cost recovery, time to port, verification rules, retention activity, bad credit, etc. Business Rules define the methods by which Number Portability is to be implemented and administered
- Following the decision, RURA should form an industry Management Group of RURA and the operators to manage the implementation
- Draw up and issue an RFP for a centralised service in the last quarter of 2014. The RFP should be issued to third party vendors of NP centralised services.
- Work to have a third party vendor in place by the end of the 1st quarter 2015.
- Ensure that selected vendor starts to develop their own capabilities from the inception of the project.

This clear road map, and RURA’s obvious intent, should start to galvanise the operators into looking at their options and taking appropriate action.

Finally, the operators must be convinced that RURA will not be deflected by other initiatives that ‘should be launched before MNP’, and that MNP will be launched first followed by other NP types. They should understand that the medium to long term NP benefits are experienced by all consumers’ not just customers who port their numbers.
8.6.2 Option 2

RURA could decide not to implement MNP until some future date whilst they address other issues which that have a greater competitive effect or are of a higher priority for the Rwandan market, e.g. addressing increases in operator network coverage / quality or introducing MVNOs. Such measures may also reduce multi SIM use which will be an advantage to a future MNP implementation.

However, in considering this option RURA must consider what it would do during the period between now and the start of the MNP implementation; how long that period should be and the possible effect of the MNP delay on the market. As shown earlier:

- the current termination rates could be reduced
- the current on-net / off-net price differentials are significant – in one case the off-net price is 3 times the on-net price
- the very high pre-paid to post-paid split is being experienced in other countries
- multi SIM use is typical for the region but will increase, especially given that MTN have stated that they are content with the concept of people carrying multiple SIMs
- at 65%, penetration rates still have room to grow

Also, given the implementation time scales proposed above, a two-year delay to the implementation start (for example) would mean a minimum of a three year period between now and service launch. How will the market dynamics change in that period? This report highlights some of the issues that can change and may provide a barrier to MNP when it is introduced:

- Smart phone penetration
- Blackberry services
- Mobile money
- Exclusive value added services.

It is inevitable, and desirable, that these products become widespread in the Rwandan market as part of the overall improvement in flexibility and choice for all consumers. Indeed, most, if not all, are already in place in Rwanda albeit with some having a low level of take-up at this time.

However, these types of products also make the introduction of MNP more difficult. Rules and processes need to be built to ensure that customers are free to port their number(s) even when using such products. If RURA were to start the implementation of MNP now, whilst the take-up of some of these products is low, then the interaction between MNP and these products is easier to manage. The barrier effect will increase as their usage increase.

To overcome this, RURA should issue an explicit Regulatory Decision now stating when MNP will be introduced. The Regulatory Decision should include a clause that states that "any product or service introduction or development should ensure that the implementation of MNP is taken into account such that customers of that product or service are not prevented..."
or hindered in any way from porting their mobile number because of the Terms and Conditions surrounding that product or service, or the technical construction of that product or service’. This will allow RURA to refer to that regulatory decision whenever necessary and/or appropriate.

8.6.3 Option 3

RURA could decide to implement MNP until certain market conditions are met.

A number of regulators have adopted this principle, usually based on penetration levels i.e. we will implement MNP when the penetration rate reaches xx%. However, RURA stated in 2011 that they would not implement MNP until the penetration rate exceeded 60% and as shown; this measure was reached and exceeded during 2013. It follows then that RURA would need additional justification now to delay again, so what level would be appropriate?

Measures that could be introduced include:

1. Setting a target network coverage for 3G or above i.e. say 70% population coverage;
2. Stating that MNP will be implemented as soon as multi SIM is below a certain level;\(^{33}\)
3. Stating that MNP will be implemented once the real penetration rate reaches a certain percentage;
4. Stating that MNP will be implemented as soon as ARPU reaches a certain figure, or that post-paid subscriptions reach a certain percentage;
5. Stating that MNP will be implemented as soon as on-net / off-net price differential flatten out.

These are all very reasonable regulatory targets for RURA to aim for but to make MNP implementation dependent on any of them creates an ‘hostage to fortune’ because:

1. If another MNO enters the market does RURA apply the same target, thereby delaying MNP further, or is the new operator exempt from the target?
2. This effectively is what the BTA study has concluded. However, multi SIM use is now a normal part of the market for many countries, and is increasing not falling. This trend is certain to continue in Rwanda, especially if MNP is not implemented. The Adam Smith study based some of its calculations on the fact that a market like Ghana with 6 operators, low termination rates and, for the most part, good network coverage has a low level of multi SIM use. But the NCA state that multi SIM use is ‘sizable’ so Adam Smith’s assumption is almost certainly incorrect.
3. From the current penetration rates, this condition requires growth to continue to the point where most customers have service and many carry multiple SIMs. This can only happen if network coverage improves dramatically, especially into rural areas. With 80% of the population living in rural areas and 55% of the population having no SIM (service) at all it follows that many people living in rural areas have no mobile

\(^{33}\) This would be hard to establish as currently there are no exact statistics on Multi SIM use – data provided by operators are just estimates.
Rwanda Utilities Regulatory Authority
Cost Benefit Analysis on the introduction of MNP in Rwanda

Issue Draft 0.5

4. Both ARPU's and post-paid subscriptions are very low and may continue to be so. The level of post-paid subscriptions is typical for a sub-Saharan African country and, apart from MNP; it is hard to see what can be done to substantially change this situation. Even MNP implementation will only change this over the long term. ARPU's will only improve as/when the percentage of post-paid subscriptions improves.

5. RURA can help this by reducing mobile termination rates but substantial improvements in this area will only really materialise post MNP implementation. Before that operators will see an advantage in maintaining the differentials.

Regulators that have made the implementation of MNP dependent on such targets, as RURA did in 2011, have found that either the target has not been reached and is unlikely to be reached or, conversely, that the target has been reached, and customers / consumers are demanding that the regulator now fulfils their commitment.

This places a special burden on RURA.

If RURA decided to delay again now stating that they will decide to implement MNP once certain (other) market conditions are met they will risk looking indecisive, possibly leading to the assumption that once the stated market conditions are met (if ever) other 'reasons' will be found to delay again. Conversely, generally speaking mobile penetration rates have increased in virtually every country with mobile service, and continue to increase. This trend will continue, especially given the emergence of M2M services. This provides RURA with the opportunity to 're-set' the minimum penetration rate figure required to trigger MNP in Rwanda.

8.6.4 Option 4

RURA could declare that they do not wish to proceed with MNP at this time without making any comment about their future intentions, or whether they believe that MNP is a positive or negative issue for the Rwandan market.

RURA could issue a statement along the lines of the following: 'while MNP is generally a good thing and may have benefits to Rwandan consumers, the current market [does not have sufficient/effective competition or that the estimated costs seriously outweigh the consumer benefits] and RURA must focus its efforts to ensuring that competition is present and effective. RURA therefore do not, at this time, feel that the benefits that consumers would derive from MNP warrant imposing this requirement on service providers at this time. However we reserve the right to revisit this conclusion at some future date'.

There would also be a need for RURA to focus their comments on the following:

- That the estimated costs of MNP implementation (including the on-going ‘per port’ costs) make the implementation unviable and/or detrimental to the ability of operators to invest in improved infrastructure and services
- That currently there is insufficient / ineffective competition in the market and RURA must craft regulation to ensure that competition is present and effective
Accept that multi-SIM use is not a “problem;” rather, it seems like a solution that the Rwandan market has made available, at least in the short – medium term

8.7 Overall Recommendation

Through the writing of this report, InterConnect have sought to ensure that they have provided RURA with a true picture of the current situation in Rwanda, experience from other countries in regard to MNP implementations and, consequently, the likely effect that MNP will have on the Rwandan market. It can be seen that the case for implementing MNP is not clear cut, there are some issues which will need to be addressed, not least are the issues of cost, which is not insignificant, Confidential Text Removed. Additionally, there is the key issue of multi-SIM use:

People carry multiple SIMs/Handsets to overcome:

- Poor network quality/coverage
- Substantial on-net / off-net price differentials
- To take advantage of short term offers or promotions
- To differentiate between business and personal calls
- Status

Multi SIM use and short term offers/promotions:

- It is likely that short term ‘special’ promotions means customers tend to buy a SIM, take advantage of the offer then discard the SIM, resulting in a SIM quickly becoming inactive. This could result in a large number of inactive SIMs being included in the ‘active customer’ figures
- Operators may not be ceasing these inactive SIMs in a reasonable time because it enhances their ‘active customer’ and percentage market share figures
- If a large number of inactive SIMs are included in the operators statistics as ‘active’ then this will drive down the ARPU figures.

Other issues which will have an effect, both positive and negative, on the performance of MNP in Rwanda are:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Positive effect</th>
<th>Negative effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of customers with at least one mobile service is much lower than the RURA statistics show due to multi SIM use</td>
<td>MNP starts to address the underlying reasons why people carry more than one SIM/Handset – on-net / off-net price differentials and poor network quality.</td>
<td>The headline figure for mobile usage is 6.836m (March 2014) however, given the probable rate of multi-SIM use the true figure is closer to 4.625m. This will depress the overall number of ports expected on an annual basis.</td>
</tr>
<tr>
<td>Availability of multi SIM handsets</td>
<td>This will allow customers to choose their supplier for their primary number whilst being free to take advantage of any short term offers/promotions from other operators.</td>
<td>This is likely to persuade some customers to continue to carry multiple SIMs making portability a less attractive option.</td>
</tr>
<tr>
<td>Competition in the mobile market in</td>
<td>MNP increases competition which</td>
<td>If people feel they do not have a</td>
</tr>
</tbody>
</table>
some rural areas is a concern (based on technical roll-out) in turn increases investment in network improvements. Overcoming network failures and allowing complete freedom of choice will be a key competitive tool for operators. free and open choice of all operators then they will not feel so inclined to port thereby depressing annual port rates.

