incyte consulting

Laurasia Associates
Communication Consultants

Mobile Number Portability for PNG: Discussion Paper on Costs and Benefits

A Discussion Paper identifying the costs and benefits of the implementation of mobile number portability in Papua New Guinea as required pursuant to Section 189 of the *National Information and Communications Technology Act, 2009*

7 October 2016

Table of Contents

1. Executive Summary

1.1. Purpose of this document

This document has been prepared for the purpose of facilitating industry and wider public discussion on the nature of Mobile Number Portability (MNP) and the advantages and disadvantages that might attend the implementation of MNP in one form or another in PNG.

At this stage the document does not represent the views of the National Information and Communications Technology Authority (NICTA). NICTA will consider the views of industry representatives and of the public before it adopts a final view of the matter and makes appropriate decisions.

The document contains several conclusions and recommendations. NICTA would ask readers and potential commentators to consider these conclusions as very preliminary. They do serve the valuable purpose of focusing comments and discussion. They are the recommendations of the Consultants retained by NICTA to undertake the study, and even from the Consultants' point of view, the conclusions and recommendations are subject to refinement through the public discussion and consultation process.

1.2. The objective of number portability

The main effect of number portability is to reduce the costs of changing operator for subscribers. This benefits the subscriber and increases competition. There are two fundamentally different forms for a requirement for number portability:

- An obligation on all operators to implement number portability so that it is available to any user as a user right from a given date. This is the form of requirement that leads to the highest costs.

- An obligation on operators with significant market power to export numbers on request to another operator. This is a form of requirement focused on promoting competition at minimum cost. It does not ensure the provision of portability for all users because its availability depends on commercial decisions and actions by the operators. This form of requirement leads to the lower mandatory costs and allows greater flexibility to minimize costs.

The "user right" form of requirement is the most common form, yet most discussions on portability focus on its effect in promoting competition and this is an inconsistency. Because the market shares of the different operators in PNG are far from equal with Digicel having a much larger share that the others, both forms are presented and considered.

1.3. The options considered

Two alternative forms of requirement are considered:

- User Right Requirement: A "user right" requirement for all mobile operators to implement number portability within a year after which any user can port their number to any other operator

- Competition requirement: An obligation on operators with significant market power (which would be only Digicel in PNG) to export numbers on request to another operator. Any operator without significant market power that requests portability would also have to accept requests from other operators. This would not necessarily result in any numbers becoming portable and would probably not result in all numbers becoming portable. This requirement could be introduced at any time even though the request to initiate portability might not be made until the new entrant enters the market. No significant costs would be incurred until such a request is made.

1.4. Assessment methodology

The Consultants have evaluated the different options using a cost benefit analysis comparing the costs and benefits of each option and calculating a benefit to cost ratio. This ratio should be substantially greater than 1 to support a requirement for portability and in our view at least 1.3 because of the uncertainty in the estimates used.

The following cases have been evaluated over a period of 15 years:

User right requirement

Case 1a: The existing three operators only with an annual porting rate of 0.3%.

Case 1b: The existing three operators only, but with Bmobile having increased investment and competitiveness leading to a higher porting rate of 1% in year one, 2% in year two and 3% thereafter.

Case 2: The existing three operators only with an annual porting rate of 0.3% for the first two years of operation then a new entrant enters the market and the porting rate rises to 1% in year 3, 2% in year 4 and 3% in year 5 and onwards.

Competition requirement

Case 3a: A new entrant enters the market for year 3 and the porting rate is 1% in year 3, 2% in year 4 and 3% in year 5 and onwards. In this Case only the new entrant requests porting from Digicel. The other operators do not request porting because of the high setup costs and the risk that they will lose their most valuable customers to Digicel. Digicel customers can port to the new entrant and back, but it is assumed that Digicel will not initially offer to import new entrant numbers because of the extra costs to do this and the low level of such

porting expected in the early years of the new entrant's business. Both Bmobile and Citifon are assumed not to request portability and are not involved.[1]

Case 3b: The same as case 3a but with higher setup costs included both for Digicel and the new entrant.

The benefits are categorized as:

- Type 1A: Benefits to subscribers who change operator anyway in avoided costs of changing number;
- Type 1B: Benefits to subscribers who change operator only with portability in terms of lower costs and better service;
- Type 2: Benefits to all subscribers from increased competition;
- Type 3: Benefits to the contacts of subscribers who change operator anyway in avoided costs of updating records of their numbers and wasted calls.

These benefits have been assessed using the best methods available and averaged for four different types of subscriber. The benefits calculated are conservative because modest porting levels have been assumed based on the experience of overseas countries with similar levels of economic development.

The operators were invited to provide information on expected costs, since these costs can vary significantly depending on the equipment currently in use. Not all of the licensed mobile operators have cooperated in providing the cost data requested of them. In these cases the Consultants were able to develop estimates based on similar operations in other countries using equipment and systems that are available from global equipment and systems vendors.

[1] Bmobile and/or Citifon could request portability and become involved but this would be a voluntary commercial decision where presumably they would foresee increased profits that would outweigh their costs. This possibility can be omitted from the cost benefit analysis as it is not a requirement. The cost benefit analysis only has to include unrecoverable costs that arise directly from the requirement.

Figure 1.1: Porting Obligations and Costs for each Mobile Operator under each Case

Case	Description	Digicel	Bmobile	Citifon/Telikom	New Entrant
1a & b	Full MNP for all current operators immediately	High costs	High costs	High costs	N/A
2	Full MNP for all current operators immediately and new entrant joins 2 years later	High costs	High costs	High costs	Medium costs
3a	Port Out by Digicel on request from New Entrant.	Lower costs	Not Involved	Not Involved	Lower costs
3b	Port Out by Digicel on request from New Entrant	Medium costs	Not Involved	Not Involved	Medium costs

In the case of PNG, Bmobile and Citifon are small networks with far less coverage compared to Digicel and may not have the capacity to sustain the investment and other costs associated with MNP, since many of the costs are not proportional to scale at all. The Consultants have made a capital intensity assessment highlighting these issues

1.5 Cost Benefit Analysis

The ratios of assessed benefits to assessed costs have been calculated for each of Cases 1a, 1b, 2, 3a and 3b, as set out in the figure below.

Figure 1.2: Contributions to benefit to cost ratio for each Case

	T1A and T3	T1B	T2	Total
Case 1a	0.06	0.12	0.14	0.33
Case 1b	0.47	0.95	0.12	1.54
Case 2	0.35	0.72	0.12	1.19
Case 3a	1.11	2.27	0.38	3.75
Case 3b	0.64	1.31	0.22	2.17

Note: This Figure appears as Figure 11.7 in Section 11 of this report

The assessment above means that for Case 1a the overall benefits are only one third (or 0.33 times the cost) the cost, but for Case 1b with increased investment in Bmobile the benefits are 1.54 times the costs. Case 1 is the only case that involves an assumption that MNP would be implemented now with only the current operators in prospect.

The other cases all involve an assumption that the Minister will approve a New Entrant licence to commence operations in around two years' time. Cases 2, 3a and 3b all show net benefits – that is, benefits that are greater than the costs involved.

For Case 2 even with the new entrant the net benefits are slender, considering the margin for error that may occur in estimating costs and benefits.

The other cases, 3a and 3b, are much more robust in terms of the benefit to cost ratios that they entail. They involve less cost yet have a good porting rate. Case 3 gives the New Entrant operator a choice whether to require Digicel to port numbers to it. If it does so, then it will have to reciprocate and port out numbers to Digicel if Digicel requests this.

1.6 Preliminary conclusions

As noted above, the preliminary conclusions and recommendations are those of the Consultants, not of NICTA which has yet to form a view on the matter. Consultation with industry operators and the public will be an important input to shaping final views on both the conclusions and action plans that may develop as a result.

The Consultant's conclusions are:

- While the market in PNG meets the majority of criteria for the successful introduction on MNP, the degree of competition is currently inadequate and MNP could lead to a reduction in market shares for the smaller operators Bmobile and Citifon.
- The lack of effective competition could be addressed if an appropriately resourced New Entrant operator enters the market, or if there is further substantial investment in Bmobile sufficient to enable it to win more market share;
- Number portability will lead to a need to examine tariff transparency issues further to ensure that callers to ported numbers do not have to pay more than they expect;
- Requiring the introduction of number portability as a user right would impose an unfair and unsustainable financial burden on any operator that is unlikely to win much new business through portability - currently Bmobile and Citifon;
- Digicel is able to afford the introduction of number portability both as a user right and as a measure to promote competition; and
- A future New Entrant should be able to absorb the cost of providing number portability as part of its overall investment. Its costs would be lower than those of the other operators because number portability would be designed in to the network rather than added on as a later modification. Any new entrant would probably regard number portability as an essential tool for competing with the established operators.

- Case 1a has a significant net cost; whilst Cases 1b, 2, 3a and 3b have net benefits. The net benefits for Case 1b provide a reasonable justification for portability, but Case 2 is more marginal and the net benefits for Cases 3a and 3b, although robust, are dependent on elections by operators to be involved in MNP. If the operators opt out of MNP and make no requests for porting out by Digicel, their customers will not have a porting option with current service numbers.

1.7 Consultant's recommendations

The Consultants recommend:

(1.) That NICTA should only consider introducing MNP if and when there is sufficient further investment in an existing operator such as Bmobile to make it able to increase its market share significantly, or a New Entrant is licensed and has entered the PNG market;

(2.) That both user right and competition requirements should be considered further by NICTA and the preferences of the industry and the public should be gauged.

2. Objectives and Background

NICTA has retained Incyte Consulting and its Number Portability specialist consultancy partner, Laurasia (referred to as the Consultants) to this report on the feasibility of implementing Mobile Number Portability (MNP) services in PNG.

This report summarises the findings of the Consultant's assessment of the PNG mobile market environment and dynamics, and the potential implications and benefits of number portability based on experience from other similar markets. The report covers:-

- Benchmarking of the current PNG against countries with similar economic profiles to PNG, to compare market competitive dynamics;
- An economic and operational MNP impact assessment analysis, focussing on:
  - Implementation costs, in particular central/ shared costs, operator specific costs and cost obligations for NICTA ;
  - Porting and Routing cost recovery and commercial options;
  - Impact on existing mobile termination, licencing/ numbering, third party access and international traffic routing commercial models/ cost recovery;
- Assessment of the existing NICTA statutory and regulatory framework and the economic environment of PNG, to identify and quantify the potential barriers resulting from and opportunities realisable from the introduction of the MNP service into the PNG market ; and
- An outline of the recommended framework related to the potential introduction of MNP services into the PNG mobile sector, comprising the optimal regulatory, commercial, operational and technical solution for the implementation and management of the MNP service.

The PNG mobile sector has undergone substantial changes in its competitive dynamics, largely resulting from the entry in 2007 of Digicel. Since then Digicel has become the dominant player in the PNG mobile market sector with a market share in excess of 94%, compared Bmobile/ Vodafone (4.8% market share) and the mobile business of Telikom (1% market share).

Mobile service penetration is estimated at 54%, significantly lags Pacific (e.g., Fiji – 108%) and other regional emerging markets (e.g., Vietnam – 131%, Sri Lanka – 113%). ARPUs are reported to be around $US9.5 per month in PNG, which is relatively high when compared to emerging markets with similar economic profiles.

Consequently, from an economic perspective, with a population of over 7 million, healthy ARPU/ pricing and limited competition, the PNG mobile sector has strong potential for sector investment to grow mobile service demand and revenues.

3. What is MNP?

Mobile Number Portability (MNP) enables mobile telephone users to retain their mobile telephone numbers when changing from one mobile network carrier to another.

Since the introduction of number portability services in Singapore in 1997, customers across more than half of the world's countries are able to port their mobile service to alternative service providers whilst retaining their number. MNP services are available across both developed and emerging markets in North and South America, Europe, Africa, Asia and the Caribbean, see appendix A.

Within the Asia-Pacific region, MNP has been operating in Australia, New Zealand and Malaysia for many years and was launched in the Maldives in 2015. However, MNP service availability within the emerging markets of the Oceania region is still to be actively progressed.

MNP can be an enabler of greater competition, as it allows users to move freely between networks. For mobile network operators (MNOs) or mobile virtual network operators (MVNOs), MNP can become increasingly important as mobile devices become the prime form of personal communication. However, the full benefits of NP are only realised if it is implemented well.

The introduction of MNP does not dramatically change the competitive market dynamics in isolation; the market must already be competitive. MNP acts merely as a catalyst to enhance and progress competition, but regulators must clearly define the competitive areas in their markets that they are targeting improvement, for instance:-

- Increased consumer value, in permitting more customers to change service providers and to gain perceived improved value as a result;
- Improved network and service quality - in MNP markets there is an increased incentive to improve performance to retain existing customers and to attract new ones to port;
- Encouraging Innovation – the additional competitive pressures from MNO encourage innovation in new services and service options to retain and attract customers;
- Encouraging New Entrants - In markets where a large portion of the addressable market is already served, new entrants need to be able to pitch to existing customers of other MNOs. MNP enables them to do this; and
- Reduction of the influence of dominant/ incumbent operators – Where incumbent and dominant operators have undue influence through a large share of subscribers, MNP can require them to work harder to retain those customers and to attract new ones. MNP ensures that one barrier to switching operators is removed and that customers can take greater advantage of the value of offerings in the market.

Customers may want to change mobile networks for a variety of reasons that cause dissatisfaction with their current services or increase the appeal of a competitor's services, such as:

- Inadequate coverage or network service quality;
- Customer service quality or billing issues;
- Desire for a new (or subsidised) handset;
- On/ Off net tariff differentials;
- Value for money concerns;
- Strong brand or marketing of a competitor's network;
- Unique content or services on a competitor's network; or
- Desire for a change.

Without MNP, many customers would need to devote significant time, effort and expense to informing family, friends and colleagues of their new number. They may also miss calls from contacts who are unaware that the number has changed. For business customers, changing a mobile phone number can have significant financial repercussions, such as the cost of reprinting stationery, repainting signs and vehicles, and advertising the change. In many cases, the inconvenience and expense of changing a mobile number may deter users from changing network, even if they are highly dissatisfied with their current service or there are strong economic benefits from switching providers.

4. Advantages and Disadvantages of MNP

4.1 Economic benefits v consumer right

Traditionally, many Regulators have been required either under the terms of national legislation or their regulatory mandate to undertake a formal cost benefit analysis of the implementation and introduction of MNP. In more recent time, many Regulators have favoured the approach that introducing MNP is a fundamental consumer right and as such negates the need to undertake a formal cost benefit analysis. Recognition and assertion of rights does not require proof of economic net benefits.

The PNG *National Information and Communications Technology Act, 2009* is very clear on this issue. There is no provision for MNP to be considered a fundamental consumer right. Sub-section 189 (1) requires that "NICTA shall hold a public inquiry under Section 230 and publish a discussion paper identifying the costs and benefits of the implementation" of MNP in PNG.

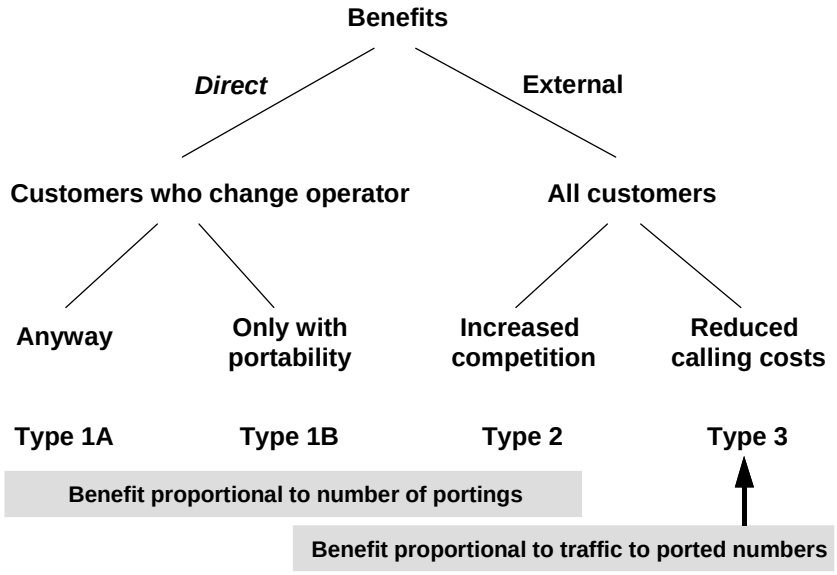
4.2 Categorisation of benefits

The benefits of number portability are normally classified as follows:

- Type 1A: Benefits to subscribers who change operator anyway in avoided costs of changing number;
- Type 1B: Benefits to subscribers who change operator only with portability in terms of lower costs and better service;
- Type 2: Benefits to all subscribers from increased competition;
- Type 3: Benefits to the contacts of subscribers who change operator anyway in avoided costs of updating records of their numbers and wasted calls.

All these benefits are roughly proportional to the number of subscribers who port. The benefits are illustrated in Figure 4.1.

Figure 4.1: Benefits of Number Portability



4.3 Costs

The costs on MNP are incurred by operators and vary depending on the implementation chosen and the functionality of their current systems.

