



The introduction of mobile number portability in Palestine

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October 2017

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1 Introduction

The author of this report, Robert Milne of Antelope Consulting International LLP ('Antelope Consulting'), was requested by the International Telecommunications Union (ITU) to investigate and provide regulatory and technical solutions for introducing Mobile Number Portability (MNP) in Palestine. MNP would enable people to change their choices of mobile service providers without changing their mobile numbers.

The investigation was conducted during and after a visit to Palestine between 7 October 2017 and 11 October 2017. During the visit the author held meetings with each of the mobile service providers (Jawwal and Wataniya). After the visit the service providers supplied copies of email messages and letters to supplement the information already supplied before the meetings. The author is grateful to them for their co-operation and efforts, and to the Ministry of Telecommunications and Information Technology (MTIT) for its support and facilities in the course of the work.

This report outlines the reasons for wanting MNP (in Section 2), discusses the conditions in which MNP is likely to be successful (in Section 3) and describes the implications for the porting process (in Section 4), the support systems (in Section 5) and the network implementation (in Section 6). It concludes with recommendations for work needed to increase the likelihood of success (in Section 7). Stakeholders may wish to comment on it when commenting on the draft Regulation for which it provides the background.

2 Motivation

2.1 Right of users

MNP can be regarded as a right of users, as it is in the European Union (EU), or as an encouragement to competition. When regarded as a right of users it has perhaps most economic significance for the many small businesses that need to keep their mobile numbers: without MNP they are tied to the same service provider, even though a different service provider might offer much more suitable services.

If MNP is a right of users then it does not require cost-benefit analysis for its justification. Though cost-benefit analysis remains common, it is rather suspect. In particular, the benefits to non-commercial customers are probably smaller now than they were twenty years ago, when cost-benefit analysis was first used for MNP: people might now have multiple handsets, or even single handsets with multiple Customer Identity Modules (SIMs), and can inform everyone on their contact lists about number changes. However, the benefits to commercial users, as indicated above, remain large and can outweigh even high costs to the service providers; moreover, in Palestine the networks are relatively modern and straightforward, so the costs should be low.

Nonetheless caution is needed about how much porting will actually happen if MNP is introduced in Palestine. Expectations of high rates of porting, obtained in surveys before MNP is introduced, are frequently not fulfilled. This may be because the survey respondents have behavioural biases, the conditions for introducing MNP are not right, or the services have improved in anticipation of the introduction of MNP. Typically service improvements reduce churn to rates that can be accommodated by the porting process without difficulty.

2.2 Encouragement to competition

When regarded as an encouragement to competition, MNP can be seen as one component of a policy; there are others, such as encouragement to Mobile Virtual Network Operators (MVNOs), publication of coverage maps, and reporting on quality of service that might be at least as important, particularly if the service providers form a duopoly. There is, however, considerable evidence that, in the right conditions, MNP can be effective in encouraging competition: prices might fall just before or just after the introduction of MNP, the market might become less concentrated, and services might become more innovative. Also, these effects of competition might make the market grow, to the benefit of all of the service providers.

Particularly important to the encouragement of competition is the state of development of the networks. When service providers have only just started, introducing MNP may simply increase competition for customers in the urban areas, instead of competition for customers everywhere; it could then inhibit network development. Published figures indicate that in 2014 Jawwal and Wataniya had 2.4 million and 0.6 million customers respectively, and that the West Bank and the Gaza Strip had 2.8 million and 1.7 million inhabitants respectively, with a median age below 20. These figures suggest that almost every adult has at least one mobile phone subscription, so the networks are well developed (at least in the West Bank). Moreover, even though Wataniya has only just started to serve the Gaza Strip, the population density can justify treating the area as urban¹.

¹ The Gaza Strip (with 5,045 people per square kilometre) has the third highest population density in the world, after Singapore (with 7,698) and Hong Kong (with 6,553).

2.3 Network development

The networks in Palestine have some attributes that can make the implementation of MNP straightforward:

- They were constructed relatively recently and relatively uniformly, so there is no need for interworking with obsolescent or unusual equipment.
- They can use simple architectures for MNP that have been mature for many years, so there is no need for experimentation or innovation.
- They are limited in number to two, so there is currently no need for a central data base system for managing porting, let alone a central intelligent network system for finding routes for calls and messages.