Low ARPU

Over time, MNP has shown to increase the number of post-paid customers with a consequential increase in ARPU. Means that the cost of each port is relatively high, 3-4 times the monthly ARPU of the average ported customer.

Very high pre-paid rates of 99%

Again, over time MNP has shown to increase the number of post-paid customers. Statistics show that pre-paid customers are less likely to take their number when they change operator moderating annual port rates.

Termination rates can be moderated

RURA lowering termination rates, in parallel with any MNP implementation, is a key enabler for operators to shrink on-net / off-net price differentials. Relatively high termination rates will make it more difficult for operators to shrink on-net / off-net price differentials weakening one of the key competitive tools for operators.

Very low cost of market entry

This encourages more people to take up service, increasing competition and overall penetration rates. This fosters a lack of loyalty to any particular mobile number or operator; increasing churn rates and number usage putting pressure on this scarce resource.

On-net / off-net price differentials – which in one case means that off-net charges are 4 times that of on-net

MNP has been shown to flatten on-net / off-net price differentials which eliminates one of the primary reasons for multi-SIM use by customers. This will continue to encourage customers to carry multiple SIMs so that they can always enjoy the lower on-net charge depending on who they call.

| Table 37 – MNP advantages & disadvantages |

Given all of the above, InterConnect firmly believes that RURA need to make a definite decision on MNP because of their previous statement (made in 2011) that they will implement MNP as soon as the headline penetration rate reaches 60%. This condition was met in 2013. To delay again now risks the assumption that RURA will always find ‘another reason’ to delay this important competitive step. A positive decision also removes uncertainty for operators and consumers alike, providing a categorical message that RURA is interested in enhancing competition for the good of all consumers in Rwanda.

There are also the additional issues as highlighted in various parts of this report, which are:

- That MNP is a consumer rights and competition issue – not a cost issue
  - People need the freedom to make informed choices about their mobile service
  - Operators need to know that if they do not provide a good service at reasonable prices people will move to another operator
• That market share is not changing, and will not change significantly unless some action is taken

• Multi SIM use will increase – encouraged by operators with largest market share

• Prices will remain high
  
  o During the industry workshop the representative from the consumer rights group stated that ‘high prices are an issue’ adding that ‘people do not feel they are getting value for money, especially from MTN’
  
  o On-net / off-net price differentials are likely to remain high – this favours operators with a large market share as they offer the prospect of a larger proportion of on-net calls

• With MNP there is no straightforward ‘spend this amount of capital and reap this level of benefit’ equation

But it should be noted that making the decision to implement MNP has not been easy for any country/regulator and yet, to date, approximately 80 countries have decided to implement. Regulators have always taken the position that consumer rights, the freedom to make choices and increased competition has dominated the argument in favour of implementation.

Having reviewed the mobile market in Rwanda, as detailed in the body of the report, InterConnect concludes that further delay from RURA on implementing MNP is in fact delaying what will inevitably become a necessary competitive tool. Therefore, InterConnect concludes there are no fundamental reasons not to implement MNP and that RURA should consider stating that they will implement at their earliest opportunity.

Recommendation – that RURA adopt Option 1 as documented above.

In making this decision RURA should be aware that:

• When you introduce MNP, the goal is not to port as many numbers as possible, the goals are to acknowledge consumer rights and increase consumer choice.

• This will be achieved by improved competition, increased investment in the telecoms sector and stimulated innovation such that customer satisfaction increases, customer service improves, multi-SIM use decreases and ARPU should increase (over the long term)

Given that RURA move forward with MNP, they will need to be pro-active throughout the implementation of MNP.

• RURA should state that they will launch MNP by the end of 2015 (for example) which provides scope for market improvements leading up to the time of launch

• RURA should state a date for the start of the project and initiate a Steering/Management group to oversee the implementation

• RURA must take an on-going Project Management role to ensure targets are met
However, if RURA decide to adopt Option 2 then InterConnect would also support that decision, with the following caveats:

- That RURA provide an explicit date when the implementation will begin, and the consequential date when MNP will be launched
- That RURA have a clear and firm plan on the measures it will take to improve the competitive position in Rwanda during the delay
- That RURA issue a statement in line with the example provide in Option 2 above

**InterConnect Recommendations:**

That RURA adopt Option 1 as documented above and initiate a project to implement MNP.

RURA should issue a statement declaring that on a certain date (by the end of the year 2015?) operators will make Mobile Number Portability available to the consumers of Rwanda

That RURA dismiss Options 3 and 4

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- Option 4 because of the 2011 statement from RURA that they will implement MNP given the correct circumstances, and the commitment made in Law No. 44/2001 of 30th November 2001 that ‘The Regulatory Board must investigate the possibility of number portability use in Rwanda or elsewhere and submit a yearly report to the Minister having Telecommunications in his/her attributions.’
Appendix A. **Porting Administration**

When considering NP implementation there are two distinct aspects, Administration and Call Routing. Administration is the processes associated with accepting and implementing customer orders to port their numbers. Call Routing is the process of correctly connecting a call to the intended recipient. The routing options are discussed in Appendix B.

There is a clear relationship between these two aspects but they are distinct and implementation decisions for them can be taken independently of each other, whilst taking into account the interfaces between the two aspects. However, in most modern implementations the two aspects are considered as a single installation – we have kept them separated for explanation purposes.

In terms of the administration and management of port orders the most common used solutions are described below.

**Implementation Options - Bilateral Solution**

Internationally, it is rare to find current occurrences where a manual (or bilateral) solution is adopted as flexible, modern centralised systems are readily available. However, in environments where port volumes are projected to be low they can be considered, either as part of an interim solution or as part of the long-term solution, because of the perceived quick and low cost to implement.

With manual solutions, each operator agrees the content and handling process for porting orders with every other operator independently. The porting orders are passed between the operators as faxes; emails; FTP transfers or some other mechanism. Customer service advisers process the orders manually as they would with any other provide, cease or modify service order. The order handling complexity arises because two operators must co-ordinate these manual processes and, potentially, network data changes, a labour intensive process. The network co-ordination issues can be reduced by the adoption of a central reference database of ported numbers, but this increases the implementation cost and time.

These manual solutions, by their nature, result in the need for ‘bi-lateral’ agreements between individual pairs of operators, often with a contract established between each pair for the management of the relationship. A critical factor in implementing the bi-lateral solution is the number of interfaces with other operators. Where only two operators exist a peer-to-peer relationship exists for MNP, this is straightforward.

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**Figure 14 - Simple Peer-to-Peer Administration Relationship**

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34 The network co-ordination issue does not arise if an onward routing approach is adopted for calls.
This are normally agreed in one of two ways:

1. Each time a pair of operators agrees (or has a regulatory requirement) to establish the ability to port numbers between them a contract is negotiated to manage that specific relationship.

2. An ‘industry group’ negotiates basic principles for the management of porting relationships and an industry agreed ‘template’ is produced. Pairs of operators use the ‘template’ to establish the contract between them. Some operators choose to ‘individualise’ an agreement dependent on the circumstances surrounding the relationship. The ‘template’ approach should speed-up the process of contract agreement but ‘individualised’ agreements extend the time.

The first option leads to a higher management overhead against the individual contract for each relationship. The second option results in simplified on-going contract management.

The existence of multiple operators significantly complicates the situation and quickly leads to a highly complex series of peer-to-peer relationships, with management problems arising with data integrity, maintenance and dispute resolution etc.

As can be seen from Figure 15, if eight mobile operators are porting numbers, there are 28 Peer-to-Peer administration interfaces creating a continuing relationship management overhead. Clearly, this overstates the current situation in Rwanda. The three operators would require 3 agreements and contracts, as shown in Figure 16.
CSI = Customer Service Interface

Figure 16 - Possible Rwandan Peer-to-Peer Administration Relationship
Some advantages and disadvantages of the peer-to-peer approach are:

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well understood, following the models (initially) established in the UK, Germany, France, Italy, Austria, Eire and elsewhere</td>
<td>Difficult to achieve rapid ‘time to port’ - 2 days is probably the best that can be achieved, due to the manual co-ordination necessary between operators</td>
</tr>
<tr>
<td>Supports all the alternative routeing scenarios especially onward routeing / call forwarding / and other switch based solutions for call routeing</td>
<td>If a centralised reference database is to be used then the manual process must include the updating of the database</td>
</tr>
<tr>
<td>Inexpensive initial deployment for the first agreement</td>
<td>Becomes more costly and complex with increasing ported numbers and number of operators</td>
</tr>
<tr>
<td>Can be established relatively quickly as each operator is responsible for their internal systems with the information flow between operators the only common development</td>
<td>Requires the creation of commercial bilateral agreements between operators. Operators need to know the terms of every existing bi-lateral agreement</td>
</tr>
<tr>
<td>Facilities can be increased as operators are added</td>
<td>Operators need to track changes to every participant’s technical capabilities</td>
</tr>
<tr>
<td></td>
<td>There is no central reference point of ported numbers, which is critical to an ‘All Call Query’ call routeing solution</td>
</tr>
<tr>
<td></td>
<td>Each operator must inform every other operator about every customer porting their number – as there is no broadcast / synchronisation facility</td>
</tr>
</tbody>
</table>

Table 38 - Advantages and disadvantages of a peer-to-peer approach

Unsurprisingly, there are a number of levels of sophistication on this basic approach, which are discussed below.