MNP costs can be subdivided as follows:

(1) One-time costs. They are the initial investments and expenses incurred for installing and commissioning MNP. One-time or set-up costs can be further categorized as follows :-

a. Common/ Shared Costs - which include
   i. Central Number Portability Administration Set-Up costs
   ii. Regulator MNP Programme Management costs
   iii. Regulator MNP Public Awareness/ Education costs

b. Individual Operator Costs
   i. Core Network Upgrade costs to support MNP related traffic routing changes
   ii. Business Systems Upgrade costs to support processing/ administration of porting transactions and supporting MNP related billing changes
   iii. MNP Programme Management costs
   iv. Engineering and Testing costs
   v. Business Process Impact Assessment and Change costs
   vi. Staff Training and Awareness costs
   vii. Legal and Commercial costs

(2) Recurring costs. These are the additional costs incurred that are required for ongoing operations and maintenance of the MNP system. Two categories of recurring costs that are relevant for cost recovery purposes are:

a. Additional costs for transferring calls. These are internal/ inter-operator specific traffic-sensitive costs. In the case of intelligent network approaches to MNP, additional costs are associated with the additional signaling capacity required for ported numbers.

b. Administrative costs incurred with every request to port a number. These are the administrative costs incurred to transfer or port a user from a donor network to a recipient network. The costs are associated with procedures undertaken when a user orders number portability. These administrative costs are incurred no matter what technical approach is used to implement number portability and can be separated into :-

i. Allocation/ sharing of Central Porting Administration System/ Service operating costs

ii. Internal operator incremental operational resourcing costs required to process porting transactions

iii. Regulator MNP service monitoring and management resourcing costs

4.4 Cost Benefit Analysis (CBA)

The Consultants have adopted a conventional CBA approach, which is described in section 11 of this report. Estimated costs are compared to benefits to determine whether the benefits of introducing and operating MNP outweigh the costs. In practice the benefits accrue to consumers and the costs to the operators. The CBA is not concerned with transfers such as imposition of charges on consumers so that they contribute towards cost recovery by the operators.

5. PNG Mobile Market

NICTA has sought information from relevant licensed operators to enable the market to be assessed and the costs and benefits of MNP to be estimated. Not all operators cooperated in the data collection phase, with the result that the Consultants have used best available estimates from a range of sources.

The Consultant has extrapolated from the ITU 2015 mobile statistics to produce an estimate of 3.96 million active mobile subscribers currently in PNG. This represents around 54 services per 100 population.[2]

The estimated split of services between the three MNOs is shown in Figure 5.1 below

Figure 5.1: Estimated Mobile Subscriptions per MNO (2016)

Operator	Estimated 2016 Mobile Subscribers	Mobile Market Share (%)
Digicel	3,727,544	94.2%
Bmobile	190,866	4.8%
Telikom	40,490	1.0%
Total Market	**3,958,900**	**100%**

The Consultants make the following observations:

1. Imbalance between Digicel and Bmobile/ Telkom network coverage

Appendix B shows coverage maps for both the Digicel and Bmobile networks. It is evident that Digicel has a much stronger nationwide coverage than Bmobile, both for the mainland and outlying islands.

Telikom reports that it has 57 CDMA sites across the country which we believe results in Telkom's network coverage being very limited, with consequences for its low market share.

2. Imbalance between GSM and CDMA services

Both Digicel and Bmobile operate GSM services whereas Telikom's mobile network is based on CDMA infrastructure. Across the world, we note that the popularity and availability of CDMA networks is rapidly diminishing in favour of GSM technology based services. Consequently the range of services and handsets offered by CDMA operators is much more restricted than those available for GSM operators, which further limits the consumer appeal and longevity of CDMA based services.

[2] Based on an estimated population of 7.3 million

It is important to understand that the lack of inter-operability between CDMA and GSM handsets could significantly impact Telikom's ability to port in target/ high-value customers from Digicel or Bmobile, since porting in customers would be required to purchase new Telikom CDMA handsets and this could act as a significant financial disincentive. The same inter-operability issue applies for customers porting from Telikom to Digicel or Bmobile, but the financial disincentive is reduced due to the much wider range of GSM handsets and enhanced GSM services.

From the Consultants' experience from other markets where there is a mix of CDMA and GSM providers, inevitably, the CDMA providers are the net losers once MNP services are introduced. If MNP is introduced into the PNG market, Telikom will find it difficult to attract and port-in former GSM customers but there will be no disincentive for customers to port out and leave Telikom.

6. Potential MNP impact on the PNG economy

6.1 Lessons from other economies

This section assesses:

(1) The different drivers which influence market pricing across 22 benchmark emerging markets that have been identified as having comparable features to the PNG market. These include:
    a. Population
    b. Gross National Income per capita (GNI)
    c. Number of mobile competitors
    d. Presence of MNP services
(2) The comparison of the PNG mobile profile and high level voice and SMS pricing with a range of emerging markets with similar socio-economic and competitive profiles, both with and without MNP; and
(3) The current value of the mobile market.

Experience and research across the world has shown that the impact of MNP on markets varies significantly and is driven by a wide range of market and environmental factors. Critically, the availability of the MNP service into a market does not drive competition directly but instead number portability acts as catalyst to enhance the competitive drivers already existing in a market.

Post-paid and pre-paid services will both be affected.

These consequences can be measured through pricing changes (introducing MNP can encourage price reductions between 20% and 50% in the short to medium term) and therefore achieve enhanced consumer value. These changes may be achieved via increasing post-paid price package content; enhancing pre-paid recharge and usage promotions; and special target promotional campaigns. Furthermore, introducing MNP can result in significant increases in consumer traffic demand of between 20% and 50% in the short to medium term, which in many countries may be pricing direct result of lower prices. Through MNP and the heightened level of competitive that results consumers will receive enhanced value with the consequence that they use the services more.

Following the launch of MNP services into new national markets, a common discernible feature is the erosion over the short to medium term of the differential between on net and off net tariffing as different operators try to differentiate themselves in the post MNP marketplace by championing the cross network tariffing space. These price differentials have been a problem in PNG and the regulated maximum differential is generous by world standards.

To benchmark the Papua New Guinea mobile sector we have identified 22 emerging markets across the Asia, Pacific, African and Caribbean regions. Each of the markets have broadly similar socio-economic profiles and have been selected to assess the impact of key market factors on average on and off net voice and SMS pricing, such as :-

- Market Penetration;
- Number of competitors; and
- Presence of MNP services.

The benchmark pricing analysis shown in Appendix D is based on the headline on-net and off-net pricing advertised on operator websites, as of the week ending 05 August 2016. The pricing has been provided in local currencies and has been converted to US Dollars to establish a common format for comparison. Where multiple-competitor data is available it is averaged.

6.2 Benchmarking of PNG ARPU

In Figure 6.1 below are estimates of each operator's monthly Average Revenue per User (ARPU).

Figure 6.1: Monthly ARPU by PNG Operator

Operator	USD	Kina
Digicel	9.50	30.10
Bmobile	3.38	10.70
Citifon	4.10	13.00
Weighted Average*	9.11	29.86

* weighted by subscriber volume

Digicel's dominant position in the market enables it to maintain a significant price leadership over its competitors. Digicel's coverage superiority means that in many areas in PNG it is effectively the only service provider.

Global or regional emerging market ARPU benchmarking data is not readily available. ARPU data published by the MTN Group within their quarterly investor update reports is set out in Appendix E. MTN operates in a wide range of emerging markets across Africa and Asia, including in Afghanistan, Benin, Cameroon, Ghana, Ivory Coast and Sudan.

Figure 6.5 below shows that average PNG monthly ARPU is nearly three times that of the average of benchmark emerging markets in which MTN operates, that is, $9.11 compared to $3.43.

Figure 6.2: ARPU comparison – MTN operations and PNG Average

Country	Region	Population (000's)	GNI ($USD)	Mobile Penetration	Number of Operators	MNP Status	Monthly ARPU $USD
Afghanistan	Asia	32,527	$ 630	62%	6	Planned	1.92
Benin	Africa	10,879	$ 860	86%	4	Planned	5.94
Cameroon	Africa	23,344	$ 1,330	72%	4	Planned	3.37
Ghana	Africa	27,410	$ 1,480	130%	6	Yes	5.40
Ivory Coast	Africa	22,157	$ 1,410	119%	3	Planned	4.55
Papua New Guinea	**Oceania**	**7,321**	**$ 2,240**	**54%**	**3**	**No**	**9.11**
Sudan	Africa	40,235	$ 1,840	70%	3	Yes	2.83

There are many factors that contribute to the ARPU differences. PNG differs from the other markets shown in Figure 6.5 because of the position of Digicel relative to other operators, with consequences for the level of competitive pressure on prices and ARPU.

6.3 Estimated Market Size

Figure 6.3 contains an estimate of the mobile market size in PNG based on ARPU and estimated subscription levels.

Figure 6.3: Estimates of Mobile Market Size (PNG 2016)

Operator	ARPU - Kina	ARPU - USD		Kina	USD	%ge
Digicel ARPU	30.12	$ 9.50	Digicel Estimated Revenue	1,347,059,851	$ 424,940,016	98.2%
Bmobile ARPU	10.73	$ 3.38	Bmobile Estimated Revenue	24,575,906	$ 7,752,652	1.8%
CitiFon ARPU	13.00	$ 4.10	CitiFon Estimated Revenue	526,370	$ 166,047	0.04%
	Average Monthly ARPU	**$ 9.11**	**Total Market Size - Estimated**	**1,372,162,127**	**$ 432,858,715**	100.0%

These estimates give Digicel a revenue share of 98.2% of the mobile market in PNG, with very small shares for Bmobile and CitiFon. The massive differences in estimated market revenues will be become a significant factor when considering the MNP investment implications of possible MNP introduction and the different impact that will have on the three mobile operators.

Typically, operators are required to invest between $2 million and $8 million to prepare for and support the introduction of MNP services. Such MNP investment burdens could be impossible for Bmobile and CitiFon, with their limited revenue bases. Specific cost assessments and financial implications will be addressed in later sections of this report.

6.4 Observations on the Mobile Market

The following observations are considered reasonable on the basis of the market data available to the Consultants, together with comparisons that have been made with other countries:

- PNG has significant existing market scale (1.372 billion Kina/ $432 million USD), with significant potential for organic market growth based on the relatively low market penetration of 54%.
- Existing PNG ARPU and prices are relatively high. Current average sector ARPU is more than double the ARPU for comparable benchmark markets in sub-Saharan Africa.

- Digicel's current market pricing in PNG is significantly higher than its pricing in comparable benchmark markets, for instance, average on-net voice $USD0.196 per minute in PNG, compared to $0.102 in Fiji, and $0.083 in Haiti.
- Digicel through its market share advantage and strong nationwide network coverage is able to maintain strong price leadership in PNG, maintaining higher prices than would occur in a more competitive market.
- Citifon's CDMA service may be a serious disadvantage in the context of MNP since to acquire customers via MNP will require new customers to purchase new handsets. Even with MNP, subscribers will still experience the barrier of having to buy a new handset if they wish to move to Citifon because it uses CDMA rather than GSM.
- The likely MNP implementation costs could be too onerous for both Bmobile and CitiFon to bear based on their existing market positions and revenues.

7. PNG Consumer Awareness and Interest in MNP

NICTA kindly undertook a short MNP consumer awareness survey during July and August 2016 in which 117 mobile subscribers were randomly selected and interviewed on their understanding and views of MNP.

Whilst the sample size is small and the interviewee demographic is restricted, nevertheless the findings suggest that PNG mobile subscribers are already used to switching their services even without MNP.

Most importantly the majority of the pre-paid subscribers interviewed would be interested in porting their mobile service and would prefer to retain their number when they change service providers.

Findings from the NICTA consumer awareness survey are as follows:-

- 99% of the interviewed mobile subscribers used pre-paid mobile services;
- 22% of the interviewed mobile subscribers have dual SIMs with Digicel and Bmobile, suggesting usage could be determined by pricing differentials or promotions and coverage differences between the two networks;
- 33% of the interviewed mobile subscribers have already changed their service provider without MNP;
- 40% of the interviewed mobile subscribers would consider switching their mobile service if MNP were available;
- 58% of the interviewed mobile subscribers consider their mobile number to be important to them;
- 86% of the interviewed mobile subscribers would prefer to keep their mobile number when switching their mobile service; and
- 84% of the interviewed mobile subscribers would not be deterred by paying a small fee (Kina 10 or so) to retain their mobile number when switching operators.

Based on the NICTA survey findings, there appears to be a reasonable level of consumer interest in MNP, and that MNP services will be valued by PNG consumers.

8. Number portability implementation

This section looks briefly at some of the implementation options and issues based on lessons learned from other countries.

8.1 Regulatory framework

If MNP is to be implemented the regulatory framework needs to ensure that it is implemented well and delivers the benefits expected. This involves attention to detail and proper documentation of detailed requirements. The following framework has been used successfully in other countries:

- Regulatory requirement - a top list of the main requirements including:
  - inter-operator and user charges
  - reporting obligations to establish statistics on porting
  - a requirement to conform to more detailed technical and procedural specifications
  - possible penalties for poor performance (normally deferred until after a year or more's operational experience)

- Routing Specification - a set of rules about routing of calls and SMS messages and the use of routing prefixes. The details would be discussed in depth with the operators

- Porting procedure specification - a detailed specification for all the interactions between the operators and each other normally via central database. This would include time limits for each action. The details would be discussed in depth with the operators

In addition a central database service would normally be procured and decisions would be needed over the contractual arrangements and funding.

It is normal practice for the regulator to form a number portability committee to develop these documents and to monitor the progress of the implementation. The operators would be members but with the work driven by experienced consultants under contract to the regulator.

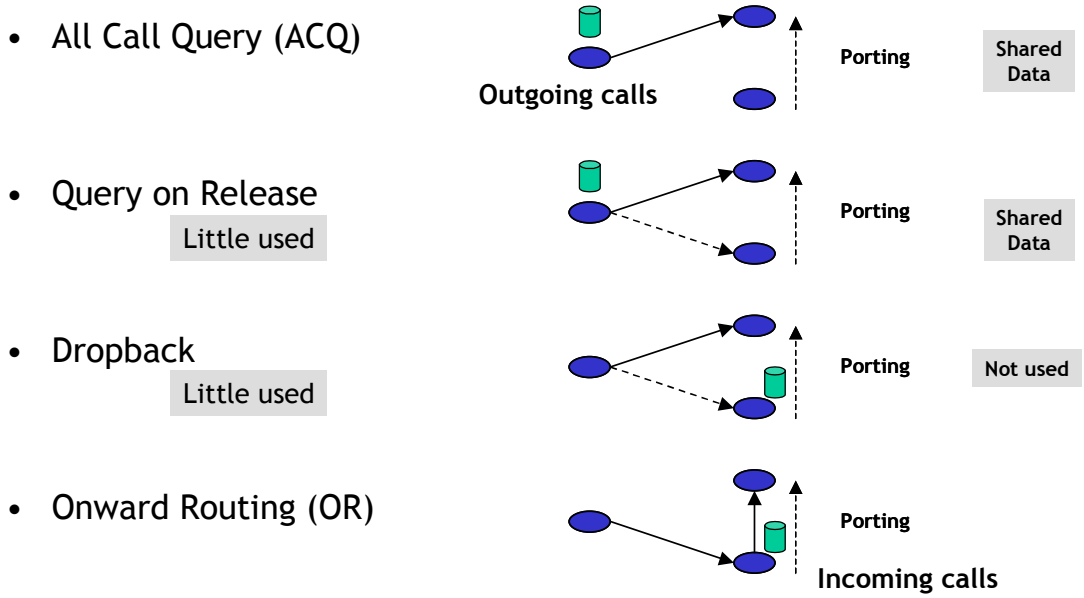
8.2 Routing for calls

The European Telecommunications Standardisation Institute (ETSI) has defined the following four technical options for number portability routing:

- Onward routing;
- Drop-back;
- Query on Release; and
- All call query.

These terms have been used both for solutions between networks and solutions inside networks – and this can cause confusion. ETSI's intention was that these terms should apply only to solutions for use between networks. Solutions for use inside networks do not need to be standardised and should not be specified by regulators.

Figure 8.1: ETSI Routing Solutions.



In **All Call Query** the network that originates the call looks up its database, which contains a copy of the list of ported numbers and which network serves them. This list may be copied from a central reference database. The network then routes the call direct to the recipient network that is serving the ported number.

In **Query on Release**, the network that originates the call routes the call to the block ("donor") network. If the block network no longer serves the number because it is ported, this network releases the call back to the originating network who then looks up the number as for All Call Query. Query on Release was designed to reduce the rate of looking up the database when databases were more expensive than they are now. Query on Release is seldom used.

In **Dropback**, the network that originates the call routes the call to the block network. If the block network no longer serves the number because it is ported, this network drops the call back to the originating network after adding information on where the call is currently served. Dropback is seldom used, if at all.

In **Onward Routing** the network that originates the call routes the call to the block network and the block network routes it to the recipient network that is serving the ported number.

Onward routing is an issue for terminating networks. In practice all networks that port out numbers have to implement onward routing because they may receive calls from other networks for numbers that they have ported out.