In these respects the introduction of MNP is timely, with no reason for delay. Whatever the reasons for delay might have been in neighbouring countries do not obviously apply in Palestine, and there has been MNP in Israel, with beneficial effects for customers, since 2007².

In some countries the regulator has a bias against regulation: regulation is introduced only to address problems that have been clearly demonstrated to exist in the countries. Such a bias inevitably leads to periods in which problems occur, usually without retrospective redress. MTIT is not constrained to introduce regulation only after problems occur. As there is by now extremely widespread experience of MNP and the associated problems, MTIT can feel able to introduce regulation without waiting for further evidence from Palestine.

2.4 Local conditions

If high proportions of customers request porting when changing service providers then number portability might be said to be successful: if customers believed that porting did not add to the inconvenience or expense of changing service providers then they would have no obvious reason not to request it. Equally, if they believed that porting was inconvenient or expensive they might be reluctant to change service providers.

The factors that contribute to the success of number portability differ between countries: a factor that appears to be influential in one country can appear to be irrelevant in another country. Some are considered in Section 3, while others, specific to the porting process, are considered in Section 4.

² For some weeks after the launch of number portability in Israel many attempts to port numbers failed, despite apparently thorough testing of the support systems, because the service providers were storing inconsistent out-of-date identity numbers and there was no central clearing house. In the first eighteen months about 600,000 mobile numbers were ported, but in the last three months of 2012 (five years after the launch) about 490,000 were ported.

3 Success factors

3.1 Awareness of porting

Customers need to be aware that porting is possible. Initially, the new entrants might perhaps provide enough publicity for porting. However, as new customers arrive and old ones forget, there is a need for sustained and repeated efforts in publicising porting. Though the service providers should develop publicity for number portability initially, MITI might add its own then or later.

3.2 Early termination charges

Subsidised phone prices are often thought to be partly responsible for the high penetration of mobile telephony, though evidently in many countries this has been achieved without them. With the advent of competition, service providers might seek to introduce phone price subsidies that could be associated with fixed contract lengths, network-locked phones and early termination charges, at least for postpaid customers. Permitting phone price subsidies and early termination charges is in keeping with letting service providers develop their own sales strategies. However, they might inhibit porting and do nothing to improve penetration.

There are few countries in which number portability was very clearly successful and effective as soon as it was introduced. One is Finland, where at the time phone price subsidies were prohibited³. If there are early termination charges customers are likely to forget them and be shocked by them when requesting porting. Generally any early termination charges should be proportional to the remaining duration of the contract length and limited to the initial phone price subsidy.

3.3 Loyalty discounts

Charges can be designed to inhibit porting (and indeed changing service providers at all) in other ways; in particular, there can be discounts for longer contract periods, bundled services, frequent use or long-term use. Such discounts should be permitted only if they are calculated without including any period of use before number portability is introduced.

3.4 Prices for off-net calls

Service providers can sometimes exploit network effects to inhibit porting. In particular, they can have large differences between the prices of on-net calls (which stay on one network) and off-net calls (which go into another network); then, when a number is ported away from a network, callers to it from that network encounter much higher prices. Mobile number portability was unsuccessful (and market concentration increased) in Portugal probably because of this: survey responses showed that users wanted to be on the same network as their acquaintances. If there are large differences between the prices of on-net calls and off-net calls then number portability can be successful.

The prices of off-net calls usually incorporate the apparent costs of off-net calls. However, those apparent costs are frequently inflated by artificially high wholesale interconnection charges, in the form of mobile termination rates. Regulators have now acted to resolve this problem, by determining that individual mobile service providers have Significant Market Power (SMP) in the markets for calls to their own customers and using regulatory powers to lower these rates.

³ About half the numbers in Finland were ported in the first three years after the introduction of number portability. Since then phone price subsidies have been legalised, in keeping with the rest of the EU.