Bilateral, Fully Manual Solution

This is the most basic of the order handling and management solutions and involves no inter-operator automation, centralised records or report generation facilities. The interaction between pairs of operators is based on sending port requests by either Fax or Email (sometimes backed-up by hard copies). All acknowledgement, verification and authorisation processes are conducted in this way or by phone call.

People based within individual service providers are responsible for managing the port request within their own operations, so all customer care and management Operational Support Systems (OSS) / Back Office Support Systems (BSS) are updated by the usual ‘in-

35 For example if one operators changes from using fax for communicating details of customer orders to, say, an email based system then all other operators must change their processes to accommodate the change whilst retaining their existing processes for the other operators. If a second operator then changes to a ‘File Transfer Protocol’ then all other operators must adopt this whilst retaining both the fax and email processes.
house’ transactions and interface methods. This order handling and management option has become unpopular because operators see it as cumbersome and, in the medium to long term, costly to manage and resource. However, it can be cost effective to establish and run in the short term. Also, where port volumes remain low in the medium to long term, it is perceived as being a cost effective option.

The primary costs associated with this approach are customer service people for each operator plus some management time.

Based on available data, the average person can complete 24 ports per day or 5280 ports per year. However, a person is required for each port in both the donor’s and the recipient’s operation centre reducing the effective transaction rate per employee to 12 ports per day, equalling 2640 ports per year. This means that the operators of Rwanda would have to employ 16 – 18 people (permanent employees) between them just to handle our estimated MNP port order requests.

**Bilateral, Semi-automated Solution**

Where bi-lateral solutions have been deployed, individual operators have sought to improve the productivity of their CSI function (Figure 16) by developing automation of their own porting transactions. Frequently this is achieved by one operator developing a bespoke automation system that interacts with their own customer care and management OSS / BSS systems. That operator then introduces the associated electronic interfaces, on a bilateral basis, between itself and the other operators. Normally it is not offered as a solution for the general industry group to use as it is optimised for the developing operator’s individual OSS / BSS systems.

This approach retains the disadvantages of all bilateral systems; there is no central management of order flows and consequently no centralised order process, records or report generation. It is, however, a more efficient use of employees as the operators only use manual procedures for exceptions.

As the level of automation is specific to individual operators, this solution is impossible to cost within a generic exercise such as this report. However, for the operator using it, it is more expensive to implement but less costly to use per port. There is no cost impact the other operators who continue with a fully manual service.

Inherent in this approach is the development cost, time and risk.

**Bilateral, Automated Solution**

The Bilateral, Semi-Automated approach can be extended so that two or more service providers fully automate their gateway / CSI (and the associated interfaces) simultaneously. This is achieved by either purchasing ‘off the shelf’ propriety CSI or developing a bespoke gateway that is used as an automated order-handling device. The CSI still has to be developed to interact with the operator’s OSS and / or BSS systems.

Oman adopted this approach, mainly because there are just two competing operators. Other countries have developed bespoke solutions between the operators, the cost of which are not publicly available.

The Bilateral approach (in itself) does not include any kind of common reference database, 0. In practice, it has disadvantages as the fully manual system of having no centralised
records or centralised report generation. However, it does, or at least should, speed-up the porting process permitting port times measured in hours and has the potential to significantly reduce order-handling errors.

**Implementation Options – Centralised System**

To overcome the complexities of a bilateral solution the concept of a Centralised, Automated, System, referred to as an order handling hub or a Number Portability Clearinghouse (NPC) has been developed. This has become one of the most common types of NP solutions, being implemented in many countries worldwide.

![Figure 17 - Centralised Administration Arrangements](image-url)
Some advantages and disadvantages of adopting a centralised solution are:

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single standard mechanism supporting customer order handling, service provisioning and notification of changed call routing</td>
<td>Each operator must implement a ‘gateway’ and / or electronic interfaces to their network and OSS / BSS systems to support the electronic data flow</td>
</tr>
<tr>
<td>Enables timely, accurate and efficient processing of number ports</td>
<td>Generally perceived to be more expensive than bi-lateral to implement, although likely to result in cheaper on-going costs per port</td>
</tr>
<tr>
<td>Can achieve port times measured in hours</td>
<td>Solution works best when call routing is managed via an ACQ or IN solution so that routeing information is automatically and simultaneously updated in all the networks</td>
</tr>
<tr>
<td>Achieving mandated ‘port times’ is monitored and managed by the Administration Service reducing regulatory risk to the operators</td>
<td>The risk of a potentially lengthy period to reach agreement between operators on the tender specification and subsequent contract terms, including functionality availability; ownership and actions in the event of default by supplier – the local regulator can reduce this time by taking an active role</td>
</tr>
<tr>
<td>Enforcement of the business rules(^\text{36}) agreed to by the operators.</td>
<td>Operators may perceive a loss of control of the process.</td>
</tr>
<tr>
<td>Can be licenced by RURA to provide a service to all operators or it can be managed jointly by a consortium of the operators, on a management contract by a neutral third party or by a neutral third party paid per port (creating financing options to reduce the initial cost)</td>
<td></td>
</tr>
<tr>
<td>Being licenced by RURA or use of a consortium or third party reduces the risk that rival operators can access commercially sensitive information</td>
<td></td>
</tr>
<tr>
<td>Automation of the exchange of number portability information between all operators</td>
<td></td>
</tr>
<tr>
<td>Provides and maintains a master or reference number portability database</td>
<td></td>
</tr>
</tbody>
</table>

Table 39 - Advantages and disadvantages of a centralised solution

\(^{36}\) The business rules are the process parameters used by the centralised system to monitor and manage individual MNP orders. These cover, for example, the maximum permitted time from order placement to port completion; along with the target times for the intermediate tasks that comprise the total process.
Based on our knowledge of costs incurred in other countries, see Table 40, and assuming that third party suppliers will 'scale' their software licence costs appropriately, our estimated system costs for Rwanda are:

<table>
<thead>
<tr>
<th>Country</th>
<th>Middle east country</th>
<th>Kenya</th>
<th>South Africa</th>
<th>Ghana</th>
<th>Nigeria</th>
<th>Rwanda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>2.7m</td>
<td>41m</td>
<td>50m</td>
<td>25m</td>
<td>176m</td>
<td>10.7m</td>
</tr>
<tr>
<td>Quantity of SIMs</td>
<td>5.4m</td>
<td>27m</td>
<td>65m</td>
<td>27m</td>
<td>127m</td>
<td>6.84m</td>
</tr>
<tr>
<td>Annual port rate</td>
<td>Estimated 2.5% (135K ports in the first year)</td>
<td>0.3% (81K per annum)</td>
<td>0.35% (225k per annum)</td>
<td>1.6% (360k ports in the first year)</td>
<td>0.15% (180k in first year)</td>
<td>Estimated 1% (46.25K ports in the first year)</td>
</tr>
<tr>
<td>Set-up charge</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Price per port</td>
<td>$8.00</td>
<td>$2.00</td>
<td>$4.70</td>
<td>$0.80 - $2.50 (actual is $1.00 due to volume related discount)</td>
<td>$1.20</td>
<td>Estimated at $3 - $6 per port including annual running charges</td>
</tr>
<tr>
<td>Annual charge</td>
<td>None</td>
<td>Unknown</td>
<td>$1m (annual running cost – this appears to be included in the $5 per port charge)</td>
<td>$400 (to the whole industry, this adds another $1.10 per port)</td>
<td>Transaction charges only (annual running cost – included in the $1.20 port charge)</td>
<td>Included in the price per port</td>
</tr>
</tbody>
</table>

Table 40 - Per port costs from selected countries

The estimated price includes all of the following:

- Third party Helpdesk
- Hardware & Third party software
- Application software licenses
- Secure data centre / hosting facility
- Backup (disaster recovery) facility
- First line technical support
- Second line technical support
- System monitoring
- Network connectivity
The ‘whole industry’ cost for a third party system which will include the order handling administration and the reference data base is estimated as $3 - $6 per port. When compared with the comparative information in the table above this seems high. This is because it is unlikely that Rwanda will benefit from the volume discounts other countries, with higher port volumes, benefit from.

The cost of operators connecting their systems and sales outlets to the centralised system will vary depending on the functionality e.g. a secure ‘Web type’ access (this is the usual arrangement) or dedicated links.

There is also the need for each operator to support their people with a ‘first line’ Helpdesk providing help and assistance with centralised system access and order flow management.

Finally, there are the interface development costs, the cost for each operator to interface their own OSS / BSS systems with the centralised system. This cost depends on the level of automation individual service provides feel is appropriate for them. Propriety, fully automated interface (a gateway), can cost up to £500,000. However, this functionality can be developed ‘in-house’, or even use manual process to take the orders and update their own OSS / BSS systems accordingly.

It is worth noting at this stage that only the centralised automated system includes the costs of a Central Reference Database (CRD), which is essential for ACQ Call routeing, and is an additional cost for bilateral solutions.

Most vendors will offer a number of financing options to the operators to mitigate the high initial cash flow.

The organisational options for the vendor relationship are:

- The system could be licenced by RURA to provide a service to the operators on a pay per use approach (as with Ghana, see below);
- The operators may choose to form a consortium to jointly purchase and own the facilities;
- As a consortium they can enter into some form of financing arrangement with the supplier;
- They may seek a neutral third party (possibly a supplier) to own the facilities and adopt a pay per use approach.