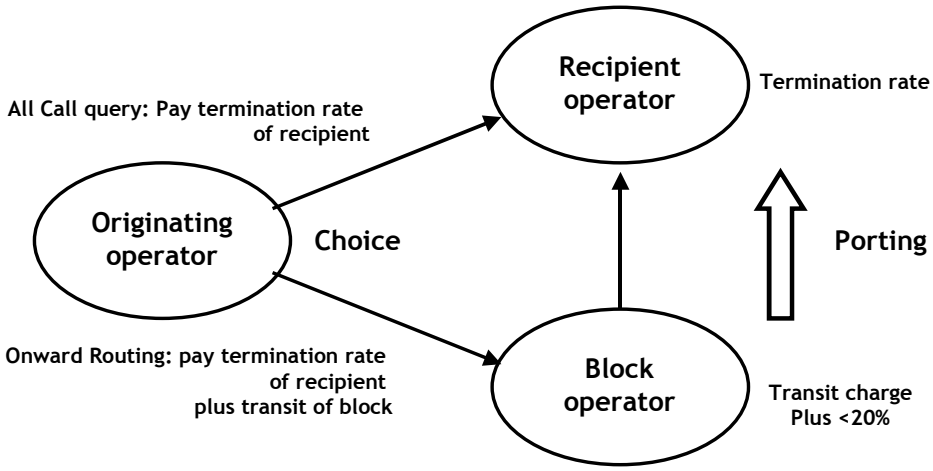
All call query in contrast is an issue for networks that originate calls to enable them to route the call in the most direct way to the network that serves the called number.

Thus onward routing and all call query are not alternatives; the implementation choice is between the following:

- Implementing just onward routing for terminating calls; and
- Implementing all call query onward for outgoing calls as well as implementing onward routing for terminating calls.

In the case of mobile networks the technology used for implementing onward routing can normally also be used for implementing all call query and so most mobile networks will implement both as the marginal cost of all call query is very low.

Figure 8.2: Routing to ported numbers



Depending on the interconnection routes available, the Originating network, O, has the option to determine which network is serving the called number and route the call there directly, e.g., along route OR, or to pass the call to the operator identified by the number block - B (block operator) .

If the call is passed to B, then B has to onward route the call to R. B will need the capability anyway to route its own subscribers' calls to numbers ported to R.

Each operator is entitled to charge for what it does and so B can both charge for their work as a transit operator and for the costs of changing the routing of the call (typically less than 20% more than the transit charge).

When an operator determines which operator is serving the ported number, it adds a number portability prefix in front of the called number to indicate the recipient network. The existence of this prefix indicates that the routing for the number has already been determined and need not be repeated.

One issue where there are asymmetrical termination rates is which termination rate should be paid for a call to a ported number, either the rate of the block network or the rate of the recipient network.

Ideally rates should be symmetrical in which case the problem would not arise. If they are asymmetrical then we favour using the termination rate of the block network so that the retail rate of the originating operator does not need to be changed to reflect a change in underlying costs for the call.

8.3 Routing for SMS messages

SMS messages are routed quite differently from calls and further discussions with the operators are needed and will be held during the visit to PNG to find out about their current routing arrangements and how best SMS messages can be routed with number portability.

8.4 Inter operator process

The most common arrangement is for the porting to be "recipient led", which means that the subscriber chooses its new operator and asks the new operator to port its number. The new operator then arranges the number porting with the old operator. The subscriber does not need to have any contact with the old operator except to pay off any existing debts. Some regulators prohibit the old operator from making better offers to deter the subscriber from porting and this is called win-back.

The inter-operator process can be direct between the operators or via a central database.

8.5 Central database

If operators are to be able to route calls direct to the network that serves the ported number then they need access to information about all ports. This is most commonly provided through a central database and the central database commonly also acts as an intermediary for messages between the operators as part of the porting process and compiles statistics about the messages and time taken at each stage of the porting process.

The central database is a service that is typically provided over a virtual private network from servers in Europe or North America. It does not have to be located physically in the country that is implementing number portability.

8.6 Recommended best practice

If NICTA decides to require number portability the following would be our baseline recommendations for discussion with the operators in the number portability committee:

- The porting process would be recipient-led and designed to ensure that all individual number ports are handled within one working day unless the recipient operator requests longer. Ports of blocks of numbers could take up to 5 working days.

- All operators who export numbers would have to support onward routing for calls from their own subscribers and incoming calls from other networks

- All Call Query for outgoing calls, although generally best practice, would not necessarily be a requirement for all operators but operators who do not implement it would have to pay other operators for onward routing calls to the correct network

- A central database service would be procured by NICTA and would handle all inter-operator messages and compile statistics from the messages. Interactions with the database could be manual or fully automated.

.

9. Stakeholder Costs

We have made assessed the expected costs for the different operators and for the regulator for each of the cases used in the cost benefit analysis. The detailed assessments are given in Appendix G and more detailed assessments for operators in Appendix H.

Figure 9.1: Cost Level Summary for each Case

Case	Description	Digicel	Bmobile	Citifon/Telikom	New Entrant
1a & b	Full MNP for all current operators immediately	High costs	High costs	High costs	N/A
2	Full MNP for all current operators immediately and new entrant joins 2 years later	High costs	High costs	High costs	Medium costs
3a	Port Out by Digicel on request from New Entrant.	Lower costs	Not Involved	Not Involved	Lower costs
3b	Port Out by Digicel on request from New Entrant	Medium costs	Not Involved	Not Involved	Medium costs

The estimation of the costs involves making assumptions about the implementations followed by each of the operators in terms of the routing methods used and the interactions with the central database (manual or fully automated). These assumptions are shown in the following table.

Figure 9.2: Implementation assumptions for the cases in the Cost Benefit Analysis

Case	Requirement	Digicel	Bmobile	Citifon/Telikom	New Entrant
1a & b	**User right** MNP for all current operators, no new entrant	Automated procedure OR + ACQ direct routing	Automated procedure OR + ACQ direct routing	Automated procedure OR + ACQ direct routing	N/A
2	**User right** MNP for all current operators plus new entrant 2 years later	Automated procedure OR + ACQ direct routing	Automated procedure OR + ACQ direct routing	Automated procedure OR + ACQ direct routing	Automated procedure OR + ACQ direct routing
3a	**Competition** MNP - Digicel ports out on request	Manual procedure OR only	Not Involved	Not Involved	Manual procedure OR only
3b	**Competition** MNP - Digicel ports out on request	Automated procedure OR + ACQ direct routing	Not Involved	Not Involved	Automated procedure OR + ACQ direct routing

For each item minimum and maximum cost levels have been estimated. In the Cost Benefit Analysis the average of these levels is used. The following tables give the costs used in the Cost Benefit Analysis in US dollars (the normal currency of procurement).

Figure 9.3: Cost estimates in US Dollars for Cases 1 and 2

Costs in US Dollars	Setup Costs USD	Running pa
CDB	$200,000	$200,000
Digicel	$7,100,000	$730,000
Bmobile	$3,200,000	$330,000
Telikom CDMA	$2,400,000	$240,000
New entrant	$1,600,000	$200,000
Regulation	$123,500	$14,000

Figure 9.4: Cost estimates in US Dollars for Case 3a

Costs in US Dollars	Setup Costs USD	Running pa
CDB	$200,000	$200,000
Digicel	$1,300,000	$170,000
Bmobile	$2,000	$0
Telikom CDMA	$1,600	$0
New entrant	$520,000	$280,000
Regulation	$123,500	$14,000

Figure 9.5: Cost estimates in US Dollars for Case 3b

Costs in US Dollars	Setup Costs USD	Running pa
CDB	$200,000	$200,000
Digicel	$6,800,000	$690,000
Bmobile	$2,000	$0
Telikom CDMA	$1,600	$0
New entrant	$1,600,000	$200
Regulation	$123,500	$14,000

10. Suitability and affordability of MNP in PNG

Is the market in PNG ready for portability and can the operators afford it?

10.1 Suitability

For the successful introduction of MNP all the following criteria need to be met:

- Adequate Market Scale and Size;
- Effective Competition;
- Sufficient consumer Interest in MNP;
- Established Interconnection between Operators;
- Adequate tariff transparency and
- Adequate Regulatory Requirements.

The Consultant's assessment of the MNP pre-requisites in the PNG mobile sector is as follows:

- Adequate Market Scale and Size: With an existing active subscriber base of over 3.5 million mobile subscribers and current market revenue of nearly $500 million, the PNG mobile market has sufficient scale to support MNP (this is discussed further below);

- Effective Competition: Operators need to be able to compete with each other effectively and this would normally be indicated by reasonably balanced market shares. The current operator market shares are significantly asymmetrical and unlikely to change under current market and regulatory conditions. This results in part from Digicel's significantly greater network coverage. Under current conditions competition is not as effective as it could be and this prerequisite is not net. If MNP were to be introduced under present conditions it would add proportionately much higher costs per subscriber to Bmobile and Citifon and could lead to them losing their most valuable subscribers to Digicel reducing their ability to compete even further. However, if a New Entrant were licensed and were willing to make the investments needed to compete with Digicel the situation would change and MNP would further enhance this competition ;

- Sufficient consumer Interest in MNP: The results of the NICTA's small scale MNP consumer survey shows that PNG mobile subscribers are already used to switching their services even without MNP. Most importantly the majority of subscribers would be interested in porting their mobile service and would prefer to retain their number when they change service providers. Based on the NICTA survey findings, there appears to be reasonable consumer interest in MNP. There is no evidence to the contrary;

- Established Interconnection between Operators: Interconnection arrangements have been in place and operating since 2008 in PNG and all networks are directly interconnected with each other;

- Adequate tariff transparency: Callers commonly determine from the early digits of a number that they plan to call which operator is serving the number and more importantly which tariff or discount will apply. When a number has been ported the early digits no longer indicate the operator and by implication the tariff. With significant differences between on-net and off-net tariffs this could result in calls being more expensive than expected if and number indicates an on-net call but the call is in fact off-net as a result of the number being ported. The differences between on-net and off-net tariffs are regulated, but remain significant, in PNG and are shown in Appendix C; and

- Adequate Regulatory Requirements: The regulatory framework needs to be sufficient to establish and enforce detailed requirements for number portability to ensure that the implementation meets the objectives. Subject to legislated procedural and other requirements, NICTA is empowered to assess the feasibility of and recommend the adoption of MNP under Section 189 of the Act. In addition it is generally empowered to regulate for technical requirements and outcomes. This prerequisite is therefore confirmed.

The conclusions are summarized in the following figure:

Figure 10.1: Summary of assessment of MNP suitability criteria

Criterion	Assessment
Adequate Market Scale and Size	Pass
Effective Competition	FAIL unless (1) there is a strong new entrant or (2) there is substantial capital investment in an existing operator
Sufficient consumer Interest in MNP	Pass
Established Interconnection between Operators	Pass
Adequate tariff transparency	Needs improvement
Adequate Regulatory Requirements.	Pass

10.2 Affordability

Can the operators afford the costs of introducing number portability?

Capital intensity is a metric used by telecommunications operators across the world to assess affordability. It measures the ratio of capital investment to annual revenue. Research suggests that a globally accepted Capital Intensity benchmark for technology investment compared to revenue is 16%, but in some emerging markets, Capital Intensity for affordable investment can be as high as 25%. From a similar study the Consultants recently completed in Benin, the average technology investment across the 4 mobile operators was 17%.

Using the 16% Capital Intensity benchmark as an indicator, Figure 10.2 below summarises the Capital Intensity measure for the estimated minimum and maximum MNP implementation cost estimates for each of the PNG mobile operators compared to estimated revenues:

Figure 10.2: Capital Intensity of Operator MNP Investments in PNG

Operator		Minimum MNP Investment	Maximum MNP Investment
Digicel	Estimated Investment	$1,008,195	$8,872,481
	Estimated Revenue	$424,940,016	$424,940,016
	Capital Intensity	***0.24%***	***2.09%***
Bmobile	Estimated Investment	$1,606	$4,099,733
	Estimated Revenue	$7,752,652	$7,752,652
	Capital Intensity	***0.02%***	***52.88%***
CitiFon/ Telkom	Estimated Investment	$ 1,606	$ 2,965,041
	Estimated Revenue	$ 166,047	$ 166,047
	Capital Intensity	***0.97%***	***1785.66%***
New Entrant	Estimated Investment	400,117	2,078,882
	Estimated Revenue	N/A	N/A
	Capital Intensity	***N/A***	***N/A***
Total Industry	Estimated Investment	**$1,715,024**	**$18,339,637**
	Estimated Revenue	**$432,858,715**	**$432,858,715**
	Capital Intensity	***0.40%***	***4.24%***

With a maximum Capital Intensity measure of 4.24% the most costly MNP service option is affordable at an overall industry level – that is, it is well within Capital Intensity upper levels. However, at operator level there is a different story. The investment required for fully automated MNP systems with ACQ routing service option would be beyond the financial capacity of both Bmobile and Citifon, resulting in Capital Intensity measures of 53% and 1785% of revenue respectively, the investment burden being significantly greater than the 16% benchmark. By contrast the Capital Intensity measure for Digicel is only 2%.

It is not possible to calculate the Capital Intensity measure for a New Entrant in the absence of revenue figures. It is expected that a New Entrant would procure equipment where the support of number portability is included and automated.

Initial conclusions from this analysis are:

- While the market in PNG meets the majority of criteria for the successful introduction on MNP, the degree of competition is currently inadequate and MNP could lead to a reduction in market shares for the smaller operators Bmobile and Citifon.
- The lack of effective competition could be addressed if there is substantial new investment in an existing operator or if an appropriately resourced New Entrant operator enters the market;
- Number portability will lead to a need to examine tariff transparency issues further to ensure that callers to ported numbers do not have to pay more than they expect;
- Requiring the introduction of number portability as a user right would impose an unfair and unsustainable financial burden on Bmobile and Citifon unless they have further investment to make them more competitive;
- Digicel is able to afford the introduction of number portability both as a user right and as a measure to promote competition; and
- A future New Entrant should be able to absorb the cost of providing number portability as part of its overall investment. Its costs would be lower than those of the other operators because number portability would be designed in to the network rather than added on as a later modification. Any new entrant would probably regard number portability as an essential tool for competing with the established operators.

11. Cost Benefit Analysis

11.1 MNP Cases considered

The Consultants have identified a set of scenarios each of which is a specific MNP service delivery option, and has subjected them to cost benefit analysis. Individual options within the set of options align with the likely interests of the different PNG mobile operators but present credible and practical options for the introduction of MNP services in PNG.

The following cases have been evaluated over a period of 15 years:

User right requirement

Case 1a: The existing three operators only with an annual porting rate of 0.3%.

Case 1b: The existing three operators only, but with Bmobile having increased investment and competitiveness leading to a higher porting rate of 1% in year one, 2% in year two and 3% thereafter.

Case 2: The existing three operators only with an annual porting rate of 0.3% for the first two years of operation then a new entrant enters the market and the porting rate rises to 1% in year 3, 2% in year 4 and 3% in year 5 and onwards.

Competition requirement

Case 3a: A new entrant enters the market for year 3 and the porting rate is 1% in year 3, 2% in year 4 and 3% in year 5 and onwards. Only the new entrant requests porting from Digicel. The other operators do not request porting because of the high setup costs and the risk that they will lose their most valuable customers to Digicel. Digicel customers can port to the new entrant and back, but we assume that Digicel will not initially offer to import new entrant numbers because of the extra costs to do this and the low level of such porting expected in the early years of the new entrant's business. Both Bmobile and Citifon are assumed not to request portability and are not involved.[3]

Case 3b: The same as case 3a but with higher setup costs included both for Digicel and the new entrant.

[3] Bmobile and/or Citifon could request portability and become involved but this would be a voluntary commercial decision where presumably they would foresee increased profits that would outweigh their costs. This possibility can be omitted from the cost benefit analysis as it is not a requirement. The cost benefit analysis only has to include unrecoverable costs that arise directly from the requirement.

11.2 Benefits

11.2.1 Subscriber model

In order to calculate the benefits to people who port, the Consultants have developed a model of the subscribers in which the following types of subscriber are separately identified:

- Type 0 – no mobile phone
- Type 1 – low income
- Type 2 – higher income
- Type 3 – own small business
- Type 4 – VIP.

It is essential to consider different subscriber types so that more realistic estimates can be made of the benefits of porting, which differ widely between subscriber types such that it is difficult to estimate an average benefit. The benefits for each type have to be calculated and then a weighted average across the different types is calculated.

The basic information about the market is in Figure 11.1 below:

Figure 11.1: Basic market information (2016)

Population	7,300,000
Active subscriptions (SIMs)	3,958,900

It is assumed that each subscriber has only one SIM, although some may have multiple SIMs, e.g. additional SIMs for data dongles or for keeping an emergency phone in the car. The numbers used with such SIMs may not be used much or at all and so there would be little demand for porting them. A few users may have a second SIM so that they can take advantage of on-net offers on both networks - such users would probably not be interested in porting their number and already have most of the benefits of number portability. Therefore the approach of assuming only one SIM per subscriber gives a slight over-estimate of the benefits. The model has not been amended to take account of multiple SIMs. Given the market dominance of Digicel and the lack of information on the number of subscribers with multiple SIMs there is little point in doing this.

Figure 11.2 contains the Consultant's estimates of the proportion of customers by user type.