The true costs of off-net calls can be different from those of on-net calls if the networks interconnect only at points remote from the call end points. Even then, whether there are great differences in cost on average depends on geographic calling patterns and switching and transmission costs. Only if there are great differences can large differences between the prices of on-net calls and off-net calls can be justified.

MITI could examine the difference in costs between on-net calls and off-net calls, by reference to the business cases of the service providers, before the introduction of number portability. The aim would be to establish the differences in prices between on-net calls and off-net calls justified by cost-orientation. Expectations of the difference in the prices of Jawwal and Wataniya might indicate what differences in prices would be acceptable to customers interested in porting their numbers; a 20% difference in prices could encourage customers to change service providers.

The mobile termination rates in Palestine do not appear to be badly out of line with those in other countries in the area, but the retail prices are higher⁴. Moreover, for some, but not all, price plans there are large differences between on-net prices and off-net prices: there are cases where the off-net price is more than three times the on-net price. Overall there could be room for a reduction.

3.5 Prices for calls to ported numbers

Regulators want prices to be apparent to users. However, when numbers are ported the prices of calls might change, because of differences between the prices of on-net calls and off-net calls or between the prices of off-net calls to one network and off-net calls to another network.

Price differences in the presence of number portability can be made more apparent or more acceptable to callers by:

- Having free announcements of pricing information (as in Portugal) or warning tones (as in Lithuania) at the starts of calls to ported numbers.
- Having toll free calls (as in Finland), toll free messages (as in Germany), bill inserts (as in Austria) or web sites (as in Denmark) to identify the networks to which numbers have been ported.
- Requiring call charges to be independent of whether numbers have been ported (as in France).
- Requiring the difference between the prices of on-net calls and off-net calls to be small.
- Requiring the receiving party to pay for all portions of calls coming from off-net.

Several of these approaches have disadvantages. Some, such as having free announcements of pricing information, might discourage porting; others, such as having toll free calls, might be too cumbersome or confusing to be used. The most acceptable to customers is likely to be requiring differences in prices to be small. Failing that, warning tones could help.

⁴ The mobile termination rates are 0.013 USD/minute and 0.018 USD per minute in Palestine; they were 0.0142 in Egypt and 0.0155 in Israel in 2014. The ITU price basket in 2015 recorded 14.51 USD (amounting to 5.69% of gross national income per head) for Palestine, 4.83 USD (amounting to 1.90% of gross national income per head) for Egypt, 4.96 USD (amounting to 1.35% of gross national income per head) for Jordan and 32.35 USD (amounting to 1.11% of gross national income per head) for Israel.

4 Porting process

4.1 Leading the processes

Though often the network implementation of number portability attracts most attention, the porting process is fundamental. If porting is not easy and cheap enough, customers will not do it and competition will not be encouraged.

To initiate porting, a user (who might not be the customer) must contact someone who 'leads' the porting by arranging for checks to be done before the number is moved from one service provider to the other. The person leading the porting might be:

- The gaining service provider (who provides the service after the porting).
- The losing service provider (who provides the service before the porting).
- A neutral third party clearing house.

The choices of who leads the porting and what checks are made, along with the porting times and the porting prices, contribute greatly to whether porting is perceived as convenient and inexpensive. They are not the only aspects of porting that customers see; for instance, customers might wish to withdraw from porting or to reverse porting performed without consent. However, they are the main ones that create controversies. Usually the resolution of the controversies implies that the losing service provider should not lead the porting.

4.2 Checking requests for porting from users

The porting process should ensure as far as reasonable that the customer wants the porting. In checking this, there is a balance to be struck between making porting easy and making porting secure. A customer who requests the initiation of porting may finally fail to proceed with it, so a way of cancelling porting before it happens (or perhaps even reversing it after it happens) is always going to be needed, regardless of where the balance is struck.

The user requesting porting might be doing so unknown to the customer; for instance, a small trader might be seeking to receive calls or messages intended for a competitor, family members might have misunderstood what the customer wanted, or someone might have stolen the phone.