The recent Ghana experience is relevant to Rwanda, despite the different populations. The central reference database and port order clearing service is run under NCA authorisation by Porting Access Ghana, a joint venture between PortingXS of the Netherlands and CIS Ghana.

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NCA considered it vital that the per-port charge should be moderate compared to market ARPU, helping operators feel more comfortable in fully subsidising the porting fee for all types of customers. This results from their time to recover the porting fee being reasonable and low risk. The policy has been successful as no operator in Ghana charges their customers for porting in, although they are permitted to do so.
Summary

All the options require some form of development by the operators with inherent time, cost and risk issues. In the case of the ‘manual’ solutions, this development needs to focus on new screen based transactions for the employees. These transactions are adapted from existing provide and cease service transactions. In addition there is the need to identify include a new ‘number status’ of ported in customer and number plan records to ensure that the number is not assigned for new service.

In the case of the centralised solution, there is an additional development, to integrate the system interfaces with operator’s existing OSS / BSS systems.

The absence of the central data reference point in the manual options creates a significant risk from data errors and corruption and along with limitations that prevent a ‘future proof’ approach. Further, the absence of a data reference point constrains the call routeing options. Whilst such a data reference point can be added to the manual solutions it increases their costs and probably negates any perceived cost advantage of manual solutions. Consequently this is a critical issue.

Therefore, a centralised automated solution is the correct one for Rwanda.
Appendix B. Routing Solutions

Four NP routing solutions are available allowing cost effective deployment, given various levels of penetration of ported numbers in different countries. A guiding principle throughout this report is that the technical solutions are fully compatible across all operators’ networks and with each other to facilitate migration and phased introduction by all operators.

The four solutions are:

<table>
<thead>
<tr>
<th>On-Switch only</th>
<th>1. Indirect Routing (onward routing)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Direct Routing (Inter-network Drop-back)</td>
</tr>
<tr>
<td>On-Switch / Off-Switch combinations</td>
<td>3. Direct Routing (Query on Release)</td>
</tr>
<tr>
<td></td>
<td>4. Direct Routing (All Call Query)</td>
</tr>
</tbody>
</table>

Table 41 - Call Routing Solutions

Onward Routing was designed with the intention of allowing rapid implementation, and was deployed in some countries. However, no recent implementation has included this solution. This solution always involves routing calls via the donor network.

Inter-network Drop-back is an enhancement of the Onward Routing solution that improves the routing efficiency of Onward Routing.

Query on Release is a variation of the ‘off-switch’ All Call Query solution that reduces the number of calls requiring database access; hence this solution may be deployed before an All Call Query solution is justified by volume and cost.

All Call Query is an ‘off-switch’ solution that routes the call directly from the originating network to the recipient network, always bypassing the involvement of the donor network. The solution requires a database query that can be the either a local database (updated by the central reference database) or the central reference database itself.

With all these solutions, the only mandatory requirements necessary (for RURA to specify or endorse) relate to information passed across network boundaries. Actions within a network are operator specific and need not be subject to any constraints, provided interconnection requirements and obligations are met. To aid clarity of explanation, typical call routeing scenarios are included in the following descriptions.

Onward Routing

In early fixed-line portability implementations and in cases where port volumes are projected to remain low in the long term, the initial NP solution is an Onward Routing solution. With the exception of calls originating in the recipient network exchange, calls to ported numbers are routed to the donor network using the dialled number. A Routing Number (Prefix) is

---

37 Also known as Call Forwarding

38 In addition, you can get calls originating and terminating in the donor network when Resellers buy wholesale capacity and brand the service so that customers think that they have changed Service Provider.

39 These prefixes form part of the National Number Plan
identified and added by the donor network and to the dialled number in the call signalling fields and the call is then routed onwards to the recipient network using the Routing Number.

Calls originating in the recipient network can be routed to the called line without the call leaving the recipient network.

Figure 18 and Figure 19 show typical simplified call flows to aid understanding. In practice, for example, drop-back may be used within the donor network to improve routing efficiency, or a network may determine and add the Routing Number at a location other than the donor exchange (for example using a database query at an interconnect switch).
Characteristics of Onward Routing:

- Onward Routing allows rapid implementation and deployment.
- Onward Routing has been successfully deployed in some countries (see Appendix G).
- Circuit usage is inefficient. Even where the donor operator implements some form of call drop back to limit the degree of tromboning within the donor network, significant levels of traffic may trombone via the donor network from operators.
- Post dial delay to ported numbers is larger than post dial delay to non-ported numbers, however, not to the extent that it would be noticeable during normal call set-up.
- The donor network is involved in routeing calls to ported numbers, and must maintain data for each ported number.

Inter-network Drop-back

In the Inter-network Drop-back solution the Routing Number is determined by the donor network but is added to the call details by a previous Network in the call set-up and not the donor network.

Initially, all calls use the dialled number to route the call to the donor network which determines the Routeing Number. The donor network then releases the call and returns the Routing Number. A previous network then adds the Routing Number to the call details and the call is then routed forward using the Routing Number to the recipient network.

A mechanism is required in each switch in the call routing to allow it to make a decision when to drop back the call to an earlier switch, or whether to route the call onwards using the Routing Number. This may be achieved on a static basis, for example where a Network has information on the drop back capabilities of previous Networks, or on a per call basis, for example using a parameter in a forward call set-up message.

Figure 20 and Figure 21 show typical simplified call flows to aid understanding.

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40 Whilst it is correct to highlight this issue because it does occur in the call-set routine, it is not significant and would not be noticeable to the customer making the call.
Characteristics of Inter-network Drop-back:

- Internetwork Drop-back improves routeing efficiency (relative to Onward Routing).
- Circuits are not held in the donor network for the call duration (except where the call originated in the donor network).
- It is a natural development from the Onward Routing (because the Call Trap and Routeing Number Determination functions are still performed in the donor network).
- The porting process established for Onward Routing continues to be largely applicable: the porting process for an individual number involves only Donor and Recipient Operators (although other operators must be aware of how to route Routing Numbers).
- International versions of ISUP do not support drop back.
- Operators must add\textsuperscript{41} other operators Routing Numbers throughout their network (with Onward Routeing, Routing Numbers only need be added within a local area).
- Post dial delay to ported numbers is larger than post dial delay to non-ported numbers\textsuperscript{40}.
- The Donor Network is involved in routing calls to ported numbers, and must maintain data for each ported number.
- Principles of interconnect charges for calls which utilise drop back are not defined.
- The migration from Internetwork Drop back to All Call Query or Query on Release is relatively complex.

**Query on Release**

All calls are routed using the dialled number to the donor network. The donor network determines that it no longer hosts the ported number and the call is released. Two variants are possible: either the release indicates ’spare number’, or the release indicates ‘ported number’. Donor network circuits are then released.

\textsuperscript{41} Prefix addition – the process of adding the specific prefix of the RN at the front of the digit stream.
An earlier network in the call set-up then determines the Routing Number (if ‘ported number’ variant is used), typically by referring to a local or central database. The Routing Number is added to the call details and the call is then routed to the recipient network using the Routing Number.

As with Inter-network drop-back, a mechanism is required to allow a network to decide whether to release a call to a previous Network, or whether to determine and add the Routing Number. This may be achieved on a static basis, for example where a Network has information on the reference database query capabilities of previous Networks, or on a per call basis, for example as indicated by a parameter in a forward call set-up message.

Since the dialled number may potentially be any number the database will contain a large quantity of numbers, and hence it is expected that the database will be held external to any exchange. For instance, the database may be a Service Control Point and accessed using Intelligent Network mechanisms.

However, the actual implementation is a network specific matter and is for each operator to determine.

![Diagram](image)

Figure 22 - Query on Release, call originates in a 3rd party network
Characteristics of Query on Release:

- Query on Release improves routing efficiency (relative to Onward Routing).
- Circuits are not held in the donor network for the call duration (except for calls originating in the donor network).
- It is only necessary to query the Number Portability database for calls to ported numbers.
- The donor network need not access data for calls to a ported number.\(^{42}\)
- The migration from the Query on Release solution to the All Call Query solution is relatively straightforward.
- Post dial delay to ported numbers is larger than post dial delay to non-ported numbers.\(^{40}\)
- The donor network is involved in routing calls to ported numbers.
- The porting process established for Onward Routing is largely inapplicable: the porting of an individual number will affect all participating Operators.
- Synchronisation of Number Portability data across databases is complex.

**All Call Query**

In the All Call Query\(^ {43} \) (ACQ) solution the originating network, or possibly a transit network acting on its behalf, determines and adds the Routing Number. The call is then routed using the Routing Number to the recipient network.

\(^{42}\) Some qualification is required: the donor network does need to maintain data for each exported number. If the donor supports only Onward Routing this data will typically be in the donor exchange. If the donor network utilises Query on Release this data will typically be external to any exchange. In either case if a previous network supports Query on Release then it is not necessary for the donor network to access the data. If no previous network supports Query on Release, or if the donor is the Originating Network, then the data must be accessed.
The determination of Routing Number involves a query to either a database or to reference data, held on the centralised database but downloaded to individual operator’s networks. Since the dialled number may potentially be any mobile number the database will contain a large number of numbers, and hence it is expected that the database(s) will be held external to any exchange, e.g. the database may be held in a neutral location or in an NRA’s or operator’s building and accessed using IN mechanisms.