Figure 11.2: Customers by User Type

Customer numbers	**Type 0**	**Type 1**	**Type 2**	**Type 3**	**Type 4**	
Customer type	**No Phone**	**Low income**	**Higher income**	**Own small business**	**VIP**	**Total**
Percentage of population	45.8%	45.2%	4.0%	4.0%	1.0%	**100%**

Then, for each subscriber type, a temporary percentage that might port per year is determined in order to provide different weightings for different types. This approach was used successfully in a recent Botswana study.

Based on the general reluctance of subscribers to change number the percentage of Type 1A portings was set at 50% and of Type 1B at 50%. (Note that subscribers who will change operator

any way have benefits Type 1A and Type 3, whereas subscribers who will change operator only with portability have benefits Type 1B only. The NICTA MNP consumer survey also provides some support for a 50%:50% split.)

The result of this assessment is the table of annual porting rates in Figure 11.3.

Figure 11.3: Porting rates per year

Customer numbers	**Type 0**	**Type 1**	**Type 2**	**Type 3**	**Type 4**	
Customer type	**No Phone**	**Low income**	**Higher income**	**Own small business**	**VIP**	**Total**
Percentage of population	45.8%	45.2%	4%	4%	1%	**100%**
Relative weighting for likelihood to port		1	3	2	2	
Normalised adjusted proportion of portings		0.673	0.178	0.119	0.030	1.0
Normalised adjusted proportion of Type 1A and T3 portings		0.336	0.089	0.059	0.015	**0.5**
Normalised adjusted proportion of Type 1B portings		0.336	0.089	0.059	0.015	**0.5**

11.2.2 Type 1A Benefits

The Type 1A benefit is the benefit to people who change operator anyway through the saved cost of avoiding a number change. These savings are in avoiding:

- Sending SMS messages about the number change to contacts
- Buying new business cards
- Changing signs that show the number
- Running old and new accounts in parallel for a period

Figure 11.4 below shows the estimates. The avoided costs are very different for different types of subscriber.

Figure 11.4: Type 1A benefits per port

Type 1 A Benefit	Type 0	Type 1	Type 2	Type 3	Type 4
Behaviour when changing number	**No Phone**	**Low income**	**Higher income**	**Own small business**	**VIP**
Percentage sending SMS and calling		30%	50%	10%	10%
Time spent (hours)		2	3	3	3
Time cost per hour (Kina)		10	100	30	150
Cost per port in Kina		**6**	**150**	**9**	**45**
Buying new business cards					
Percentage buying new business cards		0%	15%	15%	40%
Cost of new business cards		30	50	50	50
Cost per port in Kina		**0**	**8**	**8**	**20**
Buying new signs					
Percentage buying new signs		0%	0%	30%	0%
Cost of new signs				500	
Cost per port in Kina		**0**	**0**	**150**	**0**
Running dual account or messaging					
Percentage doing it		30%	50%	80%	80%
Duration in months		1	2	4	3
Cost per month		10	10	10	10
Cost per port in Kina		3	10	32	24
Total Type 1A Benefits per port		**9**	**168**	**199**	**89**
Weighted average benefit per porting					
Total=62		**6**	**30**	**24**	**3**

11.2.3 Type 1B Benefits

These are the benefits to the people who change operator only if they can keep their number from obtaining lower prices or better coverage and quality of service.

These benefits are estimated as the avoided cost of running multiple subscriptions for two years. However as multiple subscriptions would provide greater benefits than number portability, only 80% of the avoided costs is used in the assessment. The Consultants estimate the cost per month of running a subscription as 10 Kina. Thus the benefit per porting is 10 Kina/month * 24 months * 80% = 192 Kina.

It is important to note, however, that these benefits apply only to some of the people who port, that is, only to those that will change operator only with portability because they are unwilling to change their number. They do not apply to all the portings.

11.2.4 Type 2 Benefits

These are the benefits to all subscribers from increased competition reducing prices, improving coverage and quality of service.

This benefit is hard to estimate and the academic studies have indicated that mobile number portability may increase the market shares of the larger operators as well as decrease them. In

many cases it has been difficult to isolate the effect of mobile number portability on the market because its introduction has coincided with the entry into the market of a new player.

The experience, however, of consultants who have worked inside operators is that the operators normally review and improve competitiveness when portability is launched. Often this focuses on retention measures for higher ARPU subscribers such as on-net offers. It is not clear, however, whether this is a short term effect or whether the increased competitiveness endures for long.

Where mobile number portability does reduce prices, or provide equivalent benefits in terms of quality of service and coverage, these benefits would be an economic gain if they are achieved through increased productivity. If however they are achieved through reduced profits they are an economic transfer and not a gain.

Type 2 benefits are treated as follows for the purpose of this assessment:

- The Consultants undertake the cost benefit analysis first with the Type 2 benefits set to zero to see if the other more easily quantified benefits exceed the costs;
- The Consultants then explore the extent of cost reductions that would be needed to provide a net benefit in two cases: where other benefits are set to zero and where other benefits are set to their estimated value.

In order to do this it is assumed that if Type 2 benefits occur they can be characterised as a percentage reduction in prices over a period of four years from the start of portability after the four years ends prices and service are at the same level as would be reached without portability. In other words, portability brings forwards the effects of competition, but it does not make services inherently cheaper for all time. Over the four years it is assumed that the second and third years have twice the effect of the first and fourth years, that is, the ratio of the effects in the different years is 1:2:2:1. A rate of 4% price reduction per year is used for years 2 and 3 and 2% for years 1 and 4.

11.2.5 Type 3 Benefits

This is the benefit to callers to people who change network from not having to update address books or having failed calls. These benefits apply in proportion to the Type 1A portings.

Figure 11.5 below shows the estimate of these benefits.

Figure 11.5: Estimate of Type 3 Benefits

Type 3 Benefits to callers to people who do not change number	Type 1 Low income	Type 2 Higher income	Type 3 Own small business	Type 4 VIP	
Updating address books					
Number of contacts per subscriber	10	25	50	40	
Time updating address books (mins) per update	1	1	1	1	
Time cost per hour	10	100	30	150	
Cost per port in Kina	1.7	41.7	25.0	100.0	
Wasted calls					
Number of wasted calls to ceased numbers	15	25	50	50	
Cost per call to telco per minute	0.05	0.05	0.05	0.05	Kina
Duration of wasted call (mins)	1	1	1	1	
Cost of calls	7,617	5,456	7,275	1,819	
Time cost per hour	10	100	30	150	Kina
Cost of caller time	2.5	41.7	25.0	125.0	
Cost per port in Kina	3.3	42.9	27.5	127.5	
Total Type 3 Benefits per port	**4.9**	**84.6**	**52.5**	**227.5**	
					Total
Weighted average benefit per porting	**3.3**	**15.1**	**6.2**	**6.8**	**=31**

11.2.6 Summary and review

These figures for Type 3 benefits are reviewed for reasonableness and to see how the benefits compare in relation to different categories of subscriber porting. Figure 11.6 below shows the results.

Figure 11.6: Benefits by Type per Port

Benefit per porting	Type 0 No Phone	Type 1 Low income	Type 2 Higher income	Type 3 Own small business	Type 4 VIP	Average
Type 1A (applies to 70% of portings)		6.1	29.9	23.6	2.6	**62**
Type 1B (applies to 30% of portings)						**192**
Type 3 (applies to 70% of portings)		3.3	15.1	6.2	6.8	**31**

This shows that the benefits are very much biased towards the higher ARPU subscribers. The bias towards higher ARPU subscribers seems intuitively correct.

The total weighted average is 157 Kina per porting, excluding the benefits of increased competition.

11.2.7 Discount Rate

All costs and benefits are discounted at 12% per year assuming that benefits start one year after setup costs are incurred. This figure is higher than the figure typically used for infrastructure investments by Governments because telecommunications is a rapidly developing and changing market making future demand less predictable and more subject to change through

substitution (e.g., email replacing phone calls). At this level of discounting, the values at the end of 15 years are 18% of today's values.

Benefits are calculated over 15 years with the residual after the end of the 15 years being ignored.

11.3 Costs

The Consultants have used figures that are benchmarked from knowledge of estimates in other countries but the sources are confidential.

The costs used have been given at the end of section 9.

11.4 Case 3 - Additional conveyance

With Case 3, there is porting only between Digicel and the new entrant. There is no requirement for the other operators, whom are assumed to have a constant 10% of the market, to route directly to the network that is serving the ported number. Consequently there is an additional path for each call from the donor to the recipient network. A cost figure of 1 toea per minute is used and that each ported number attracts on average 894 minutes of incoming calls per year (this is based on total traffic of 200,000,000 minutes per month over the 12 months of the year divided by the number of subscribers). However only 10% of the incoming traffic comes from operators other than Digicel and the new entrant and attracts this additional cost.

11.5 Other input data

The Consultants use a figure of 15 Kina per porting for the variable costs of porting. These are the marginal costs, mainly in labour. They cover potentially both the administration of the porting and the implementation of the porting.

There will be a small cost of additional conveyance for calls to ported numbers for calls from outside PNG where the sending network is unaware that the number has been ported, but calculations in other countries show that this is likely to be negligible.

Growth in the number of subscribers is assumed to be 3% pa.

11.6 Results

For each of the cases key results are the benefit to cost ratio and also the breakdown of the total figure between different types of benefit, as shown in Figure 11.7 below.

For the costs the Consultants have taken the average of the lowest and highest estimates.

Figure 11.7: Contributions to benefit to cost ratio for each Case

	T1A and T3	T1B	T2	Total
Case 1a	0.06	0.12	0.14	0.33
Case 1b	0.47	0.95	0.12	1.54
Case 2	0.35	0.72	0.12	1.19
Case 3a	1.11	2.27	0.38	3.75
Case 3b	0.64	1.31	0.22	2.17

11.7 Interpretation

Figure 11.7 indicates that, for Case 1a, the benefits only cover 33% of the costs of MNP, but with further investment to make Bmobile more competitive the benefits might be some 50% greater

than the costs. Case 2 also shows a net benefit but not as great as Case 1b because of the additional costs of a fourth operator (the new entrant) but with the same long term porting rate as Case 1b.

If the requirement is formulated for competition and does not guarantee porting for all, then Cases 3a and 3b offer the best ratios of benefits to cost.

12. Advantages and disadvantages of the different options for NICTA

This section summarises the advantages and disadvantages of the alternative requirements that NICTA might recommend to the Minister for PNG.

12.1 User-right portability

Advantages

- Enables all subscribers to port their numbers to any operator
- Enhances competition by removing a hurdle to consumer choice and will make market entry more attractive for new entrant

Disadvantages

- Very expensive for all current operators and potentially financially unsustainable for Bmobile and Citifon
- Could result in Bmobile and Citifon losing more valuable customers
- Complex and demanding to implement across all operators

12.2 Portability to promote competition

Advantages

- Enhances competition by removing a hurdle to consumer choice and will make market entry more attractive for new entrant
- Avoids forcing operators to invest in facilities that are unlikely to be profitable
- No MNP risk of Bmobile and Citifon losing their more valuable customers
- Simpler implementation as will probably only involve Digicel and new entrant

Disadvantages

- Does not enable all subscribers to port their numbers to any operator as availability to subscribers depends on options exercised by the operators

13. Conclusions and Recommendations

The conclusions and recommendations in this Section of the report are the Consultant's. NICTA has yet to determine its final position and will take fully into account the views of the industry stakeholders and the public before doing so.

13.1 Consultant's conclusions

In this section of the report we summarise the key findings and conclusions from each stage of our analysis.

- While the market in PNG meets the majority of criteria for the successful introduction on MNP, the strength of competition is currently inadequate;
- The lack of effective competition could be addressed if an appropriately resourced New Entrant operator enters the market, or if there is further substantial investment in Bmobile sufficient to enable it to win more market share;
- Number portability will lead to a need to examine tariff transparency issues further to ensure that callers to ported numbers do not have to pay more than they expect;
- Requiring the introduction of number portability as a user right would impose an unfair and unsustainable financial burden on any operator that is unlikely to win much new business through portability - currently Bmobile and Citifon;
- Digicel is able to afford the introduction of number portability both as a user right and as a measure to promote competition;
- A future New Entrant should be able to absorb the cost of providing number portability as part of its overall investment. Its costs would be lower than those of the other operators because number portability would be designed in to the network rather than added on as a later modification. Any new entrant would probably regard number portability as an essential tool for competing with the established operators; and
- The cost benefit analysis shows that Case 1a has a significant net cost; whilst Cases 1b, 2, 3a and 3b have net benefits. The net benefits for Case 1b provide a reasonable justification for portability, but Case 2 is more marginal and the net benefits for Cases 3a and 3b, although robust, are dependent on elections by operators to be involved in MNP. If the operators opt out of MNP and make no requests for porting out by Digicel, their customers will not have a porting option with current service numbers.

13.2 Consultant's recommendations

The Consultants recommend:

(1.) That NICTA should only consider introducing MNP if and when there is sufficient further investment in an existing operator such as Bmobile to make it able to

increase its market share significantly or a New Entrant is licensed and has entered the PNG market; and

(2.) That both user right and competition requirements should be considered further by NICTA and the preferences of the industry and the public should be gauged.

Appendices

Appendix A: Number Portability in Other Countries

Appendix B: Coverage of Digicel, Bmobile & Citifon (Telikom)

Appendix C: Comparison of PNG Operator Headline Pre-Pay On and Off Net Voice and SMS Rates

Appendix D: Global Emerging Market Benchmark Tables

Appendix E: MTN Group ARPU Benchmarking Data

Appendix F: Results of NICTA's MNP Consumer Awareness Study

Appendix G: Cost estimates

Appendix H: Stakeholder MNP Costs – detail

Appendix A: Number Portability in Other Countries

Year	Mobile Number Portability	Fixed Number Portability
1995	Singapore	Hong Kong
1997		United Kingdom, USA
1998		Finland, France, Germany
1999	Hong Kong, Netherlands, United Kingdom	Ireland, Netherlands, Norway, Sweden
2000	Spain, Switzerland	Australia, Belgium, Italy, Spain, Switzerland
2001	Australia, Denmark, Macau, Norway, Sweden	Denmark, Japan, Portugal
2002	Belgium, Germany, Italy, Portugal	Austria
2003	Finland, France, Ireland, Luxembourg, United States	Taiwan
2004	Austria, Cyprus, Greece,Hungary, Iceland, Lithuania, South Korea	Cyprus, Czech Republic, Estonia, Greece, Hungary, Iceland, Lithuania, South Korea
2005	Estonia, Malta, Slovak Republic, Slovenia, Taiwan	Canada, Croatia, Latvia, Slovak Republic
2006	Croatia, Czech Republic, Japan, Oman, Poland, Saudi Arabia, South Africa	Malta, Poland, Slovenia
2007	Canada, Israel, Morocco, New Zealand, Pakistan	Israel, Morocco, New Zealand
2008	Brazil, Bulgaria, Channel Islands, Egypt, Latvia, Macedonia, Malaysia, Mexico, Romania, Turkey	Brazil, Macedonia, Singapore
2009	Dominican Republic, Ecuador, Isle of Man	Bulgaria, Dominican Republic, Luxembourg, Turkey
2010	Peru, Thailand	Saudi Arabia, South Africa
2011	Albania, Colombia, Georgia, Ghana, India, Kenya, Montenegro, Panama, Serbia	Montenegro, Panama
2012	Argentina, Bahrain, Belarus, Bosnia & Herzegovina, Cayman Islands, Chile, Gibraltar, Paraguay	Bahrain, Bosnia & Herzegovina, Cayman Islands, Chile, Gibraltar, Oman, Romania
2013	Azerbaijan, Bermuda, Cape Verde, Costa Rica, Kuwait, Moldova, Nigeria, Qatar, UAE	Bahamas, Bermuda, Moldova, Serbia
2014	Armenia, Honduras, Russia, Sudan	Peru
2015	Jamaica, El Salvador, Jamaica, Kazakhstan, Senegal, Tanzania	
2016	Afghanistan, Bangladesh, Cameroon, ECTEL, Iran, Rwanda, Sri Lanka, Trinidad & Tobago, Tunisia, Ukraine	ECTEL, Trinidad & Tobago
2017	Afghanistan, Barbados, Haiti, Rwanda, Vietnam,	

Appendix C – Comparison of PNG Operator Headline Pre-Pay On & Off Net Voice & SMS Rates

Digicel

	Period	Kina per min	
Weekday		On Net	Off Net
Off Peak	06.00-06.59	0.49	0.68
Peak	07.00--20.59	0.79	0.99
Off Peak 2	20.59-05.59	0.49	0.68
Weekend		On Net	Off Net
Off Peak	21.00-07.00	0.49	0.68
Peak	07.00-21.00	0.49	0.68

	Kina per SMS	
SMS	On Net	Off Net
	0.25	0.25

Bmobile

	Period	Kina per min	
		On Net	Off Net
Peak	06.00 - 19.00	0.5	0.77
Off Peak	19.00 - 06.00	0.25	0.47
SMS	Kina per SMS	On Net	Off Net
Peak	06.00 - 19.00	0.1	0.25
Off Peak	19.00 - 06.00	0.05	0.2

CitiFon

		Kina per min	
		On Net	Off Net
Peak		0.1	0.4
Off Peak		0.1	0.4
	Kina per SMS	On Net	Off Net
SMS		0.01	0.1