When the user requests porting, the gaining service provider or the losing service provider could check that the customer is not a victim of false representation by:

- Examining the Calling Line Identity (CLI) of the call or message in which the request is made (if porting is requested over the phone by someone using the appropriate phone).
- Making a call or sending a message to the number to be ported and noting the response of the phone (if porting is requested in a shop by someone carrying the appropriate phone).
- Making a call or sending a message to the number to be ported and asking for confirmation of the request (if porting is requested in other ways).

The gaining service provider is not always motivated to make these checks. The losing service provider might be too well motivated, by the thought that personal contact with the customers would have the potential to win them back.

Another check is to copy the identity card of the user in a shop. However, this would make porting more cumbersome without making it more secure if the user was not carrying the card or had stolen both the card and the phone.

4.3 Checking requests for porting from gaining service providers

A gaining service provider might try to arrange porting unknown to the customer (in a practice known as ‘slamming’). This might be in order to acquire extra postpaid customers; prepaid customers usually lose their credit when their service providers change, so they are less likely to be victims of slamming.

In porting led by the gaining service provider, the losing service provider could check that the customer is not a victim of slamming by making a call or sending a message to the number to be ported and asking for confirmation of the request. However, this involves personal contact between customers and losing service providers, which is expensive, frequently disliked by customers and potentially used to win back customers. The losing service provider could check that the customer is not a victim of slamming without contacting the customer, by:

- Requiring the gaining service provider to provide the identity number of the customer or the account number of the customer with the losing service provider.
- Requiring the customer to reply to an SMS message.
- Requiring the customer to acknowledge a recorded voice announcement by pressing a suitable key.

Service providers always take the names and addresses for postpaid customers and sometimes take other details. However, these are often stated and recorded differently or incorrectly. They should not be used as the basis of checks; account numbers or identity numbers are quite long enough for the purpose. Even for such numbers requests for porting can be refused wrongly because of inconsistencies in the information; requests can also be granted wrongly, when an insistent and persistent sales representative of the gaining service provider tricks someone into providing an account number or identity number (by saying “let me check how good a deal we can give you”, for example).

In porting led by the losing service provider, the losing service provider could check that the customer is requesting porting and provide to the customer a porting authorisation code; the customer would pass this code to the gaining service provider, who would have to present it to the losing service provider to establish credentials for porting. The contact between the customer and the losing service provider could be impersonal: as in France for MNP, the customer could make a call or send a message from the number to be ported to an automated response system that would check the CLI and provide the porting authorisation code.

In porting led by a clearing house, there is contact between the clearing house and the customer, instead of between the losing service provider and the customer. This could well confuse users. Nonetheless, it might lower barriers to market entry, as a new entrant would need to negotiate a single arrangement with the clearing house instead of multiple bilateral arrangements with other service providers. However, these arrangements can often be subsumed in interconnection agreements. In a country the size of Palestine there will be relatively few bilateral arrangements, so this advantage of a clearing house is unlikely to be very telling.

With suitable checks, and with few service providers, there is no advantage in having porting led by the losing service provider or a clearing house. Indeed, porting should be led by the gaining service provider, because:

- The user needs to contact the gaining service provider in any case.
- The gaining service provider has an incentive to expedite porting.

4.4 Refusing requests for porting

During porting, the losing service provider receives a request for porting from a user or the gaining service provider. This request may be refused for various reasons; for instance, the losing service provider might have suspended the service to the customer because a phone with the number has been reported to be stolen. The request should not be refused if there are disputed outstanding charges or the customer does not reply to calls or messages.

Service providers sometimes suggest that payment should be required before numbers may be ported; however, this would slow down porting greatly. Service providers have other ways of getting customers to pay their bills, irrespective of whether the numbers are ported.

Because Jawwal has operated almost as a monopoly, termination of service by the customer is likely to have been fairly unusual and not operated under a well designed process. MNP requires a properly designed process for termination that operates to the benefit of consumers.

4.5 Encouraging withdrawals of requests for porting

During porting, the losing service provider might attempt to win back the customer, particularly by reducing future charges, emphasising outstanding charges or criticising other services. In some countries for some services (such as insurance) special offers to reduce future charges, at least, are allowed. However, elsewhere they are prohibited or restricted, on the grounds that price reductions for individual customers favour self-confident customers, can lead to harassment and do not develop competition.