Optionally, networks may access the database only for dialled numbers in ranges known to contain ported numbers. This solution reduces the quantity of ‘database dips’ (which may incur a ‘per dip charge’) however, it does carry an on-net cost which depends on the network’s decode capacity. Some mechanism may be necessary to avoid multiple database queries by successive networks for example via network ‘flags’.

Some process may be necessary to cope with database inconsistencies (inconsistencies may occur, inter alia, whilst the process of porting a number is taking place). During this period the database may be out of synchronisation with the ‘true’ situation and a process is required to avoid consequential routing errors.

The model in Figure 25 has been adapted from ETSI Guide EG 201 367 V1.1.1 (1999-02) entitled ‘Intelligent Network (IN); Number Portability Task Force (NPTF); IN and Intelligence Support for Service Provider Number Portability – Figure 2’ which is available on the ETSI Web Site.

It shows the optimal routing administration solution which includes the centralised order handling platform and allows automation of port orders between participating operators and the central reference database (CRDB) of ported numbers.

43 Also known as a Centralised Data Base solution
Figure 25 - Portability Routing Administration Model

Figure 24 shows the originating network directly querying the CRDB. In reality, most countries opt for a solution where each operator maintains a copy of the CRDB data within their own networks. They use this local copy for routing queries.

When a port order is successfully completed, the order handling platform updates the CRDB, and the CRDB then updates the operators' local copies using a broadcast message. This ensures that the local copies are synchronised by CRDB and that all operators have the same information at the same time, avoiding routing errors.

Individual operators can also request periodic bulk downloads of the CRDB information. This is not part of the normal day-day porting activities but replaces corrupt or missing data as the need arises.

This complete solution (centralised administration and reference database) is often referred to as a National Clearinghouse or Number Portability Clearinghouse (NPC) as is commonly used in NP implementations around the world. There are several vendors offering this solution or variations of it.

Characteristics of All Call Query

- Optimised call routing.
- The donor network is not involved in calls to ported numbers.
- Post dial delay for calls to ported numbers is the same as post dial delay to non-ported numbers.
- Post dial delay for calls to non-ported numbers may be greater than when All Call Query is not performed.
- All operators who require knowledge of the number sported.
- The initial cost of implementing a MNP database can be relatively high.
- Arrangements are required to synchronise Number Portability data across all databases.
Summary

As stated in section 5.1 'There is a crude (and very approximate) trade-off between set-up costs (and implementation time) and on-going direct (administration and routing) costs, which varies with the implementation approach adopted. Very broadly, the administration and routing techniques that are fastest and cheapest to implement incur the greatest costs per port or per call in the medium to long term. For instance, "call forwarding" is probably the easiest and quickest routing solution to implement, thus it has low set-up costs. However, it is one of the most inefficient routing solutions per call and therefore has the highest routing costs.' Other solutions also carry some element of cost saving (although the exact amounts are impossible to calculate) but are seen as interim measures and are not regarded as long term solutions. Therefore, any cost savings must be measured against the cost of changes which will inevitable be made to move to the long term ‘future proof’ solution i.e. an All Call Query solution.

In the case of the centralised ‘central reference database’ solution, there is additional development work needed to integrate with the operator’s networks in order to accept routing change (broadcast) messages in order to correctly route calls to ported and non-ported numbers.

However, the absence of an automated central data reference point creates a significant risk from data errors and corruption and along with limitations that prevent a ‘future proof’ approach. Further, as stated in the administration summary (0), the absence of a data reference point constrains the call routing options. Whilst such a data reference point can be added to a manual solution it increases the costs and probably negates any perceived cost advantage of a manual solution. Consequently this is a critical issue.

Therefore, a centralised automated solution, which includes a central reference database updated automatically from the order handling function of the centralised solution, and used for direct routing, is the correct one for Rwanda.

This approach meets international best practice standards as seen in the table of benchmark information provided in Appendix G where close to 60% of all MNP implementations have an ACQ solution, with only 8.8% of countries have a purely onward routing solution (the remainder having a hybrid solution or are undecided). Further, this type of solution has been used in all recent implementations as stated in section 1.2 and can aid efficient routing for fixed to mobile and international incoming calls through the inclusion of the appropriate operators.

Nota Bene

The following are extracts from technical ETSI/3GPP documents which provide call routing information in support of the recommendation for Rwanda to adopt a centralised automated solution, which includes a central reference database updated automatically from the order handling function of the centralised solution.

They are provided here to reinforce the ‘future proof’ nature of the recommended solution which is designed to be technically neutral.

ETSI TS 123 066 V4.0.0 (2001-03)
Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); Support of Mobile Number Portability (MNP); Technical Realisation; Stage 2 (3GPP TS 23.066 version 4.0.0 Release 4)

Normative Annex A of the present document describes the technical realisation of the handling of calls to ported UMTS or GSM mobile subscribers using IN technology.

3GPP TS 23.140 Release 6 V6.16.0 (2009-03)

3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; Multimedia Messaging Service (MMS); Functional description; Stage 2 (Release 6)

Annex H (normative):

**Recipient MSISDN address resolution based on IMSI.**

Only if recipient addressing resolution mechanism based on a MAP query is used, the procedures defined in this annex shall be followed.

For those recipients MSISDN addresses that appear in an MM and belong to an external MMSE, the originator MMS Relay/Server shall translate (resolve) them to a routable RFC 2822 [5] address that shall be used in the “RCPT TO” SMTP subsequent commands.

Recipient MSISDN address resolution procedure:

1. The originator MMS Relay/Server determines that the recipient MSISDN address belongs to an external MMSE.

2. The originator MMS Relay/Server shall interrogate the recipient HLR for the associated IMSI by invoking the standard GSM-MAP operation SRI_for_SM as described in [62] and [64]. This operation should be invoked with the SM-RP-PRI parameter set to ‘true’. As an optional feature, to complement the mandatory SRI_for_SM operation, the Relay/Server may also support the Send_IMSI MAP operation as described in [62] and [64].

3. In case of a successful interrogation the originator MMS Relay/Server shall determine the MCC and MNC and look up for a matching entry in an IMSI table. The IMSI table shall maintain the associations of MCC + MNC → MMSE FQDN. Subsequently the originator MMS Relay/Server shall be able to resolve (e.g. using standard DNS) the MMSE FQDN to an IP address for establishing the SMTP (MM4) session.

4. If the recipient MSISDN is not known to belong to any MMSE (No entry in the IMSI table, GSM-MAP error, etc.), the MMS Relay/Server shall invoke an appropriate address resolution exception handling procedure. These procedures are not standardized.

**NOTE:** Although the mandatory GSM-MAP operation SRI_for_SM is a standardized operation, in some cases HLR is unable to return the correct recipient’s IMSI number (GSM MAP error received) due to e.g. recipient’s settings or recipient network’s
settings. In that case MMS Relay/Server shall invoke an appropriate exception handling procedure. These procedures are not standardized.

The above procedure complies with the Mobile Number Portability (MNP) requirements and technical realization as they are specified in [63] and [64] respectively. In addition, this procedure complies with the Non-call related signalling MNP procedures for direct and indirect routeing as it is described in [64], Annex B.

Figure 26 provides an example message flow diagram:

![Message flow diagram](image)

Figure 26 – Message flow of the recipient MSISDN address resolution based on IMSI

3GPP Work Item = 60188 (MNP) "GSM mobile number portability euro MNP / North American MNP" [R99]

This page lists the 3GPP Technical Specifications and Reports which are or might in future be associated with or affected by the above work item. Click on the spec to open its web page.

<table>
<thead>
<tr>
<th>Spec</th>
<th>Title</th>
<th>WG</th>
</tr>
</thead>
<tbody>
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<td>23.018</td>
<td>Basic call handling; Technical realization</td>
<td>C4</td>
</tr>
<tr>
<td>09.02</td>
<td>Mobile Application Part (MAP) Specification</td>
<td>C4</td>
</tr>
<tr>
<td>23.066</td>
<td>Support of Mobile Number Portability (MNP); Technical realization; Stage 2</td>
<td>C4</td>
</tr>
<tr>
<td>03.18</td>
<td>Basic Call Handling</td>
<td>C4</td>
</tr>
<tr>
<td>22.066</td>
<td>Support of Mobile Number Portability (MNP); Service description; Stage 1</td>
<td>S1</td>
</tr>
<tr>
<td>02.66</td>
<td>Support of Mobile Number Portability (MNP); Service description; Stage 1</td>
<td>S1</td>
</tr>
<tr>
<td>03.66</td>
<td>Support of GSM Mobile Number Portability (MNP); Stage 2</td>
<td>C4</td>
</tr>
<tr>
<td>29.002</td>
<td>Mobile Application Part (MAP) specification</td>
<td>C4</td>
</tr>
</tbody>
</table>
3GPP Work Item = 60144 (-) “Mobile Number Portability” [R99]

This page lists the 3GPP Technical Specifications and Reports which are or might in future be associated with or affected by the above work item. Click on the spec to open its web page.

<table>
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<td>C4</td>
</tr>
<tr>
<td>23.066</td>
<td>Support of Mobile Number Portability (MNP); Technical realization; Stage 2</td>
<td>C4</td>
</tr>
</tbody>
</table>
Appendix C. **Cost Recovery**

**Categories of cost to be recovered**

It is evident that the establishment of Number Portability generates costs for the telecommunication service providers (operators) involved. Given that these costs arise because customers are changing operator, the operators (especially those losing the customer) will seek to recover their costs.