Sources – Operator websites – August 2016

Appendix D – Global Emerging Market Benchmark Tables

Country	Region	Population (000's)	GNI ($USD)	Mobile Penetration	Number of Operators	MNP Status
Afghanistan	Asia	32,527	$ 630	62%	6	Planned
Bangladesh	Asia	160,996	$ 1,190	83%	5	Planned
Benin	Africa	10,879	$ 860	86%	4	Planned
Burundi	Africa	11,179	$ 260	46%	3	Planned
Cameroon	Africa	23,344	$ 1,330	72%	4	Planned
Dominican Republic	Caribbean	10,528	$ 6,130	83%	3	Yes
Ethiopia	Africa	99,391	$ 590	43%	1	No
Fiji	Oceania	892	$ 4,800	108%	2	No
Ghana	Africa	27,410	$ 1,480	130%	6	Yes
Haiti	Caribbean	10,711	$ 820	70%	2	Planned
Ivory Coast	Africa	22,157	$ 1,410	119%	3	Planned
Jamaica	Caribbean	2,726	$ 5,010	112%	2	Yes
Maldives	Oceania	409	$ 6,670	207%	2	Yes
Mauritius	Africa	1,263	$ 9,610	141%	3	No
Myanmar	Asia	53,897	$ 1,280	77%	3	No
Papua New Guinea	**Oceania**	**7,321**	**$ 2,240**	**47%**	**3**	**No**
Senegal	Africa	15,129	$ 1,000	100%	3	Yes
Seychelles	Africa	93	$ 14,760	158%	2	No
Sri Lanka	Asia	20,966	$ 3,800	113%	5	No
St Lucia	Caribbean	185	$ 7,390	102%	2	Planned
Sudan	Africa	40,235	$ 1,840	70%	3	Yes
Trinidad	Caribbean	1,360	$ 18,600	158%	2	Planned
Vietnam	Asia	91,704	$ 1,980	131%	6	Planned
Sources		www.data.worldbank.org		www.itu.int		

Country	On Net Voice - Local Currency - per minute	Off Net Voice - Local Currency - per minute	USD - Local Currency	On Net Voice - $USD per minute	Off Net Voice - $USD- per minute
Afghanistan	11	13	69	$ 0.159	$ 0.188
Bangladesh	0.9	1.23	78.43	$ 0.011	$ 0.016
Benin	60	60	592.03	$ 0.101	$ 0.101
Burundi	168	210	1677.2	$ 0.100	$ 0.125
Cameroon	60.63	90.96	592.05	$ 0.102	$ 0.154
Dominican Republic	6	7.8	45.95	$ 0.131	$ 0.170
Ethiopia	0.59	N/A	22.1	$ 0.027	N/A
Fiji	0.205	0.22	2.06	$ 0.100	$ 0.107
Ghana	0.1095	0.122	3.96	$ 0.028	$ 0.031
Haiti	4.9	4.9	64	$ 0.077	$ 0.077
Ivory Coast	109.8	109.8	592.05	$ 0.185	$ 0.185
Jamaica	2.95	4.94	126.8	$ 0.023	$ 0.039
Maldives	0.718575	1.03915	15.38	$ 0.047	$ 0.068
Mauritius	1.2	3.6	35.25	$ 0.034	$ 0.102
Myanmar	33.3335	37.5	1186.25	$ 0.028	$ 0.032
Papua New Guinea	**0.5002**	**0.72085**	**3.17**	**$ 0.158**	**$ 0.227**
Senegal	62.7	62.7	592.05	$ 0.106	$ 0.106
Seychelles	2.2914	2.82045	13.2	$ 0.174	$ 0.214
Sri Lanka	1.5	1.5	145.57	$ 0.010	$ 0.010
St Lucia	0.815	0.815	2.7	$ 0.302	$ 0.302
Sudan	0.1749	0.1899	6.07	$ 0.029	$ 0.031
Trinidad	0.91785	0.91785	6.7	$ 0.137	$ 0.137
Vietnam	1190	1390	22302	$ 0.053	$ 0.062

Country	On SMS - Local Currency - per SMS	Off SMS - Local Currency - per SMS	USD - Local Currency	On Net SMS - $USD per SMS	Off Net SMS - $USD- per SMS
Afghanistan	2.3	2.5	69	$ 0.033	$ 0.036
Bangladesh	0.5	0.5	78.43	$ 0.006	$ 0.006
Benin	12	25	592.05	$ 0.020	$ 0.042
Burundi	25	30	1677.2	$ 0.015	$ 0.018
Cameroon	40.3	50.5	592.05	$ 0.068	$ 0.085
Dominican Republic	1	1.75	45.95	$ 0.022	$ 0.038
Ethiopia	0.35	N/A	22.1	$ 0.016	N/A
Fiji	0.14	0.19	2.06	$ 0.068	$ 0.092
Ghana	0.0435	0.0675	3.96	$ 0.011	$ 0.017
Haiti	1.35	2.4	64	$ 0.021	$ 0.038
Ivory Coast	34	34	592.05	$ 0.057	$ 0.057
Jamaica	3	3.5	126.8	$ 0.024	$ 0.028
Maldives	0.2	0.35	15.38	$ 0.013	$ 0.023
Mauritius	0.6	0.6	35.25	$ 0.017	$ 0.017
Myanmar	20	20	1186.25	$ 0.017	$ 0.017
Papua New Guinea	**0.165354**	**0.23854**	**3.17**	**$ 0.052**	**$ 0.075**
Senegal	31	10	592.05	$ 0.052	$ 0.017
Seychelles	0.41	0.685	13.2	$ 0.031	$ 0.052
Sri Lanka	0.25	0.25	145.57	$ 0.002	$ 0.002
St Lucia	0.195	0.255	2.7	$ 0.072	$ 0.094
Sudan	0.06	0.06	6.07	$ 0.010	$ 0.010
Trinidad	0.335	0.525	6.7	$ 0.050	$ 0.078
Vietnam	300	350	22302	$ 0.013	$ 0.016

Appendix E – MTN Group ARPU Benchmarking Data

MTN Group Limited

Quarterly update for the period ended 31 March 2016

ARPU
(US dollar)

Country	1Q15	2Q15	3Q15	4Q15	**1Q16**	QoQ%
SEA						
South Africa	7,45	7,46	7,22	6,40	**5,32**	(16,9)
Uganda	2,79	2,34	2,13	2,29	**2,49**	8,7
Rwanda	2,27	2,25	2,21	1,95	**2,01**	3,1
Zambia	4,23	3,83	3,65	2,84	**2,45**	(13,7)
South Sudan	8,26	8,33	7,75	4,71	**2,06**	(56,3)
Botswana (joint venture)	6,27	6,35	6,28	5,60	**5,45**	(2,7)
Swaziland (joint venture)	8,06	7,81	7,97	7,08	**5,60**	(20,9)
WECA						
Nigeria	5,68	5,25	4,99	4,87	**5,40**	10,9
Ghana	3,57	3,15	3,29	3,09	**3,13**	1,3
Cameroon	3,83	3,43	3,68	3,60	**3,37**	(6,5)
Ivory Coast	5,07	4,70	4,59	4,69	**4,55**	(3,0)
Benin	6,05	5,78	6,09	5,80	**5,94**	2,4
Conakry	2,69	2,34	2,01	2,15	**1,70**	(20,9)
Congo B	9,14	9,02	9,48	9,00	**8,22**	(8,7)
Liberia	5,07	4,70	3,96	4,31	**3,73**	(13,5)
Bissau	3,79	4,16	3,58	3,15	**3,24**	2,9
MENA						
Iran (joint venture)	4,01	4,03	3,91	3,61	**3,71**	2,8
Syria	3,31	3,04	2,95	3,91	**2,09**	(46,5)
Sudan	2,47	2,59	2,62	2,61	**2,83**	8,4
Yemen	4,51	3,66	4,06	4,10	**4,10**	–
Afghanistan	2,76	2,89	2,86	2,59	**1,92**	(25,9)
Cyprus	19,35	19,37	19,80	18,38	**17,78**	(3,2)

Appendix F: Results of NICTA's MNP Consumer Awareness Study

1.	Total Number of interviews	Interviewees with Mobile Service	Interviewees with No Mobile Service
	117	106	11

2.	Number of interviewees with Dual Mobile Service (Digicel & Bmobile)	Number of Interviewees with Bmobile only	Number of Interviewees with Digicel only
	23	7	76

3.	Number of interviewees with Pre-Paid Services	Number of Interviewees with Post Paid Services
	105	1

4.	Number of interviewees who have switched services or network provider before	Number of Interviewees who have never switched services or network provider	Number of Interviewees Not Sure if they have switched services or network provider
	35	57	14

5.	Number of interviewees who value their mobile number	Number of Interviewees who do not value their mobile number	Number of Interviewees who are not sure if they value their mobile number	Number of Interviewees who have never switched services or network provider
	21	21	7	57

6.	Number of interviewees who would switch their network provider	Number of interviewees who would not switch their network provider	Number of Interviewees Not Sure if they would switch their network provider
	43	7	56

7.	Number of interviewees who considered their mobile number to be important	Number of interviewees who did not consider their mobile number to be important	Number of Interviewees who were Not Sure if their number was important or would not switch their service
	62	4	40

8.	Number of interviewees who would prefer to retain their mobile number when switching	Number of interviewees who would not retain their mobile number when switching	Number of Interviewees who were Not Sure if they would prefer to retain their mobile number when switching
	91	10	5

9.	Number of interviewees who would pay to switch their mobile number	Number of interviewees who would not pay to switch their mobile number	Number of Interviewees who were Not Sure if they who would pay to switch their mobile number
	89	11	6

Consumer study undertaken by NICTA between late July and early August 2016, with 117 respondents taken from existing high value and public sector work market segments

Appendix G: Cost estimates

Based on substantial experience of supporting MNP programmes across the world, the Consultants are able to provide generic estimates for each cost element.

G.1 Operator costs

The key number portability implementation costs relate to engineering and infrastructure changes to core network and business systems required to support MNP and related core network traffic routing upgrades These costs can account for up to 70% of overall operator MNP implementation costs. They include:-

- Engineering routing solution design, implementation and testing of the All Call Query (ACQ) direct routing core network infrastructure: between $300,000 and $6 million per operator, depending on network scale, complexity, number of vendors etc.
- Completing impact assessment, software re-engineering of downstream business systems to adapt key mediation, rating and billing processing for real-time pre-pay (IN platform) and batch post-paid to process CDRs with routing number prefixing: can cost between $100,000 and $2 million per operator, dependent on scale and complexity of existing business systems, number of vendors involved etc.;
- Upgrading interconnect billing system functionality, hardware and testing can cost each operator between $50,000 and $250,000 to complete to ensure correct processing of interconnect traffic conveyed between operators using ACQ direct routing; and
- Number of retail outlets that would be configured and authorised for handling NP transactions:
    - Directly managed and authorised Distributors;
    - Additional equipment required (e.g. document scanners, network connectivity);
    - Pre-launch and on-going training.
- Re-configuration of bank ATM's and other 3rd-party managed facilities that are configured to enable payments and recharge transactions.

The financial expenditure with vendors required by operators to implement the necessary core network and business system changes, are likely to be matched by corresponding significant internal technical resourcing necessary to ensure the core network and system changes are assessed, implemented and fully tested, requiring up to 18 man months of resourcing from key internal technical functions.

Consequently each operator's required expenditure to support the MNP service will be determined by a wide range of specific factors including:-

- Core network system upgrade to support the selected routing approach;
    - Number of vendors;
    - Type of core network platforms;
    - Complexity and scale of core network infrastructure;

    - Status of core network platforms – age etc
    - Internal vs external engineering support resourcing
- Value Added System (VAS) upgrade to support the selected routing approach and service access to ported consumers;
    - Number of vendors;
    - Type of VAS platforms;
    - Complexity and scale of VAS infrastructure;
    - Status of VAS platforms and interconnection – age etc
    - Internal vs external engineering support resourcing
- Business system upgrade to support automated ported provisioning and billing system changes determined by revised CDRs with selected MNP routing formats;
    - Number of vendors;
    - Type of business systems platforms;
    - Complexity and scale of business systems infrastructure;
    - Status of business systems platforms – age etc
    - Internal vs external technical and commercial support resourcing
- Centralised MNP gateway to interwork with the MNP clearinghouse;
    - Degree of MNP automation required;
    - Number of vendors;
    - Type of interworking platforms;
    - Complexity and scale of business system/ core network infrastructure;
    - Internal vs external engineering support resourcing
- Business process and organisational changes to support the delivery of MNP;
    - Organisational structure & scale
    - Degree of automation vs manual activity in provisioning, billing and CRM processes
    - Staff numbers and locations
- Retail systems and channel resource changes to provide consumer access to MNP services;
    - Organisational structure & scale
    - Number & types of retail channels
    - Retail functionality and capabilities
    - Staff number and locations
- Technical and financial testing resources;
    - Organisational structure
    - Corporate governance requirements & systems
    - Range and variety of products, services and propositions impacted by MNP
    - Organisational structure & scale
- Staff training to support the MNP service;
    - Organisational structure & scale
    - Number & types of retail channels & back office support teams
    - Retail and back-office functionality and capabilities
    - Staff number and locations

- Commercial MNP acquisition and retention proposition/ product development and delivery
    - Market position
    - MNP commercial objectives
    - Product range – variety and scale
    - Consumer base – types and volumes
    - Retail and channel structure and reach.

G.2 Operator Cost Information

The Consultants have estimated set-up costs for each of the existing licensed mobile operators, as well as for a new MNO entrant that could be licensed in the future by NICTA.

Unfortunately, only Citifon (Telikom) provided NICTA with the requested information of their core network, OSS and CRM systems and business operations. No such information was received from Digicel and Bmobile despite NICTA's requests. Consequently, the Consultants have estimated implementation set-up costs for Digicel and Bmobile based on experience of working with similar Digicel and other operator operations in the Caribbean.

Appendix H sets out the detailed cost estimates for each operator, which form the basis of the cost side of the modelling presented in Section 9 of this report.

G.3 Digicel

The Consultants have assumed that the Digicel PNG network and business systems are integrated and based around a single vendor, Ericsson, with multi-site locations to provide the scale and resilience to support Digicel's position as nationwide market leader

- Core Network Upgrade to support ACQ direct routing or onward indirect routing: Single Core Network Vendor - Ericsson. Multiple MSCs/MGWs - In-built FNR ACQ Routing Functionality. Additional bespoke development activity may be required to facilitate Onward Routing of traffic from non-porting operators to ported numbers;
- VAS Platform Upgrade: Integrated VAS from same vendor, that is, Ericsson or Redknee
- OSS/ Business Systems Upgrade: Integrated post-paid/ IN, CRM and Billing system from same vendor, that is, Ericsson or Redknee/ Microsoft;
- Provisioning/ System Upgrade: Integrated Provisioning and CRM systems from same vendor, that is, Ericsson or Redknee;
- MNP Gateway Development and Implementation: Bespoke NP gateway from NeoConsult to interwork with Digicel Ericsson core network and Digicel Business Systems;
- Engineering Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;

- Testing Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- MNP Programme Management and Advisory Support: Internal resources that will be allocated to manage the internal MNP programme supported by external MNP specialist consultants;
- Business Process Re-design: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- Staff Training: 300 to 500 retail, dealer and other customer services staff who require MNP training based on 149 channels including 10 retail stores.

The Consultants have modeled three separate MNP scenarios, namely:-

1. Digicel implementation costs to support full automated MNP port in and port out functionality including ACQ direct routing;
2. Digicel implementation costs to support porting out only requirements but including ACQ direct routing; and
3. Digicel implementation costs to support porting out only requirements but including onward indirect routing instead of ACQ direct routing

Figures G.1 and G.2 below summarise the estimated cost ranges and cost driver breakdown for each of the modelled scenarios.

Figure G.1: Digicel- Range of Estimated Costs for each modelled MNP Scenario

MNP Option	Minimum Estimated Costs	Maximum Estimated Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$5,332,592	$8,872,481
2. Port Out only functionality including ACQ direct routing	$5,065,633	$8,489,844
3. Port Out only functionality including onward indirect routing	$1,008,195	$1,646,227

Figure G.2: Digicel - Breakdown of Costs for each Modelled Scenario

Set-Up Cost	1. Fully Automated Port In & Out functionality including ACQ direct routing	2. Port Out only functionality including ACQ direct routing	3. Port Out only functionality including onward indirect routing
Core Network	74.9%	69.9%	49.1%
Business Systems/ OSS Upgrade	22.6%	24.1%	45.1%
Engineering/ Testing Support	0.5%	3.9%	0.7%
NP Programme Management	1.4%	0.3%	1.1%
Business Process Changes	0.1%	1.5%	3.1%
Staff Training	0.4%	0.1%	0.8%
Total Technology Related Set-up Costs	***98.0%***	***97.9%***	***94.9%***

Note: The figures add to the total proportion of technology costs in the set-up costs – and therefore do not add to 100%.

G.4 Bmobile

The Consultants have assumed that the Bmobile PNG network and business systems are smaller in scale than those of Digicel and could be based around Huawei or ZTE core infrastructure linked to a range of ancillary platforms for from tier 2/3 providers such as Cerillion or Ushacomm. In view of Bmobile's smaller network coverage and customer base, it is assumed that its network and business systems are located at discrete locations rather than being duplicated for scale and resilience. It is also assumed that some elements/ systems are nearing end of life and would require bespoke developments or upgrades to support MNP functionality.