Restrictions on contact with customers need not apply to business customers that have many numbers. Such customers have their own account managers and their own pricing plans and contract terms that are not generally available. They are also likely to have consecutive numbers, which might have mechanisms for porting different from those of individual numbers.

4.6 Times for porting

Surveys of consumers frequently indicate that consumers want porting to be fast. Yet there are countries where porting is fairly widespread despite taking weeks. What might be more important is certainty about when, if ever, service will be lost during porting.

In some countries, such as Malta, service is not lost during porting. Avoiding loss of service lets the customers make calls to correct problems and use new phones immediately after purchase. It might require the gaining service providers to activate numbers for the customers before the losing service providers remove numbers; the numbers thus activated might be temporary numbers but after the completion of porting they would need to be taken out of circulation for six months (say).

There can be floods of requests for porting, particularly when there are special offers. In some countries there are therefore requirements for checking requests up to limits in the quantities of requests checked. Such limits might be especially appropriate when service providers are small and therefore have little capacity to absorb peaks in demand well.

4.7 Prices for porting

Porting incurs costs that the losing service provider and the gaining service provider might wish to recover from the customer. These costs are likely to be smaller than the savings that the customer makes after some months by changing service providers. Nonetheless they can inhibit porting significantly, because decisions are often influenced more by immediate losses than by prospective gains. The charges levied for porting numbers are probably partly responsible for the lack of success of number portability in Germany, for example.

Accordingly, gaining service providers usually do not levy charges for porting numbers to them. However, losing service providers might wish to levy charges and might need to be restrained from doing so, especially when market concentration is high.

5 Support systems

5.1 Practices

The customer experience of the porting process depends on how much protection there should be, which in turn depends on the likelihood of impersonation, misleading selling, and overenthusiastic customer retention. For mobile services, a reasonable compromise is roughly that:

- The customer asks the gaining service provider to get the number ported.
- The gaining service provider asks the losing service provider to agree to the porting.
- The losing service provider agrees to the porting and lists any payments due.
- The customer confirms that the number is to be ported.
- The gaining service provider fixes the time for the porting and tells the network operators.

Thus the porting process comprises several essentially straightforward actions done one after another. These actions nonetheless lead to minor changes in existing systems such as those for customer relationship management, billing and provisioning, for both the service provider that is gaining the customer and the service provider that is losing the customer.

5.2 Realisation

To implement the actions of the porting process employees of the mobile service providers and mobile network operators would just access some of their own support systems and exchange emails. The systems would need extra fields in records indicating whether numbers were ported and new tables recording the numbers of requests to initiate porting that had been granted and refused.

Initially email messages might suffice for communication, provided that they had standardised formats, were digitally signed and were stored for audit purposes. However, when the volumes of ports grow, more elaborate automated interfaces would help. In particular, a simple work flow management system could schedule the actions in the porting process. Such systems are available from specialised companies such as BPM'online, Kissflow, Pipefy, ProcessMaker, Promapp and RunMyProcess, with free trials in some cases, as well as Oracle (for example). There might be a work flow management system specific to each particular service provider and integrated with its customer relationship management system to provide a uniform and familiar user interface.

Alternatively there might be a work flow management system with its own data base that was common to all of the mobile service providers. This would form a simple clearing house for co-ordinating exchanges of information about porting and storing information about ported numbers. It might be developed and operated on behalf of the service providers by a third party or indeed by MTIT itself, perhaps using cloud storage.

In several countries there are substantial clearing houses established and operated by companies that supply operational support systems or business support systems for telecommunications; among them are Case SA, El Corte Ingles, Kapsch, MediafonDatapro, NetNumber, PortingXS, Syster, Teletech and UTI, as well as bigger companies such as Neustar, Syniverse and Ericsson (through its subsidiary Telcordia). The large quantity of suppliers testifies to the widespread adoption of MNP in general and clearing houses in particular.