The three distinct types of cost involved with mobile number portability are:

- Set-up / Establish Capability
- Administration
- Call Routing

However the actual costs incurred by operators varies depending on a number of factors including the solution that is selected; the size and complexity of the individual operator’s network; and the network technology used. These costs will be incurred irrespective of any competitive advantage (or otherwise) gained by any individual operator.

**Per Operator System Set–up Costs**

Operators’ incur system set-up when they establish the capability to provide NP to customers, irrespective of whether any customer actually ports their number or not. As such they can be considered as capital (Capex) costs, although predicted porting rates can be used to convert them to equivalent per port costs (Opex) for cost comparison purposes.

These costs result from network and system modifications, configurations or re-configurations, including adapting or replacing software. Also included are the test costs incurred in testing the new / modified systems and inter-operator and centralised service and/or database testing.

Set-up costs can be broken down into the following categories:

- **Common set-up costs**: These are the costs incurred in setting up any centralised solution, i.e. a portability clearinghouse and / or a reference database.
- **Per operator set-up costs**: These are the costs incurred by individual operators within their own operations, including the costs to set up access to any centralised services and to modify their networks and OSS/BSS systems, e.g. billing and mediation, customer record systems and maintenance systems.
Costs of a Centralised Database

As part of the set-up costs, costs are incurred in the establishing a centralised database. These costs include (but may not be limited to) the following:

- The cost of the tender / contractual process to procure the centralised database;
- Dependent detailed solution selected, there may be the need to pre-populate the database numbering data which will involve the Numbering Plan Administrator (RURA)\(^4\);
- The cost to each operator to establish connectivity with the database. This may be a VPN or dedicated links. The on-going cost of the connection is included in the per port costs;
- The cost of taking downloads of information from the database. These include an initial bulk download of all / any number data and the on-going ‘Broadcast’ downloads of individual number changes or periodic port activity updates\(^4\);
- There may be additional costs for disaster recovery arrangements, as agreed at the contract stage.

Costs of the Number Portability Clearing House

As part of the set-up costs, costs are incurred establishing the National Clearinghouse. These costs will include (but may not be limited to) the following:

- The cost of the tender / contractual process to procure the national clearinghouse\(^4\);
- The cost for each operator to establish interconnection with the clearinghouse, either via dedicated links or on a per-activity basis;
- The cost of negotiating the order processes and procedures. These processes and procedures need to be agreed between the operators and with RURA before working with the clearinghouse supplier to build them into the clearinghouse as part of the establishment process;
- There may be additional costs for disaster recovery arrangements, and as agreed at the contract stage.

Per Port Costs

These costs are incurred by operators every time a customer ports. These are Current Expenditure (Opex) costs.

\(^4\) For example, if the database is to contain all mobile numbers, then they will need to be pre-populated as part of the establishment process. However, if the database is to contain only ported mobile numbers then there will be no requirement to pre-populate numbers. Ported number routing information will be loaded, individually, as part of the individual port activation process. In practice, most implementations contain all the appropriate numbers from the National Numbering Plan (NNP).

\(^4\) All routing information associated with ported numbers is stored on a single routing table; there is no justification for the provision of separate routing tables for fixed and mobile ported numbers. The reason is that calls that originate on mobile networks are not always for mobile numbers, many are destined for fixed services. This is also true of calls that originate on fixed networks, that many calls are destined for mobile destinations. Since the goal is direct routing, all Service Providers need to know what the correct routing information is, no matter whether the originating number is fixed or mobile.

\(^4\) This cost is often borne by the regulator (RURA in this case) who tends to manage the process through to completion whether or not service providers are involved in the selection process.
These are the administrative costs incurred in the process of transferring a customer number from the donor operator to the recipient operator, and include the need to modify the customer’s data in the OSS / BSS systems of the donor network, and as the costs in the establishing the revised call routing details for the ported number.

Per Port costs include, but are not limited to, the following:

Service ordering procedures:

- Use of the inter-operator NP service management procedures and process (service activation / deactivation or modification) either via a centralised order handling service or manual (bilateral) order handling service.
- Validation and authorisation of individual port activation requests.
- Processing of individual port activation requests, via an agreed inter-operator business process

Provisioning - modification of user data in the information systems:

- Processing the order and updating business and operations systems
- Customer care and billing systems (including customer accounts and maintenance systems)
- Inter-operator accounting and billing systems

Notification - modification of user data in the network elements

- Activating the port in the network

Costs will be incurred by individual operators in using the centralised database. These costs will include (but may not be limited to) the following:

- The on-going maintenance and/or license costs that are dependent on the agreements made at contract stage.
- There may be on-going management costs for the centralised database, dependent on the agreements made at contract stage and the inter-working arrangements between the operators and RURA.

Individual operators will incur costs in using the National Clearinghouse. These costs will include (but may not be limited to) the following:

- The on-going maintenance and/or license costs that are dependent on the agreements made at contract stage.
- There may be on-going management costs for the clearinghouse, dependent on the agreements made at contract stage and the inter-working arrangements between the operators and RURA.

**Additional Conveyance Costs**

These are the additional costs incurred in routing each and every call to a ported number. These utilisation costs are Current Expenditure (Opex) costs.

These costs result from the use of resources to set up the call to the ported number and the provision of switch and transmission capacity for the duration of each ported call. These are defined as being costs *additional* to the cost of conveyance of non-ported calls. These
additional costs can result (for example) from a longer (number of network elements used) route being taken by a call to a user who has ported to a new provider.

- In the case of an onward routing solution there are always additional conveyance costs because the donor network is always involved in a call to a ported number, see Appendix B. In the worst case, this can lead to ‘tromboning’ of calls between operators leading to higher transport costs.

Figure 27 illustrates the situation. The originating operator passes the call to the donor who ‘onward routes’ the call to the recipient. However, if the originator and recipient are the same operator the call will ‘trombone’ from the originator to the donor and back to the recipient. This is a very inefficient way to route calls and causes additional conveyance charges in accordance with interconnect agreements.

- In the case of an ACQ solution using a centralised reference database the additional cost is limited to the ‘look-up’ of the data in order to route the call to the recipient network. The actual amount of these costs is determined by the contracted payments with the third party vendor. These costs are significantly reduced if the operators use a local ‘database’ in their own network for this lookup.

Table 42\(^47\) provides a good overview of the costs involved, whilst Table 43, from the same source, shows the cost drivers on the implementation of Number Portability.

---

Table 2 – Costs Incurred in Provision of Number Portability

<table>
<thead>
<tr>
<th>Number Portability</th>
<th>System set-up cost</th>
<th>Per-operator set-up</th>
<th>Per-line set-up</th>
<th>Additional conveyance</th>
<th>Other administration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-switch solutions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs involved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Software evolutions in switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adaptation of information systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creation of inter-operator service management tools and procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adaptation of maintenance and customer support procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initial programming of switches (except for 2nd number solution)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Modification of subscriber data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tromboning and non-optimal routing of calls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allocation of non-geographic numbers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Significance of costs</strong></td>
<td>High proportion of total costs</td>
<td>Small proportion of total costs</td>
<td>Very small</td>
<td>Varies depending on technical solution: but can be quite high</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Main party incurring cost</strong></td>
<td>The bulk of the costs will fall on the incumbent or donor network operator, although new entrants will also incur some costs</td>
<td>Low impact on the incumbent operator as well as other originating and transit operators</td>
<td>Medium for the incumbent and low for other operators</td>
<td>High impact on the donor network operator and medium for others</td>
<td>Very low impact on the NRA</td>
</tr>
<tr>
<td><strong>Off-switch solutions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs involved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set-up of intelligent network</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adaptation of information systems</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Creation of inter-operator service management tools and procedures</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Adaptation of maintenance and customer support procedures</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initial programming of switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to national NP database</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Modification of subscriber data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional conveyance of IN query</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Significance of costs</strong></td>
<td>Significant proportion of total cost (higher than on-switch solutions)</td>
<td>Higher proportion of total costs than for on-switch solutions</td>
<td>Very small</td>
<td>Negligible</td>
<td>Very small</td>
</tr>
<tr>
<td><strong>Main party incurring cost</strong></td>
<td>High impact on all operators, but low on other operators</td>
<td>Medium impact on all operators</td>
<td>Medium impact on the incumbent and low on other operators</td>
<td>Very low impact on all call-originating operators</td>
<td>Very low impact on the NRA</td>
</tr>
</tbody>
</table>

Table 42 - Cost Incurred in the provision of Number Portability
### Table 2.1: Identification of modifications for the implementation and provision of number portability service (system per operator set-up)