- Core Network Upgrade to support ACQ direct routing or onward indirect routing- Single Core Network Vendor - Huawei/ ZTE- Single MSC/MGW - In-built ACQ Routing Functionality. No upgrade requirements to support Onward indirect routing;
- VAS Platform Upgrade: Integrated VAS from same vendor, that is, Huawei/ ZTE - limited to SMS, Voicemail & USSD;
- OSS/ Business Systems Upgrade: Integrated post-paid/ IN, CRM and Billing system from second tier 3rd party, that is, Ushacomm/ Cerillion;
- Provisioning/ System Upgrade: Integrated Provisioning and CRM systems from same vendor, that is, Huawei/ ZTE;
- MNP Gateway Development & Implementation: Bespoke NP gateway from second tier 3rd party;
- Engineering Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;

- Testing Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- MNP Programme Management and Advisory Support – Internal resources that will be allocated to manage the internal MNP programme supported by limited advice from external MNP specialist consultants;
- Business Process Re-design: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- Staff Training: 150 to 200 retail, dealer and other customer services staff to receive MNP training based on 5 resellers plus 9 retail stores.

Two separate MNP scenarios have been modelled, namely:-

1. Bmobile implementation costs to support full automated MNP port in and port out functionality including ACQ direct routing; and
2. Bmobile implementation costs to support onward indirect routing only. Bmobile not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers;

Figures G.3 and G.4 below summarise the estimated cost ranges and cost driver breakdown for each of the modelled scenarios.

Figure G.3: Bmobile - Range of Estimated Costs for each modelled MNP Scenario

MNP Option	Minimum Estimated Costs	Maximum Estimated Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$2,332,057	$4,099,733
2. Bmobile not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	$1,606	$2,379

Figure G.4: Bmobile - Breakdown of Costs for each Modelled Scenario

Set-Up Cost	1. Fully Automated Port In & Out functionality including ACQ direct routing	2. Onward Routing only - Not involved in porting - No Porting functionality
Core Network	69.5%	0.0%
Business Systems/ OSS Upgrade	26.9%	0.0%
Engineering/ Testing Support	0.7%	43.4%
NP Programme Management	2.4%	0.0%
Business Process Changes	0.2%	0.0%
Staff Training	0.3%	56.6%
Total Technology Related Set-up Costs	***97.1%***	***43.4%***

Note: The figures add to the total proportion of technology costs in the set-up costs – and therefore do not add to 100%.

G.5 Citifon (Telikom)

Citifon provided some information about its network and business systems, but this was limited and additional have had to be made about the core network and VAS platforms in particular. The Consultants have assumed that the Citifon network and business systems are smaller in scale than those of Digicel and Bmobile and could be based on Huawei or ZTE core infrastructure linked to a range of ancillary platforms for from tier 2 or 3 providers including Sir Lanka billing provider, AvaBill. As the fixed incumbent provider Telikom will be required to ensure that its core network routing infrastructure is upgraded to enable fixed to mobile and mobile to fixed traffic to be routed using MNP ACQ or onward routing protocols. It is assumed that the Citifon infrastructure would be located across multiple Telkom sites for legacy reasons and some elements and systems are nearing end of life and would require bespoke development or upgrades to support MNP functionality.

- Core Network Upgrade to support ACQ direct routing or onward indirect routing: Single Core Network Vendor - Huawei/ ZTE- Single MSC/MGW - In-built ACQ Routing Functionality. Licence based on small subscriber base but Telkom also has to route mobile to fixed traffic and vice versa. No upgrade requirements will be needed to support Onward indirect routing;
- VAS Platform Upgrade: Integrated VAS from same vendor, that is, Huawei/ ZTE - limited to SMS, Voicemail and USSD;
- OSS and Business Systems Upgrade: Integrated post-paid, IN, CRM and Billing system from AvaBill and Huawei;
- Provisioning/ System Upgrade: Integrated Provisioning and CRM systems from same vendor, that is, Huawei/ ZTE;
- MNP Gateway Development and Implementation: Bespoke NP gateway from second tier 3rd party, that is, AvaBill;

- Engineering Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- Testing Support: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- MNP Programme Management and Advisory Support: Internal resources that will be allocated to manage the internal MNP programme supported by limited advice from external MNP specialist consultants;
- Business Process Re-design: Internal resources that will be used to support the MNP implementation programme with fully recovered salary costs based on generic PNG salary benchmark data;
- Staff Training: 50 to 60 retail, dealer, and other customer services staff to receive MNP training based on 5 resellers plus 4 retail stores.

Two separate MNP scenarios have been modelled, namely:-

1. Citifon/Telikom implementation costs to support full automated MNP port in and port out functionality including ACQ direct routing; and
2. Citifon/Telikom implementation costs to support onward indirect routing only. Citifon/Telikom not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers;

Figures G.5 and G.6 below summarise the estimated cost ranges and cost driver breakdown for each of the modelled scenarios.

Figure G.5: Citifon- Range of Estimated Costs for each modelled MNP Scenario

MNP Option	Minimum Estimated Costs	Maximum Estimated Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing. Please note – Telkom/ CitiFon required to be able to ACQ route traffic between fixed and mobile networks	$1,807,937	$2,965,041
2. CitiFon/Telkom not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	$1,606	$1,606

Figure G.6: Citifon - Breakdown of Costs for each Modelled Scenario

Set-Up Cost	1. Fully Automated Port In & Out functionality including ACQ direct routing	2. Onward Routing only - Not involved in porting - No Porting functionality
Core Network	63.0%	0.0%
Business Systems/ OSS Upgrade	33.5%	0.0%
Engineering/ Testing Support	0.5%	51.9%
NP Programme Management	2.8%	0.0%
Business Process Changes	0.1%	0.0%
Staff Training	0.1%	48.1%
Total Technology Related Set-up Costs	***97.0%***	***51.9%***

Note: The figures add to the total proportion of technology costs in the set-up costs – and therefore do not add to 100%.

G.6 New Entrant

The Consultants have assumed that a potential New Entrant will be intending to build market share by, amongst other programs, targeting Digicel subscribers through the MNP service.

To be effective as a competitor in the short to medium term, a potential new entrant will be likely to establish a nationwide mobile network with leading edge VAS, BSS and OSS functionality. The Consultants have assumed that such a new entrant will ensure that its main vendor delivers integrated infrastructure with in-built MNP porting and ACQ routing functionality. Experience in other markets suggests that the incremental MNP functionality and features are included in the initial network and systems roll-out and therefore are not directly identifiable as separate cost items. The Consultants have therefore provided estimates of the costs of the specific MNP functional elements and features but recognize that since the new entrant is deploying greenfield integrated network and infrastructure, then their effective MNP related costs are likely to be lower than an existing operator, such as Digicel, that is required to upgrade existing systems and platforms to support the MNP service.

The Consultants have assumed that a new entrant will wish to implement a fully automated MNP porting capability complete with the corresponding ACQ direct routing functionality to optimize efficiency and quality of service, and will procure a turnkey fully integrated MNP compliant MNP network and business system solution, with all functions integrated and from a single vendor, such as Huawei or ZTE, with multi-site locations to provide the scale and resilience to support strategic aspirations to rapidly grow its subscriber base and market share.

Two separate MNP scenarios have been modelled, namely:-

1. New entrant implementation costs to support full automated MNP port in and port out functionality including ACQ direct routing; and
2. New entrant implementation costs to support porting in and out requirements but including onward indirect routing instead of ACQ direct routing

Figures G.7 and G.8 below summarise the estimated cost ranges and cost driver breakdown for each of the modeled scenarios.

Figure G.7: New Entrant - Range of Estimated Costs for each modelled MNP Scenario

MNP Option	Minimum Estimated Costs	Maximum Estimated Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$1,220,643	$2,078,881
2. Porting in and out requirements but including onward indirect routing instead of ACQ direct routing	$400,117	$632,342

Figure G.8: New Entrant - Range of Estimated Costs for each modelled MNP Scenario

Set-Up Cost	1. Fully Automated Port In & Out functionality including ACQ direct routing	2. Port In only functionality including onward indirect routing
Core Network	47.4%	60.9%
Business Systems/ OSS Upgrade	46.6%	26.3%
Engineering/ Testing Support	1.1%	2.8%
NP Programme Management	4.1%	7.6%
Business Process Changes	0.2%	0.5%
Staff Training	0.6%	1.9%
Total Technology Related Set-up Costs	***95.2%***	***90.0%***

Note: The figures add to the total proportion of technology costs in the set-up costs – and therefore do not add to 100%.

G.7 Central/ Shared MNP Central Clearinghouse and Administration system

A centralized MNP service model is being assumed for costing purposes.

There are different MNP Central Clearinghouse and Administration system options available. Figure G.9 lists a number of different cost models that have been adopted in different medium sized emerging markets across the world.

Figure G.9: MNP Central Clearinghouse and Administration System options

Model Type	Description	Initial Capital Costs	Five year Operational costs
Option 1. High CAPEX & Low OPEX	All costs associated with the vendor project management; Design; Development; Installation; Testing are charged.	Ranges from US$100k to US$400k – Dependent upon dimensioning (Volume); scalability; licensing	Range from US$1 million to US$2.5 million
Option 2. Set-up Costs & Higher OPEX	Vendor charges for Project Management but apportions remainder of CAPEX across five year operations.	Set-upcharges from US$175k to US$500k	OPEX charges on the basis of a monthly management fee plus transaction costs apportioned on the basis of Recipient; Repatriation & Synchronisation
Option 3. Full Transaction based	Vendor calculates transaction cost based on anticipated porting volumes.	No capital expenditure	Transaction costs apportioned on the basis of Recipient; Repatriation & Synchronisation [however, vendors may also negotiate a minimum monthly charge – either shared between all operators or apportioned based on % from previous month]

G.8 Costing Assumptions

For the purposes of this study, Option 2 for MNP Central Clearinghouse/ Administration System has been used, that is. a combination of initial/ upfront CAPEX and annual OPEX service charges which are recovered from the operators who are part of the MNPO system.

- Initial/ Upfront CAPEX $200,000
- Annual OPEX service charge $200,000
- **5 year Total Cost of Ownership** **$1,200,000**

The MNP Central Clearinghouse/ Administration system cost estimations are based on recent MNP programmes in emerging markets across the Caribbean.

G.9 NICTA

Should NICTA consider proceeding with the introduction of the MNP service the Consultants recommend that NICTA actively leads the MNP development and implementation programme from the outset using a clearly defined programme governance framework. This approach will be necessary to effectively lead and manage the multiple stakeholders and to ensure the MNP service is launched on time.

NICTA should dedicate a senior resource for a period of around 12 months to actively manage the MNP programme supported by specialist external MNP consultants as necessary.

On this basis NICTA's MNP programme management support costs to be $100,000 to $120,000, made up of:

- NICTA MNP lead resource - 1 person year - $20,000
- MNP specialist consultant support - $80,000 to $100,000

In addition, NICTA should make provision for training internal NICTA staff to (a) be aware of the MNP service; and (b) to establish a function to monitor and manage the MNP service post launch. The estimated cost is $14,000

G.10 Summary of Stakeholder MNP One-Off/ Set-up Costs

Figure G.10: Summary of Stakeholder MNP One-Off/ Set-up Cost

Stakeholder	Minimum MNP Investment	Maximum MNP Investment
Digicel	$1,008,195	$8,872,481
Bmobile	$1,606	$4,099,733
CitiFon/ Telkom	$1,606	$2,965,041
New Entrant	$400,117	$2,078,882
Central Number Portability Clearinghouse	$200,000	$200,000
NICTA	$103,500	$123,500
Total Industry	**$1,715,024**	**$18,339,637**

The wide variation between the estimated minimum and maximum MNP investment reflects the difference in stakeholder implementation costs for the fully automated MNP service requiring all operators to apply ACQ direct routing and the basic scenario where only Digicel and the New Entrant are required to manually process porting requests and traffic routing to ported numbers is provided only by Digicel and the New Entrant (subject to the New Entrant requesting MNP) using the simpler onward routing approach. In this second scenario, neither Bmobile nor CitiFon would be involved in porting customers but the real cost benefit to both of these operators would be that they would not required to invest in routing or porting related core network or system upgrades because they will onward route traffic as normal to Digicel and the New Entrant, who will be responsible for onward routing the traffic to the ported numbers.

G.11 Recurring Costs

Outlined below are the assumptions and considerations used to derive cost estimates for ongoing recurring service delivery for each of the different operators, separated where appropriate for each routing option. These costs are:

- **Operators: Additional costs for transferring calls**
  - For options requiring operators to implement ACQ direct routing, the ACQ definition requires all national traffic originated and terminated in PNG. Thus, there would be no additional or incremental routing charges involved in ACQ routing of national traffic;
    - For options requiring some or all operators to implement onward routing, traffic is forwarded from the originating network to the nominated number range holder who will then determine if the called number is ported or not. Where the called number is ported out, the number range holder will onward route the traffic to the recipient network that the called number has ported to.
      - Since onward routing requires the number range holder to use its network to process and route traffic for former subscribers, it is reasonable for the number range holder to levy an onward route charge to the originating operator for the use of its network.
      - It is difficult to benchmark the likely onward routing charge since every emerging market has adopted ACQ routing which does not require routing charges and thus there are no precedents from other markets. The Consultants have assessed the onward routing charge $0.03 (1 toea) per minute.
      - The Consultants have assessed the current interconnect traffic on a per subscriber basis for Bmobile and Citifon with Digicel and have used this as a basis to calculate the likely onward routing volumes for each network based on estimated porting rates.
  - **Administration costs for every request to port a number**
    - **Donor Porting Charges:** It is assumed that donor operators may be permitted to charge recipient operators for the directly attributable and incremental costs for processing porting out requests . The donor porting costs will vary depending on whether the donor operator adopts fully automated or manual porting systems and facilities:
      - Fully automated porting applications: It is assumed that donor operators will be required to establish resources to monitor automated porting systems and to perform fault rectification and management activities. We have assumed failure rates of 10% of porting volumes requiring 20 minutes of manual rectification activity charged at benchmarked fully recovered staff rates;
      - Manual porting facilities: Where operators use manual staff intensive porting functions to process porting requests, it is

assumed that each porting request requires 20 minutes of manual resource charged at benchmarked fully recovered staff rates.

- **MNP system upgrade annual support costs:** It is assumed that operators will be required to pay their system vendors to support the MNP related upgrades implemented in their core network, VAS platforms, provisioning and CRM systems, and MNP gateways. The IT sector support cost benchmark of 10% of the original CAPEX value has been used for annual support charges.

- **Central Number Portability Clearinghouse**
  - **Monthly/ Annual Service Charges:** It is assumed that the central Number Portability Clearinghouse provider will charge $200,000 per annum to provide and operate the PNG central MNP clearinghouse platform and service. The estimated annual charge is based on the Consultant's experience in similar medium scale emerging markets across the Caribbean and Africa.
- **NICTA**
  - **Ongoing MNP Service Management and Performance Monitoring:** It is assumed that NICTA would be required to provide resources to operate and set-up a MNP service management and performance monitoring function to monitor MNP service performance and manage MNP service and customer issues. Based on an experienced analyst for one week each month, the cost will be around $3,500 per annum.

G.12 Digicel

Figure G.11 below outlines the assumptions used to calculate the estimated Digicel annual MNP support for the different MNP service options being considered.

Figure G.11: Assumptions relating to Digicel costs for each MNP scenario

MNP Service Option	Donor Porting Costs	MNP Routing System Support Costs	MNP Porting System Support Costs
1. Fully Automated Port In and Out functionality including ACQ direct routing	Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 1% annual porting demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 5 heads to deal with porting in and out queries	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum
2. Port Out only functionality including ACQ direct routing	Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 1% annual porting (port out only)	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum

	demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 3 to deal with porting out queries only		
3. Port Out only functionality including onward indirect routing	Manual Processing of Porting Requests - Annual demand 0.5% (no new entrant) and 3% (with new entrant) - each porting request requiring 20 mins of manual activity	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum

Figure G.12 below summarises the estimated minimum and maximum annual support costs Digicel would be required to fund to operate the different MNP service delivery scenarios. .

Figure G.12: Digicel – Range of Annual Support Costs for each MNP scenario

MNP Service Option	Minimum Estimated MNP Annual Support Costs	Maximum Estimated MNP Annual Support Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$540,148	$922,600
2. Port Out only functionality including ACQ direct routing	$515,148	$864,560
3. Port Out only functionality including onward indirect routing	$128,546	$212,600

G.13 Bmobile

Figure G.13 below outlines the assumptions used to calculate the estimated Bmobile annual MNP support for the different MNP service options being considered.

Figure G.13: Assumptions relating to Bmobile costs for each MNP scenario

MNP Service Option	Donor Porting Costs	MNP Routing System Support Costs	MNP Porting System Support Costs	Onward Routing Charges from Number Block Operator
1. Fully Automated Port In and Out functionality including ACQ direct routing.	Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 10% annual porting (mostly Bmobile customers porting to Digicel) demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 3	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum	Not Applicable

	heads to deal with porting out queries only			
2. Bmobile not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	Bmobile not involved in porting in or out of numbers	Not Applicable	Not Applicable	1. Digicel is allowed to provide central onward routing service charged at 1 toea per minute ($0.003) per minute 2. Based on 2015 Digicel Interconnect data - Bmobile outbound interconnect traffic per Bmobile subscriber – 17.25 mins per annum

Figure G.14 below summarises the estimated minimum and maximum annual support costs Bmobile would be required to fund to operate the different MNP service delivery scenarios.