<table>
<thead>
<tr>
<th>IMPACTS</th>
<th>Categories 1 and 2: ON-SWITCH SOLUTIONS</th>
<th>2: Number translation solutions</th>
<th>Categories 3: OFF-SWITCH SOLUTIONS</th>
<th>Database query solutions with use of a prefixed number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variant 1c: use of a 2nd number</td>
<td>Variant 1d: use of a generic number</td>
<td>Variant 1e: transparent call forwarding (prefix)</td>
<td>Variant 3b: query by default</td>
</tr>
<tr>
<td>Hardware Investments</td>
<td>Yes: Also generate recurrent costs (lower if call drop-back is used)</td>
<td>Yes: Also recurrent costs (lower if call drop-back is used)</td>
<td>(not relevant)</td>
<td>(not relevant)</td>
</tr>
<tr>
<td>Setup of an IN database</td>
<td>(not relevant)</td>
<td>(not relevant)</td>
<td>Yes: Introducion of the SCP</td>
<td></td>
</tr>
<tr>
<td>Software modifications for dynamic call processing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• at the donor switch</td>
<td>No: use of call forwarding procedures as such</td>
<td>Yes: not to use call forwarding facilities</td>
<td>No</td>
<td>Yes if it is the exchange which performs the IN query</td>
</tr>
<tr>
<td>• at the recipient switch</td>
<td>No: use of call forwarding procedures</td>
<td>Yes: to retrieve the ported number required to terminate the call</td>
<td>Yes: same as variants b, c, d of CF solutions</td>
<td>Yes: same as variants b, c, d of CF solutions</td>
</tr>
<tr>
<td>• between the donor switch and the upper transit switch</td>
<td>Yes if call drop-back mechanism is to be implemented</td>
<td>Yes (for call drop-back mechanism)</td>
<td>(not relevant)</td>
<td></td>
</tr>
<tr>
<td>• in the exchange which performs the IN query</td>
<td>(not relevant)</td>
<td>(not relevant)</td>
<td>Yes: Introducion of the SSF (Service Switching Function) if not already available</td>
<td></td>
</tr>
<tr>
<td>• in the signaling protocols</td>
<td>No</td>
<td>Possibly: upgrade of the switches to support &quot;long&quot; numbers</td>
<td>Possibly: switch upgrade to support &quot;long&quot; numbers</td>
<td>Possibly: upgrade of the switches to support &quot;long&quot; numbers</td>
</tr>
<tr>
<td>• in the routing functions</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Software modifications for filling in rerouting information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Initial updating</td>
<td>No</td>
<td>Yes: creation of routing on prefix</td>
<td>Yes: routing on prefix</td>
<td>Yes: creation of routing on prefix</td>
</tr>
<tr>
<td>• update at the donor switch</td>
<td>Yes: can be derived from call forwarding existing procedures</td>
<td>No: entered via routing tables</td>
<td>No: entered via routing tables</td>
<td></td>
</tr>
<tr>
<td>• update at some database</td>
<td>(not relevant)</td>
<td>(not relevant)</td>
<td>Yes (= hardware for interfaces). Database update + synchronisation with master database</td>
<td></td>
</tr>
</tbody>
</table>

### Modifications of the OSS tools and procedures

- **Inter-operator ordering procedures**: Yes: To be created. Administrative and operational procedures and information exchange interfaces for the management of portability activation/deactivation/modification orders etc (manually and/or automated)
- **Customer care system**: Yes: Software modifications to manage the ported numbers (distribution: origin operator/current operator/directory number/network address etc)
- **Billing and accounting system**: Yes: Creation of new interconnection tariffs for calls to ported numbers, management of service activation fees etc for inter-operator billing and customer billing
- **Directory system**: Yes: For internal directory: a new database to keep track of former customers which have been ported to a third network
- **Number administration system**: Yes: To manage the list of numbers allocated to the various operators, the list of ported/imported numbers etc (especially for NSP)
- **Maintenance procedures**: Yes: inter-operator technical procedures to be added, customer support area to be clarified

Boxes in grey indicate where modifications are required.

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Table 43 - Cost drivers for the implementation of NP
Appendix D. **Cost Recovery Principles**

Telecommunications service providers are commercial companies that have an underlying duty to make a profit for their owners/shareholders and/or stakeholders. In order to fulfil this duty, all costs incurred by the business need to be recovered in some form or fashion. We discussed how these costs are incurred by operators in Appendix C. This Appendix seeks only to clarify the principles of cost recovery for NP.

The most common principles of cost recovery in regulated telecommunications markets are:

- Cost Causation
- Cost Minimisation
- Distribution of Benefits
- Reciprocity and Symmetry
- Effect on Completion
- Practicality
- Relevant

The individual principles of cost recovery are described below, and are summed up by some NRA’s as follows:

The Hong Kong Office of Telecommunications Authority (OFTA):

“The underlying principle for cost recovery of number portability shall be that all operators should be fairly compensated for the reasonable relevant costs incurred for the services rendered to the other operators for the implementation of operator portability. It is expected that customers will be charged a fee for the retention of telephone numbers upon change of operators and there would be inter-operator charges to compensate the operators for the above-mentioned costs. The network operators are expected to negotiate a commercial agreement among them to recover the costs incurred in the implementation of number portability”

and the Infocommunications Development Agency of Singapore:

“The charging principles for NP are ultimately intended to enhance consumer interests by promoting a competitive telecommunications industry. It is important to recognise the types of benefits that would accrue to all industry participants, namely porting customers, other customers, and telecommunications operators, and then assess the reasonableness of charges proposed by operators. The principles are designed to favour the introduction of competition without in any way favouring any one carrier or class of carriers.”

The overall principles controlling the ability of individual operators to recover costs from each other will have a big impact on the costs incurred and therefore the charges that may be levied on users for utilising the service. Cost allocation policy is discussed in Appendix E, but suffice to say, at this point that the principles which should be adopted are aimed at minimising costs not encouraging high costs or inefficiency in the implementation of NP.
In terms of developing the NP cost recovery principles it is prudent to examine the origin of the cost. The two distinct types of costs for NP are the ‘Establishment Costs’ and ‘Utilisation Costs’, where:

- Establishment costs are those costs incurred in effectively fulfilling the requirements of National Legislation; regulatory Directives and / or licence conditions.
- Utilisation costs are those costs incurred when a customer seeks to take advantage of the service and port their number(s).

**Cost Causality**

The principle of cost causation requires that the person causing the cost to be incurred should pay for the costs incurred. This principle suggests that the donor operator should recover their costs from the recipient operator. The recipient can then make a commercial decision on whether to recover those costs, and their own costs, from the customer. The recipient may conclude such charges are a commercial disincentive to customers to port their number to them. They could instead decide to absorb the costs, recovering them via the products and services they provide to their own customers.

This principle seems clear when considering utilisation costs as described in Appendix E. However, how does the principle apply to the Establishment Costs? The ultimate origin of the costs in Rwanda is RURA in requiring the operators to implement NP, so should individual operators be seeking to recover their costs from RURA? RURA’s role (and that of all regulators) is to create a competitive environment wherever possible. The requirement placed on operators to introduce NP is part of creating that environment on behalf of the Rwandan consumers. Thus, the logic leads to the conclusion that the ultimate origin of the requirement is the consumers of the service, the customers. Therefore, the Establishment Costs are a cost for an operator of being in the telecommunications market and should be recovered as part of their general overheads.

**Cost Minimisation**

The principle of cost minimisation requires that all those who have the ability to affect the magnitude of the costs have incentives to minimise the costs. Operators minimise costs whilst improving operational efficiency by adopting the most cost effective solutions and technology. With all the service providers minimising costs, the productive efficiency in providing NP is maximised.

The effect of cost minimisation is greatest when the cost allocation policy is correctly applied to encourage minimisation, i.e. the cost is treated as an overhead that operators will minimise for competitive advantage.

**Distribution of Benefits**

There are three categories of customer benefits from NP:

- Benefits which accrue to porting customers directly;
- Benefits which accrue to all customers through enhanced competition made possible by NP;
- Benefits which accrue to all customers in the form of fewer misdialed calls and fewer calls to directory enquiries.

These are in addition to the general economic benefit discussed in Section 2.6.
However, these benefits are only realised if the introduction of NP is not hampered by high costs with consequential high charges. RURA has a responsibility to ensure the free flow of customers who wish to port between operators.

**Reciprocity and Symmetry**

The principle of reciprocity is driven by the introduction of NP helping to create a competitive environment. Reciprocity means that each operator has the same opportunity to recover the same costs from the same entity, for example, a donor may recover the cost of the administration of a port from the recipient. At the time of the next port, however, the roles may be reversed i.e. the donor becomes the recipient and vice versa. Regardless of the roles, the cost recovery principle remains the same.

The operators have the same obligations and therefore the same cost drivers. This enables each to be competitive in the market, even though there is an argument that says that the incumbent operator will be a net loser in the early period of NP. This apparent imbalance is redressed as the incumbent operators will have the largest cost in establishing NP but will have the ability to recover the largest value of utilisation costs by virtue of the fact they will be the net exporter in the early period of NP. As time goes by the imbalance equalises as the flow of customers between operators equalises.48

**Effective Competition**

Effective completion is enhanced by the free flow of customers between competing operators via NP (amongst other products and service). However, inter-operator charges should diminish incumbent operators’ competitive advantages of market awareness, reduce customer inertia in changing operators and enable new operators to provide NP services on a viable basis. To ensure effective competition, the charges for switching operators must not be set unduly high.

For RURA the issue is to ensure that charges do not become a disincentive to use NP as it encourages lower prices and better products and packages.

**Practicality**

In deciding on the practicality of a particular solution the principle should focus on the costs both in the short and the long term, i.e. overall value for money. The outcome principle guiding the ability for individual operators should not just be ‘easy to implement’ but should also underpin all other principles as laid out here.

**Relevant Costs**

RURA must ensure that the costs attributed by operators to the establishment and management of NP are the true incremental costs incurred. There is a risk that costs relating to other functionality may be included. The cost of a particular development or the procurement of hardware / software or other equipment should show the percentage of use directly involved with NP or that the development or procurement of hardware / software or other equipment is solely for the use of NP. Only costs that are attributed to NP in this way should be considered in the cost recovery.

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48NP churn continues to grow in many EU countries; however, individual operators regard their own import/export figures as commercially sensitive and will only release them to their own NRA, who will then collate them to a country figure. However, ‘experience’ of working with NRA’s and in-country industry groups provides information that this ‘levelling’ out of churn is the experience of countries with a mature NP market.
A further consideration is that the costs involved in implementing NP are reasonable and efficient. RURA should ensure that a significant part of the costs fall on the operators that incur them by placing constraints on how these costs may be reflected in prices. This will provide an incentive to ensure that the costs are efficient.
Appendix E. Allocation of Costs

System Set-up Costs

System set-up costs are incurred at the outset of NP implementation as a result of the RURA decision requiring NP capabilities. Porting numbers from the donor operator to the recipient operator do not cause these costs. Furthermore, inter-operator charges for system set-up costs can be used anti-competitively to raise rivals’ costs and reduce an operator’s incentive to be cost-efficient.

Based on the Benchmark data provided below, operators should bear their own system set-up costs. It can be seen that in almost all countries (where information is available) the regulator has required operators to bear their own cost of system set-up for NP. Eleven of the fourteen benchmark countries state that operators will bear their own set-up costs. Of the remaining three countries, one provides no information at all whilst one seems to state that the NRA will bear the cost and the remaining regulator delegates the decision to the operators themselves.

System set-up costs are to be borne by each operator unless an operator incurs costs in support of NP implementation from which it cannot benefit. This view is consistent with establishing charges that promote effective competition; ensuring that charges are based on cost and encouraging cost minimisation.

So, in general, requiring each operator to bear their own costs has a number of advantages, including:

- providing operators with strong incentives to minimise their costs;
- ensuring the benefits of the NP service are wide spread;
- that inter-operator charges do not increase the costs faced by new entrants helping to ensure effective competition;
- treating all operators in a non-discriminatory way;

Costs of the Centralised Database

This would be part of the responsibility placed on all operators to establish NP in Rwanda, as such it forms part of the Set-up costs that should be borne by all operators and is not recoverable.

Costs of the Number Portability Clearing House

This would be part of the responsibility placed on all operators to establish NP in Rwanda, as such it forms part of the Set-up costs that should be borne by all operators and is not recoverable.

Per Port Set-up Costs

Charges for NP administration should be determined using a narrow definition of incremental costs to take into consideration the external benefits resulting from a customer’s decision to port their number. As such, donor operators will not be allowed to recover certain costs that are common to providing NP administrative services and other services (such as turning off the old service and turning on the new service) on the basis of Cost Causation as discussed in Appendix D. Low inter-operator charges also reduce the ability of a donor operator to raise recipient operator costs in an anti-competitive manner.
Additionally, RURA must ensure that the inter-operator charges are based on costs that are relevant and are only the costs and values that will be incurred by a responsible and efficient operator. Costs that are judged to be outside of this standard should be discounted. This will ensure that the principle of cost minimisation is maintained.

Finally, it should be a commercial decision whether the recipient operator recovers the charge from the porting customer or builds the costs into the wider products and services provided by the operator to the customer.

**Additional Conveyance Costs**

Appendix B includes the implied recommendation that an All Call Query routing solution be adopted for NP in Rwanda. This ensures that all calls will be routed directly from the originating network to the recipient network (via any applicable transit network). Therefore the only additional conveyance cost is the cost of the data look-up by the originating operator to obtain the correct routing information. This data look-up is usually performed within the operators own network routing tables, which obtain their information from the centralised database. The cost for such individual look-ups is negligible and individual operators should not be seeking to recover the cost of the data look-ups as an identifiable NP cost.

This principle is in line with the principles discussed throughout Appendix D, and in particular meets the following requirements:

- It ensures Cost Minimisation
- It is Reciprocal and Symmetric
- It is Non – Discriminatory
- It is a Practical solution
Benchmark Data from Selected Countries

Confidential Text Removed

Table 44 - Countries' Cost Recovery Policies: Benchmark data
Appendix F. **Benchmark Data – Prices & Tariffs**

The table below provides a range of standard mobile tariffs for operators in a range of countries, plus the termination charges in those countries. It also provides the on-net / off-net price differentials in those countries.

*Confidential Text Removed*

Table 45 - Countries’ Mobile Tariffs: Benchmark Data
Appendix G. Benchmark Data – Number Portability Information

The table below provides information on countries that have launched MNP. It provides the launch data, time to implement and porting volumes, where available, as well as other relevant information where that is available.

*Confidential Text Removed*

Table 46 - Countries' Number Portability Benchmarks
Appendix H. **Glossary of Portability Terms and Abbreviations**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARPU</td>
<td>Average Revenue Per User – the average amount of spend per mobile phone user, quoted on a monthly or annual basis</td>
</tr>
<tr>
<td>BlackBerry Services</td>
<td>The BlackBerry is a line of wireless handheld devices and services designed and marketed by Research In Motion Limited (RIM) operating as BlackBerry.</td>
</tr>
<tr>
<td>BSS</td>
<td>Business Support Systems</td>
</tr>
<tr>
<td>BTA</td>
<td>Botswana Telecommunications Authority</td>
</tr>
<tr>
<td>CAPEX</td>
<td>Capital Expenditure - CAPEX are used by a company to acquire or upgrade physical assets such as equipment, property, or industrial buildings.</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access - CDMA is an underlying channel access method</td>
</tr>
<tr>
<td>Churn Rate</td>
<td>Churn rate is the number of customers joining a network over a given period (usually one year) as matched against the number of customers leaving the same network</td>
</tr>
<tr>
<td>CIA</td>
<td>Central Intelligence Agency</td>
</tr>
<tr>
<td>Donor Operator</td>
<td>The donor or donor network is the operator losing or ‘exporting’ the mobile number (MSISDN)</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile</td>
</tr>
<tr>
<td>Handset Locking</td>
<td>Handsets that are ‘locked’ into a single network, so that SIM cards from another network will not work in that handset</td>
</tr>
<tr>
<td>ITU - International Telecommunications Union</td>
<td>A United Nations body that makes recommendations on all telecommunications matters to ensure international interoperability of individual networks.</td>
</tr>
<tr>
<td>M-Banking</td>
<td>Mobile Banking - Mobile banking is a system that allows customers of a financial institution to conduct a number of financial transactions through a mobile device such as a mobile phone or personal digital assistant.</td>
</tr>
<tr>
<td>MMS</td>
<td>Multimedia Messaging Service (MMS) is a standard way to send messages that include multimedia content to and from mobile phones</td>
</tr>
<tr>
<td>MNO</td>
<td>Mobile Network Operator – Operators that own or manage their own (mobile) networks</td>
</tr>
<tr>
<td>MNP</td>
<td>Mobile Number Portability – The porting of numbers used for mobile telecommunications services</td>
</tr>
<tr>
<td>MOICl</td>
<td>Ministry Of Information and Communication Infrastructure</td>
</tr>
<tr>
<td>M-Pesa</td>
<td>M-Pesa is a commercial Brand M-Banking Service</td>
</tr>
<tr>
<td>MVNO – Mobile Virtual Network Operator</td>
<td>Operators that do not own or manage their own (mobile) networks, but purchase capacity from an existing mobile operator and then resell the capacity to business and residential customers under their own brand.</td>
</tr>
<tr>
<td><strong>OECD</strong></td>
<td>The Organisation for Economic Co-operation and Development (OECD)</td>
</tr>
<tr>
<td><strong>OPEX</strong></td>
<td>An operating expense, operating expenditure, operational expense, operational expenditure or OPEX is an on-going cost for running a product,</td>
</tr>
<tr>
<td><strong>OSS</strong></td>
<td>Operational Support Systems</td>
</tr>
<tr>
<td><strong>Penetration rate</strong></td>
<td>The number of in-use mobile numbers per 100 head of population</td>
</tr>
<tr>
<td><strong>Post-paid</strong></td>
<td>Customers who are ‘contracted’ to a mobile operator and are invoiced for services used</td>
</tr>
<tr>
<td><strong>Pre-paid</strong></td>
<td>Customers who pay in advance of the use of the service</td>
</tr>
<tr>
<td><strong>Price Elasticity</strong></td>
<td>Price elasticity of demand is a measure used in economics to show the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price</td>
</tr>
<tr>
<td><strong>Range Holder Operator</strong></td>
<td>Is the operator allocated a certain number range by RURA for allocation to end user customers</td>
</tr>
<tr>
<td><strong>Recipient Operator</strong></td>
<td>The recipient or recipient network is the operator gaining or ‘importing’ the mobile number (MSISDN)</td>
</tr>
<tr>
<td><strong>RURA</strong></td>
<td>Rwanda Utilities Regulatory Authority</td>
</tr>
<tr>
<td><strong>SIM</strong></td>
<td>A customer identity module or subscriber identification module (SIM) is an integrated circuit that securely stores the international mobile subscriber identity (IMSI) and the related key used to identify and authenticate customers on mobile telephony devices</td>
</tr>
<tr>
<td><strong>SIM Registration</strong></td>
<td>Is the process of registering the personal data of the purchaser or user of a pre-pay SIM</td>
</tr>
<tr>
<td><strong>SMP</strong></td>
<td>Significant Market Power – operators are deemed to have sufficient market share such that they can influence the whole market by their actions</td>
</tr>
<tr>
<td><strong>SMS</strong></td>
<td>Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems, using standardised communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices</td>
</tr>
<tr>
<td><strong>Termination rate</strong></td>
<td>Is the money paid by the originator of a mobile call to the terminator of that call and is an agreed rate between the two operators</td>
</tr>
<tr>
<td><strong>TPV</strong></td>
<td>Third Party Vendor – in this case, the supplier of any centralised NP hub and/or central reference database that may be used for number portability</td>
</tr>
</tbody>
</table>

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i Source GSMA SSA Mobile Economy 2013