Figure G.14: Bmobile – Range of Annual Support Costs for each MNP scenario

MNP Service Option	Minimum Estimated MNP Annual Support Costs	Maximum Estimated MNP Annual Support Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$237,078	$422,828
2. Bmobile not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	$ 579	$1,158

G.14 Citifon/ Telikom

Figure G.15 below outlines the assumptions used to calculate the estimated CitiFon/ Telkom annual MNP support for the different MNP service options being considered.

Figure G.15: Assumptions relating to Citifon costs for each MNP scenario

MNP Service Option	Donor Porting Costs	MNP Routing System Support Costs	MNP Porting System Support Costs	Onward Routing Charges from Number Block Operator
1. Fully Automated Port In & Out functionality including ACQ direct routing. Please note – CitiFon/ Telkom required to be able	Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 10% annual porting (port out only Citifon	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum	Not Applicable

to ACQ route traffic between fixed and mobile networks	customers porting to Digicel) demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 1 head to deal with porting out queries only			
2. Citifon not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	Citifon not involved in porting in or out of numbers	Not Applicable	Not Applicable	1.Digicel is allowed to provide central onward routing service charged at 1 toea per minute $0.003 per minute 2. Based on 2015 Digicel Interconnect data – Citifon outbound interconnect traffic per Citifonsubscriber – 59.58 mins per annum

Figure G.16 below summarises the estimated minimum and maximum annual support costs Citifon/ Telikom would be required to fund to operate the different MNP service delivery scenarios.

Figure G.16: Citifon/Telikom – Range of Annual Support Costs for each MNP scenario

MNP Service Option	Minimum Estimated MNP Annual Support Costs	Maximum Estimated MNP Annual Support Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing. Please note – CitiFon/ Telkom required to be able to ACQ route traffic between fixed and mobile networks	$176,956	$294,276
2. CitiFon/ Telkom not involved in porting in or out and only required to route traffic to operators involved in ported. Porting operators will be responsible for traffic routing to ported numbers	$2,014	$4,028

G.15 New Entrant

Figure G.17 below outlines the assumptions used to calculate the estimated New Entrant annual MNP support for the different MNP service options being considered.

Figure G.17: Assumptions relating to New Entrant costs for each MNP scenario

MNP Service Option	Donor Porting Costs	MNP Routing System Support Costs	MNP Porting System Support Costs	Onward Routing Charges from Number Block Operator
1. Fully Automated Port In and Out functionality including ACQ direct routing	Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 2% annual porting demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 5 heads to deal with porting in & out queries since new entrant is likely to driving porting demand	10% of CAPEX development costs per annum	10% of CAPEX development costs per annum	Not Applicable
2. Porting in and out requirements but including onward indirect routing instead of ACQ direct routing	Manual Processing of Porting Requests - Annual demand 2% - each porting request requiring 40 mins of manual activity	Not Applicable	Not Applicable	Digicel is allowed to provide central onward routing service charged at 1 toea per minute $0.003 per minute New Entrant subscriber is 4 times greater than the CitiFon/ Telkom interconnect mins per annum – 238 mins per subscriber

Figure G.18 below summarises the estimated minimum and maximum annual support costs New Entrant would be required to fund to operate the different MNP service scenarios.

Figure G.18: New Entrant – Range of Annual Support Costs for each MNP scenario

MNP Service Option	Minimum Estimated MNP Annual Support Costs	Maximum Estimated MNP Annual Support Costs
1. Fully Automated Port In & Out functionality including ACQ direct routing	$155,296	$252,600
2. Porting in and out requirements but including onward indirect routing instead of ACQ direct routing	$182,291	$387,957

G.16 Summary of Stakeholder MNP Estimated Annual Recurring Costs

Figure G.19: Summary of Stakeholder MNP Estimated Annual Recurring Costs

Stakeholder	Minimum Estimated MNP Annual Support Costs	Maximum Estimated MNP Annual Support Costs
Digicel	$128,546	$922,600
Bmobile	$ 579	$422,828
Citifon/ Telikom	$2,014	$294,276
New Entrant	$155,296	$387,957
Central Number Portability Clearinghouse	$200,000	$200,000
NICTA	$3,500	$3,500
Total Industry	**$489,935**	**$2,231,161**

The wide variation between the estimated minimum and maximum MNP industry annual support costs reflects the impact of estimated routing and porting system support costs for the MNP service options requiring all or some operators to implement and support ACQ routing and automated porting, accounting for between 76% and 99% of the maximum estimated annual operator support costs.

With the exception of the New Entrant, the ACQ based service options were significantly more expensive for all operators than options involving onward routing and manual porting.

For Bmobile and Citifon, the MNP service options where these operators are not involved in porting numbers and continue to route traffic to either Digicel or the New Entrant for onward routing, the impact of paying onward routing charges is minimal, costing Bmobile $579 and Citifon $2,014, per annum.

For the New Entrant, the MNP service option where the New Entrant is able to manually port customers from Digicel, but is required to pay onward routing and donor porting charges to Digicel is 53% more expensive than the annual support charges for the fully automated ACQ service option. Based on a 2% porting demand, the Consultant's estimate that Digicel donor manual porting charges will cost the New Entrant up to $263,000 per annum, together with maximum additional onward routing costs of $64,000 per annum. Clearly, manual porting combined with onward routing would not be attractive to the New Entrant who is likely to push for a fully automated MNP and ACQ routing from the launch of its mobile operations.

Appendix H: Stakeholder MNP Costs - detail

Summary of Key Routing Options by Stakeholder

Option	Description	Digicel	Bmobile	Telikom	New Entrant
1	Full MNP for all current operators immediately including ACQ direct routing	ACQ	ACQ	ACQ	N/A
2	Full MNP for all current operators only when new entrant commences commercial service including ACQ direct routing	ACQ	ACQ	ACQ	ACQ
3a	Port Out/ Export - Digicel - On request from another operator but limited to New Entrant - only Digicel & New Entrant will perform Onward Routing for ported out numbers only	Onward Routing	Onward Routing via Digicel	Onward Routing via Digicel	Onward Routing
3b	Port Out/ Export - Digicel - On request from another operator - ACQ routing	ACQ	Onward Routing via Digicel or New Entrant	Onward Routing via Digicel or New Entrant	ACQ

Summary of Set-Up Costs by Option - assume average of each stakehiolders low & high costs

Option	Description	Digicel	Bmobile	Telikom	New Entrant	Total Set-Up Costs
1	Full MNP for all current operators immediately including ACQ direct routing	$ 7,102,536	$ 3,215,895	$ 2,386,489	N/A	**$ 12,704,920**
2	Full MNP for all current operators only when new entrant commences commercial service including ACQ direct routing	$ 7,102,536	$ 3,215,895	$ 2,386,489	$ 1,649,763	**$ 14,354,683**
3a	Port Out/ Export - Digicel - On request from another operator but limited to New Entrant - only Digicel & New Entrant will perform Onward Routing for ported out numbers only	$ 1,327,211	$ 1,993	$ 1,606	$ 516,230	**$ 1,847,040**
3b	Port Out/ Export - Digicel - On request from another operator - ACQ routing	£ 6,777,738	$ 1,993	$ 1,606	$ 1,649,763	**$ 8,431,099**

Summary of Annual Operating Costs by Option - assume average of each stakeholders low & high costs

Option	Description	Digicel	Bmobile	Telikom	New Entrant	Total Annual Operating Costs
1	Full MNP for all current operators immediately including ACQ direct routing	$ 731,374	$ 329,953	$ 235,616	N/A	**$ 1,296,943**
2	Full MNP for all current operators only when new entrant commences commercial service including ACQ direct routing	$ 731,374	$ 329,953	$ 235,616	$ 203,948	**$ 1,500,891**
3a	Port Out/ Export - Digicel - On request from another operator but limited to New Entrant - only Digicel & New Entrant will perform Onward Routing for ported out numbers only	$ 170,573	$ 869	$ 3,021	$ 285,125	**$ 459,588**
3b	Port Out/ Export - Digicel - On request from another operator - ACQ routing	$ 689,854	$ 869	$ 3,021	$ 203,948	**$ 897,692**

Digicel - Fully Automated MNP Systems with ACQ

Stakeholder	Digicel - Fully Automated MNP Systems with ACQ			
MNP Role - Likely to net gainer from Bmobile/ Telikom if no new entrant present - estimated porting demand 1% or less. If new entrant present then Digicel could be net loser - estimated porting demand 2%.				
Core Network upgrade to support ACQ routing	Single Network Vendor - Ericsson. Multiple MSCs/MGWs - In-built FNR ACQ Routing Functionality	N/A	$ 3,500,000	$ 6,000,000
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Ericsson or Redknee	N/A	$ 400,000	$ 800,000
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from same vendor, ie Ericsson or Redknee/ MS	N/A	$ 600,000	$ 800,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated provisioning/ & CRM systems from same vendor, ie Ericsson or Redknee	N/A	$ 400,000	$ 600,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from NeoConsult to interwork with Digicel Ericsson core network & Digicel Business Systems	N/A	$ 300,000	$ 450,000
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation & configuration support	7 to 18 man months	$ 8,167	$ 21,000
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue assurance testing	20 to 25 man months	$ 20,260	$ 25,325
NP Programme Management & Advisory Support	12 months dedicated internal programme resource & external MNP consultancy support	15 to 24 man months	$ 77,500	$ 128,000
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development	5 to 12 man months	$ 5,065	$ 12,156
Staff Training	300 to 500 retail/ dealer/ customer services staff to receive MNP training - 149 channels incl 10 retail stores	23 to 38 man months	$ 21,600	$ 36,000
Total Estimated Operator MNP Set-Up Investment			**$ 5,332,592**	**$ 8,872,481**

Digicel - Fully Automated MNP Systems with ACQ

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	44K Kuna per annum = $14,000 USD - source - Glassdoor	$ 1,167	
Testing Support	Aligned to above - 38K Kuna per annum = $12,160 USD	$ 1,013	
Retail/ Customer Services	Aligned to above - 36K Kuna per annum = $11,520 USD	$ 960	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 1% annual porting demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 5 heads to deal with porting in & out queries	$ 20,148	$ 57,600
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 390,000	$ 680,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 130,000	$ 185,000
Total Annual Operating Costs		**$ 540,148**	**$ 922,600**

Digicel - Port Out Only - ACQ & Automated Centralised Porting Systems

Stakeholder	Digicel - Port Out Only - ACQ & Automated Centralised Porting Systems			
MNP Role - Likely to net gainer from Bmobile/ Telikom if no new entrant present - this option would not apply				
MNP Role - If new entrant present then Digicel could be net loser - estimated porting demand 2% - this option would apply				
Core Network Upgrade to support ACQ routing	Single Network Vendor - Ericsson. Multiple MSCs/MGWs - In-built FNR ACQ Routing Functionality	N/A	$ 3,500,000	$ 6,000,000
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Ericsson or Redknee	N/A	$ 400,000	$ 800,000
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from same vendor, ie Ericsson or Redknee/ MS	N/A	$ 600,000	$ 800,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same vendor, ie Ericsson or Redknee. Development costs reduced from ($600,000/$400,000) to reflect reduced functional requirements to only process port out apporval & deactivation	N/A	$ 250,000	$ 400,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from NeoConsult to interwork with Digicel Ericsson core network & Digicel Business Systems. Development costs reduced from ($450,000/ $300,000) reflect requirement to only process port-out and routing update broadcast messages	N/A	$ 200,000	$ 300,000
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation & configuration support	7 to 18 man months	$ 8,167	$ 21,000
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue assurance testing	20 to 25 man months	$ 20,260	$ 25,325
NP Programme Management & Advisory Support	12 months dedicated internal programme resource & external MNP consultancy support	15 to 24 man months	$ 77,500	$ 128,000
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development. Revised to 1 month MNP port out impact assessment & 1 business process/ training development	5 to 12 man months - revised to 2-3 man months to revise & estabish port out support functions	$ 2,026	$ 3,039
Staff Training	300 to 500 retail/ dealer/ customer services staff to receive MNP training - 149 channels incl 10 retail stores - Revised to train MNP helpdesk support team responible for managing processing of port out requests & high-level briefing of retail/ dealer / customer services staff - reduced from 23 to 38 man months	8 to 13 man months	$ 7,680	$ 12,480
Total Estimated Operator MNP Set-Up Investment			**$ 5,065,633**	**$ 8,489,844**

Digicel - Port Out Only - ACQ & Automated Centralised Porting Systems

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	44K Kuna per annum = $14,000 USD - source - Glassdoor	$ 1,167	
Testing Support	Aligned to above - 38K Kuna per annum = $12,160 USD	$ 1,013	
Retail/ Customer Services	Aligned to above - 36K Kuna per annum = $11,520 USD	$ 960	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 1% annual porting (port out only) demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 3 heads to deal with porting out queries only	$ 20,148	$ 34,560
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 390,000	$ 680,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 105,000	$ 150,000
Total Annual Operating Costs		**$ 515,148**	**$ 864,560**

Digicel - Port Out Only - Onward Routing - Manual Porting Systems

Stakeholder	Digicel - Port Out Only - Onward Routing - Manual Porting Systems			
MNP Role - Likely to net gainer from Bmobile/ Telikom if no new entrant present - This Option would not apply				
MNP Role - If new entrant present then Digicel could be net loser - estimated porting demand 2% - this option would apply				
Core Network Upgrade to support simple onward routing	Single Network Vendor - Ericsson. Multiple MSCs/MGWs - Core Network Configuration to Separate Out & Manually Apply Onward Routing to Ported Out	N/A	$ 500,000	$ 800,000
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Ericsson or Redknee - Deactivate VAS access to ported out numbers & update SMSC changes to update SMS signalling to	N/A	$ 150,000	$ 250,000
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from same vendor, ie Ericsson or Redknee/ MS - Implement manual deactivation of ported out numbers & closure of retail billing. Update interconnect billing systems to facilitate onward routing of traffic	N/A	$ 200,000	$ 300,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same vendor, ie Ericsson or Redknee. - Assume manual deactivation of ported out numbers and application of	N/A	$ 100,000	$ 200,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from NeoConsult to interwork with Digicel Ericsson core network & Digicel Business Systems. - Not required since porting requests will be managed manually via NPC web GUI and not automated XML functionality. Since indirect Onward Routing will be used then there is no need for the NP Gateway	N/A	$ -	$ -
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 2-3 months implementation &	6 to 9 man months	$ 7,000	$ 10,500
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue	12 to 16 man months	$ 12,156	$ 16,208
NP Programme Management & Advisory Support	6 months dedicated internal programme resource & external MNP consultancy	8 to 12 man months	$ 29,333	$ 54,000
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development. Revised to 1 month MNP port out impact assessment & 1 business process/ training	5 to 12 man months - revised to 2-3 man months to revise & estabish port out support functions	$ 2,026	$ 3,039
Staff Training	Revised to train MNP helpdesk support team responible for managing processing of port out requests & high-level briefing of retail/ dealer / customer services staff	8 to 13 man months	$ 7,680	$ 12,480
Total Estimated Operator MNP Set-Up Investment			**$ 1,008,195**	**$ 1,646,227**

Digicel - Port Out Only - Onward Routing - Manual Porting Systems

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	44K Kuna per annum = $14,000 USD - source - Glassdoor	$ 1,167	
Testing Support	Aligned to above - 38K Kuna per annum = $12,160 USD	$ 1,013	
Retail/ Customer Services	Aligned to above - 36K Kuna per annum = $11,520 USD	$ 960	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Manual Processing of Porting Requests - Annual demand 0.5% (no new entrant) and 3% (with new entrant) - each porting request requiring 20 mins of manual activity	$ 33,546	$ 57,600
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 65,000	$ 105,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 30,000	$ 50,000
Total Annual Operating Costs		**$ 128,546**	**$ 212,600**

Bmobile Fully Automated MNP Systems with ACQ

Stakeholder	Bmobile Fully Automated MNP Systems with ACQ			
MNP Role - likely to be net loser to Digicel due to smaller customer base, limited products & poor network - only involved in small %ge of porting transactions - assumed 10% Bmobile customer base (est 250,000) port out				
Core Network Upgrade to support ACQ routing	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW - In-built ACQ	N/A	$ 1,500,000	$ 2,500,000
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail &	N/A	$ 150,000	$ 300,000
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from second tier 3rd party, ie Ushacomm/ Cerillion	N/A	$ 250,000	$ 450,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network	N/A	$ 200,000	$ 400,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party	N/A	$ 150,000	$ 300,000
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation &	5 to 14 man months	$ 4,800	$ 13,440
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue	12 to 18 man months	$ 9,996	$ 14,994
NP Programme Management & Advisory Support	12 months dedicated internal programme resource & external MNP consultancy	15 to 24 man months	$ 54,400	$ 103,040
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development	5 to 8 man months	$ 4,165	$ 6,664
Staff Training	150 to 200 retail/ dealer/ customer services staff to receive MNP training - 5 resellers plus 9 retail stores	11 to 15 man months	$ 8,696	$ 11,595
Total Estimated Operator MNP Set-Up Investment			**$ 2,332,057**	**$ 4,099,733**

Bmobile Fully Automated MNP Systems with ACQ

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 960	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 833	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 773	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 10% annual porting (mostly Bmobile customers porting to Digicel) demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 3 heads to deal with porting	$ 12,078	$ 27,828
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 165,000	$ 280,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 60,000	$ 115,000
Total Annual Operating Costs		**$ 237,078**	**$ 422,828**

Bmobile - Not involved in Porting - Onward Routing only

Stakeholder	Bmobile - Not involved in Porting - Onward Routing only			
MNP Role - likely to be net loser to Digicel due to smaller customer base, limited products & poor network - only involved in small %ge of porting transactions - assumed 10% Bmobile customer base (est 250,000) port out				
Assumed that Bmobile will not be involved in porting numbers and Bmobile will route traffic as normal to Digicel/ New Entrant & Digicel/ New Entrant will be responsible for routing to Ported Numbers				
Core Network Upgrade to support ACQ routing	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW - Assumed that Bmobile will continue to route all mobile traffic to either Digicel or New Entrant based on network code as usal and Digicel/ New Entrant will onward route to the correct network in the case of ported numbers. No change required	N/A	$ -	$ -
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail & USSD - Since Bmobile will rely on Digicel/ New Entrant performing onward routing for ported numbers, then no changes are required to VAS	N/A	$ -	-
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from second tier 3rd party, ie Ushacomm/ Cerillion - See above - No changes required to Bmobile business systems since Bmobile will not be required to change routing or	N/A	$ -	$ -
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network vendor, ie Huawei - No Impact	N/A	$ -	$ -
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party/ AvaBill - Not required - Since indirect Onward Routing will be performed by Digicel/ New Entrant, then there is no need for Bmobile to procure a NP Gateway	N/A	$ -	$ -
Engineering Support	Bmobile will not be required to change core network or business systems	N/A	$ -	$ -
Testing Support	1 month internal support (core network) to support Digicel/ New Entrant to test onward routing functions	1 man month	$ 833	$ 833
NP Programme Management & Advisory Support	Bmobile will not be required to dedicate Programme Management resources	N/A	$ -	$ -
Business Process Re-design	Bmobile not required to change business processes since Bmobile not involved in Porting numbers in or out	N/A	$ -	$ -
Staff Training	150 to 200 retail/ dealer/ customer services staff to receive basic training to explain to customers that Bmobile is not involved in the MNP service - 5 resellers plus 9	1-2 man months	$ 773	$ 1,546
Total Estimated Operator MNP Set-Up Investment			**$ 1,606**	**$ 2,379**

Bmobile - Not involved in Porting - Onward Routing only

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 960	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 833	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 773	
Operating Costs			
MNP Operational helpdesk suppoirt costs	**Assume - Bmobile not involved in porting in or out of numbers**	$ -	$ -
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ -	$ -
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ -	$ -
Bmobile onward routing charges levied by Digicel	See assumptions below - 0.5% porting demand	$ 579	$ 1,159
Total Annual Operating Costs		**$ 579**	**$ 1,159**
Onward Porting Routing Operational Costs			
Assume incumbent operator (Digicel) is allowed to provide central onward routing service charged at 1 toea per minute $0.002			
Based on 2015 Digicel Interconnect data - Bmobile outbound interconnect traffic per Bmobile subscriber mins per annum	17.25	Routed interconnect traffic minutes per subscriber per annum	
Assume inbound & outbound interconnect traffic is balanced			

Telikom Fully Automated MNP Systems with ACQ

Stakeholder	Telikom Fully Automated MNP Systems with ACQ			
MNP Role - Limited involvement due to small CDMA customer base - likely to be net loser to Digicel - only involved in small %ge of porting transactions - Required to upgrade core network to route fixed/mobile traffic using ACQ				
Activity	**Assumptions**	**Resourcing - Man Months**	**Minimum Estimated Investment $ USD**	**Maximum Estimated**
Core Network Upgrade to support ACQ routing	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW - In-built ACQ Routing Functionality -Licence based on small subscriber base but Telikom also has to route mobile to fixed traffic & vice versa	N/A	$ 1,000,000	$ 1,600,000
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail & USSD	N/A	$ 150,000	$ 250,000
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from second tier 3rd party, ie AvaBill/ Huawei	N/A	$ 250,000	$ 400,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network vendor, ie Huawei	N/A	$ 200,000	$ 400,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party/ AvaBill	N/A	$ 150,000	$ 200,000
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation & configuration support	5 to 12 man months	$ 4,800	$ 11,520
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue assurance testing. Testing staffing likely to reduced due to limited CDMA & fixed routing testing	4 to 8 man months	$ 3,332	$ 6,664
NP Programme Management & Advisory Support	6 months dedicated internal programme resource & external MNP consultancy support	6 to 10 man months	$ 45,760	$ 89,600
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development	3 to 5 man months	$ 2,499	$ 4,165
Staff Training	Assume - 50 to 60 retail/ dealer/ customer services staff to receive MNP training - 5 resellers plus 4 retail stores	2 to 4 man months	$ 1,546	$ 3,092
Total Estimated Operator MNP Set-Up Investment			**$ 1,807,937**	**$ 2,965,041**

Telikom Fully Automated MNP Systems with ACQ

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 960	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 833	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 773	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 10% annual porting (port out only Telikom customers porting to Digicel) demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 1 head to deal with porting out queries only	$ 1,956	$ 9,276
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 115,000	$ 185,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 60,000	$ 100,000
Total Annual Operating Costs		**$ 176,956**	**$ 294,276**

Telikom - Not involved in Porting - Onward Routing only

Stakeholder	Telikom - Not involved in Porting - Onward Routing only			
MNP Role - Limited involvement due to small CDMA customer base - likely to be net loser to Digicel - only involved in small %ge of porting transactions - Required to upgrade core network to route fixed/mobile traffic using ACQ				
Assumed that Telikom will not be involved in porting numbers and Telikom will route traffic as normal to Digicel/ New Entrant & Digicel/ New Entrant will be responsible for routing to Ported Numbers				
Activity	**Assumptions**	**Resourcing - Man Months**	**Minimum Estimated Investment $ USD**	**Maximum Estimated**
Core Network Upgrade to support ACQ routing	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW - Assumed that Telikom will continue to route all mobile traffic to either Digicel or New Entrant based on network code as usal and Digicel/ New Entrant will onward route to the correct network in the case of ported numbers. No change required	N/A	$ -	$ -
VAS Platform Upgrade	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail & USSD - Since Telikom will rely on Digicel/ New Entrant performing onward routing for ported numbers, then no changes are required to VAS	N/A	$ -	-
Business System Upgrade	Assume integrated post-paid/ IN, CRM & Billing system from second tier 3rd party, ie AvaBill/ Huawei - See above - No changes required to Telikom business systems since Telikom will not be required to change routing or billing	N/A	$ -	$ -
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network vendor, ie Huawei - No Impact	N/A	$ -	$ -
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party/ AvaBill - Not Required - Since indirect Onward Routing will be performed by Digicel/ New Entrant, then there is no need for Telikom to procure a NP Gateway	N/A	$ -	$ -
Engineering Support	Telikom will not be required to change core network or business systems	N/A	$ -	$ -
Testing Support	1 month internal support (core network) to support Digicel/ New Entrant to test onward routing functions	1 man month	$ 833	$ 833
NP Programme Management & Advisory Support	Telikom will not be required to dedicate Programme Management resources	N/A	$ -	$ -
Business Process Re-design	Telikom not required to change business processes since Telikom not involved in Porting numbers in or out	N/A	$ -	$ -
Staff Training	Assume - 50 to 60 retail/ dealer/ customer services staff to receive basic training to explain to customers that Telikom is not involved in the MNP service- 5 resellers plus 4	1 man month	$ 773	$ 773
Total Estimated Operator MNP Set-Up Investment			**$ 1,606**	**$ 1,606**

Telikom - Not involved in Porting - Onward Routing only

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 960	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 833	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 773	
Operating Costs			
MNP Operational helpdesk suppoirt costs	**Assume - Telikom not involved in porting in or out of numbers**	$ -	$ -
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ -	$ -
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ -	$ -
Telikom onward routing charges levied by Digicel	See assumptions below - 0.5% porting demand	$ 2,014	$ 4,028
Total Annual Operating Costs		**$ 2,014**	**$ 4,028**
Onward Porting Routing Operational Costs			
Assume incumbent operator (Digicel) is allowed to provide central onward routing service charged at 1 toea per minute $0.002			
Based on 2015 Digicel Interconnect data - Telikom outbound interconnect traffic per Telikom subscriber mins per annum	59.58	Routed interconnect traffic minutes per subscriber per annum	
Assume inbound & outbound interconnect traffic is balanced			

New Entrant - Fully Automated MNP Systems with ACQ

Stakeholder	New Entrant - Fully Automated MNP Systems with ACQ			
MNP Role - Likely to net gainer porting customers in from Digicel & Bmobile - estimated porting demand 2%. Assumed that New Entrant core network & business systems include base MNP / ACQ routing functionality from the outset				
New Entrant ACQ/MNP specific costs have been estimated since most new entrant operators will ensure that MNP/ ACQ functionality is included in their initial core network procurement and such MNP/ ACQ functions will not be purchased separately				
Core Network Upgrade to support ACQ routing - Incremental ACQ routing costs above initial set-up	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW -additional ACQ Routing Functionality from launch	N/A	$ 500,000	$ 750,000
VAS Platform Upgrade - Incremental MNP functionality costs above initial set-up	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail & USSD	N/A	$ 100,000	$ 200,000
Business System Upgrade - - Incremental MNP functionality costs above initial set-up	Assume integrated post-paid/ IN, CRM & Billing system from same vendor, ieHuawei/ ZTE	N/A	$ 200,000	$ 300,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network vendor, ie Huawei/ ZTE	N/A	$ 200,000	$ 400,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party - MNP specific cost only	N/A	$ 150,000	$ 300,000
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation & configuration support. Reduced from Digicel/ Bmobile resourcing since core network/ business/ VAS platforms should be specified and configured to support MNP/ ACQ from outset	5 to 10 man months	$ 5,833	$ 11,667
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue assurance testing. Reduced from Digicel/Bmobile resourcing since routing/ traffic testing could be included in the network roll-out & MNP related RA testing can be aligned to BAU RA testing	8 to 12 man months	$ 8,104	$ 12,156
NP Programme Management & Advisory Support	Assume MNP programme management & consultancy support will be included in the new entrant business set-up. Assume MNP requires additional 6 months support	6 to 9 man months	$ 47,000	$ 90,500
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development - Assumed that initial new entrant business launch business processes will be aligned to MNP service requirements - Resourcing reduced to 2-3 months	2 to 3 man months	$ 2,026	$ 3,039
Staff Training	100 to 150 retail/ dealer/ customer services staff to receive MNP training - Assume new entrant sets-up 10 owned retail stores & 3 resellers at launch.	8 to 12 man months	$ 7,680	$ 11,520
Total Estimated Operator MNP Set-Up Investment			**$ 1,220,643**	**$ 2,078,882**

New Entrant - Fully Automated MNP Systems with ACQ

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 1,167	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 1,013	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 960	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Automated MNP systems interworking with the NPC to process porting requests. Low - Assume 10% porting requests require manual intervention - 2% annual porting demand, each porting request requiring 20 minutes manual intervention - High -- Assume MNP helpdesk staffing of 5 heads to deal with porting in & out queries since new entrant is likely to driving porting demand	$ 40,296	$ 57,600
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 60,000	$ 95,000
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 55,000	$ 100,000
Total Annual Operating Costs		**$ 155,296**	**$ 252,600**

New Entrant - Port In & Out - Onward Routing

Stakeholder	New Entrant - Port In & Out - Onward Routing			
MNP Role - Likely to net gainer porting customers in from Digicel & Bmobile - estimated porting demand 2%. Assumed that New Entrant core network & business systems include base MNP / ACQ routing functionality from the outset				
Please Note - It is likely that the New Entrant will procure a fully MNP/ ACQ compliant core network/ business systems infrastructure from the outset and thus providing interim Onward Routing functionality will be an additional investment				
Core Network Upgrade to support ACQ routing - Incremental ACQ routing costs above initial set-up	Single Network Vendor - Huawei/ ZTE- Single MSC/MGW -Bespoke development to check HLR & onward route all Off Net mobile traffic irrespective of number range to Digicel, or check incoming onward routed mobile traffic (from Bmobile/ Telikom) & re-route where necessary - Please Note - additional ACQ Routing Functionality may be required post new entrant service launch - not costed	N/A	$ 200,000	$ 300,000
VAS Platform Upgrade - Incremental MNP functionality costs above initial set-up	Assume integrated VAS from same vendor, ie Huawei/ ZTE - limited to SMS, Voicemail & USSD - Bespoke changes to enable ported in numbers to access VAS services & to complete on net and off net SMS signalling - **Please Note - additional ACQ routing related VAS system development may be required to align with post launch ACQ core routing update - not costed**	N/A	$ 50,000	$ 75,000
Business System Upgrade - - Incremental MNP functionality costs above initial set-up	Assume integrated post-paid/ IN, CRM & Billing system from same vendor, ieHuawei/ ZTE - bespoke development to bill ported in numbers - **Please Note - additional Billing system development may be required to align with ACQ core network changes to support rating changes - not costed**	N/A	$ 50,000	$ 100,000
Provisioning/ CRM System Upgrade to support NPC interworking	Assume integrated Provisioning/ & CRM systems from same core network vendor, ie Huawei/ ZTE - bespoke development to provision ported in numbers - **Please Note - Development of Automated Porting In & Out Functionality may be required once the new entrant operations are established - not costed**	N/A	$ 50,000	$ 75,000
NP Gateway Development & Implementation to connect and interwork the NPC with core netwoork routing and business systems porting functions	Assume bespoke NP gateway from second tier 3rd party - MNP specific cost only - NOT REQUIRED since porting requests will be managed manually via NPC web GUI and not automated XML functionality. Since indirect Onward Routing will be used then there is no need for the NP Gateway	N/A	$ -	$ -
Engineering Support	2-3 months core network/ VAS/ business system MNP impact assessment & design plus 3-4 months implementation & configuration support. Reduced from Digicel/ Bmobile resourcing since core network/ business/ VAS platforms should be specified and configured to support MNP/ Onward Routing from outset - **Please Note - additional engineering resourcing may be required if new entrant is obliged to migrate to ACQ routing & automated MNP support once the new entrant operations are established - not costed**	4 to 8 man months	$ 4,667	$ 9,333.33
Testing Support	2-3 months internal support (core network/ IT) plus 2 months external testing support plus 1 month revenue assurance testing. Reduced from Digicel/Bmobile resourcing since routing/ traffic testing could be included in the network roll-out & MNP related RA testing can be aligned to BAU RA testing	6 to 9 man months	$ 6,078	$ 9,117
NP Programme Management & Advisory Support	Assume MNP programme management & consultancy support will be included in the new entrant business set-up. Assume MNP requires additional 6 months support	4 to 8 man months	$ 29,667	$ 49,333
Business Process Re-design	1-2 months MNP impact assessment plus 2-3 months business process revision & training development - Assumed that initial new entrant business launch business processes will be aligned to MNP service requirements - Resourcing reduced to 2-3 months	2 to 3 man months	$ 2,026	$ 3,039
Staff Training	100 to 150 retail/ dealer/ customer services staff to receive MNP training - Assume new entrant sets-up 10 owned retail stores & 3 resellers at launch.	8 to 12 man months	$ 7,680	$ 11,520
Total Estimated Operator MNP Set-Up Investment			**$ 400,117**	**$ 632,343**

New Entrant - Port In & Out - Onward Routing

Monthly Resource Cost - Fully Recovered - $USD/ Man Month			
Engineering Support	Assume 80% of Digicel - 36k Kuna per annum = $11,520 USD - source - Glassdoor	$ 1,167	
Testing Support	Aligned to above - 31K Kuna per annum = $10,000 USD	$ 1,013	
Retail/ Customer Services	Aligned to above - 29K Kuna per annum = $9,280 USD	$ 960	
Operating Costs			
MNP Operational helpdesk suppoirt costs	Assume - Manual Processing of Porting Requests - Annual demand 2% - each porting request requiring 40 mins of manual activity	$ 115,200	$ 268,774.32
MNP Routing related system support costs	Assume - 10% of CAPEX development costs per annum	$ 25,000	$ 37,500
MNP Porting related system support costs	Assume - 10% of CAPEX development costs per annum	$ 10,000	$ 17,500
New Entrant Onward Routing Interconnect Costs - Digicel	See assumptions below - 2% porting demand	$ 32,092	$ 64,183
Total Annual Operating Costs		**$ 182,292**	**$ 387,958**
Onward Porting Routing Operational Costs			
Assume incumbent operator (Digicel) is allowed to provide central onward routing service charged at 1 toea per minute $0.002 per minute			
Based on 2015 Digicel Interconnect data with Telikom - Assume New Entrant subscriber outbound interconnect traffic per New Entrant subscriber is 4 times Bmobile interconnect mins per annum	238.32	Routed interconnect traffic minutes per subscriber per annum	
Assume inbound & outbound interconnect traffic is balanced			