A clearing house resembles an allocated number database in some ways and might be extended to other applications. Various such applications have been put forward; the more plausible include number allocation to service providers, individual short code assignment to content providers, and message broadcast to all customers (irrespective of their service providers). These applications require slightly different database contents and functions. If they are not obviously needed they do not weigh significantly in favour of centralising the database.

There does not seem to be a case for a substantial clearing house in Palestine yet, as there are only two service providers currently and there will probably be fairly low rates of porting: the rates of porting are often found to be lower than they were predicted before the introduction of MNP, because the service providers have already taken steps to keep their customers, such as reducing prices and improving quality.

5.3 Development

If MNP is introduced it should be working effectively and efficiently from the first day, as otherwise it will develop a poor reputation from which it will be very slow to recover. Installing a simple clearing house (or indeed making integration and testing exhaustive) might delay the introduction of MNP by three months (say). However, this might be a price worth paying if would reduce the quantities of prolonged or abandoned attempts to port.

5.4 Maintenance

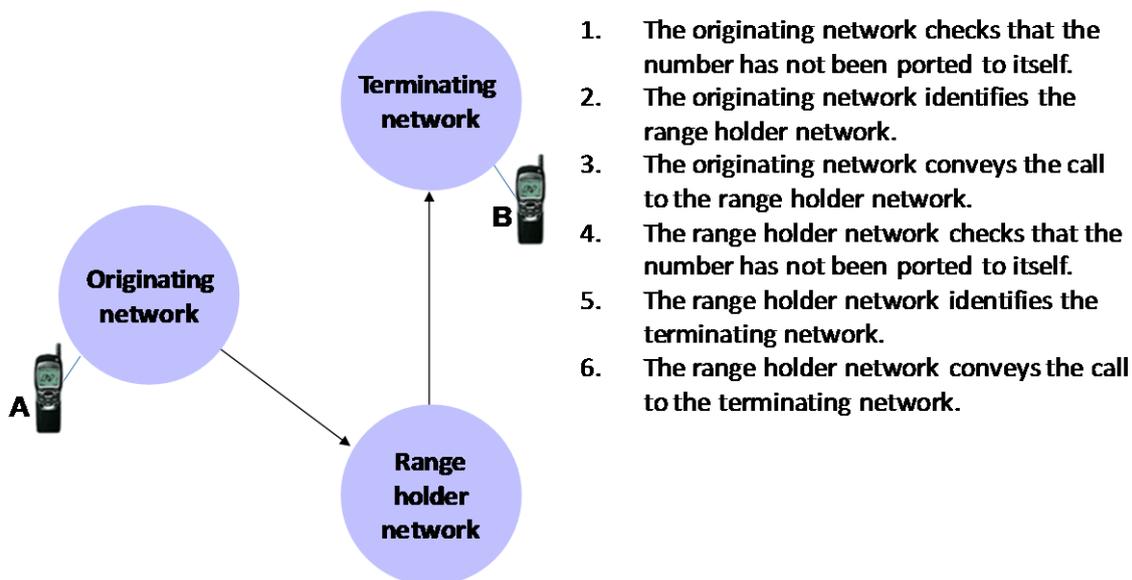
Two service providers might be holding details about a customer who was taking service from them both; these details could easily be inconsistent because they were inaccurately stated or had become out-of-date. If there is not a clearing house storing the master copy of the details needed to check the validity of requests for porting, the inconsistencies can lead to the refusal of requests that should be granted. Hence there need to be checks that the data bases of the service providers are consistent and rules for removing inconsistencies (such as “use the identity number that was provided on the most recent occasion when the customer showed the identity card”).

6 Network implementation

6.1 Principles

The most straightforward network implementation of MNP (and perhaps the first to be adopted anywhere) uses 'indirect routing' (which is also called 'onward routing'): when a network receives a call destined for a ported number the call is conveyed to the network of the network operator to which the number has been allocated, where it is conveyed to the network of the network operator to which the number has subsequently been ported. The network operator to which the number has been allocated is the 'range holder' for the number; in this report the network operators that receive the call and deliver the call in Palestine are the 'originating network operator' and the 'terminating network operator' respectively. Figure 1 illustrates all this.

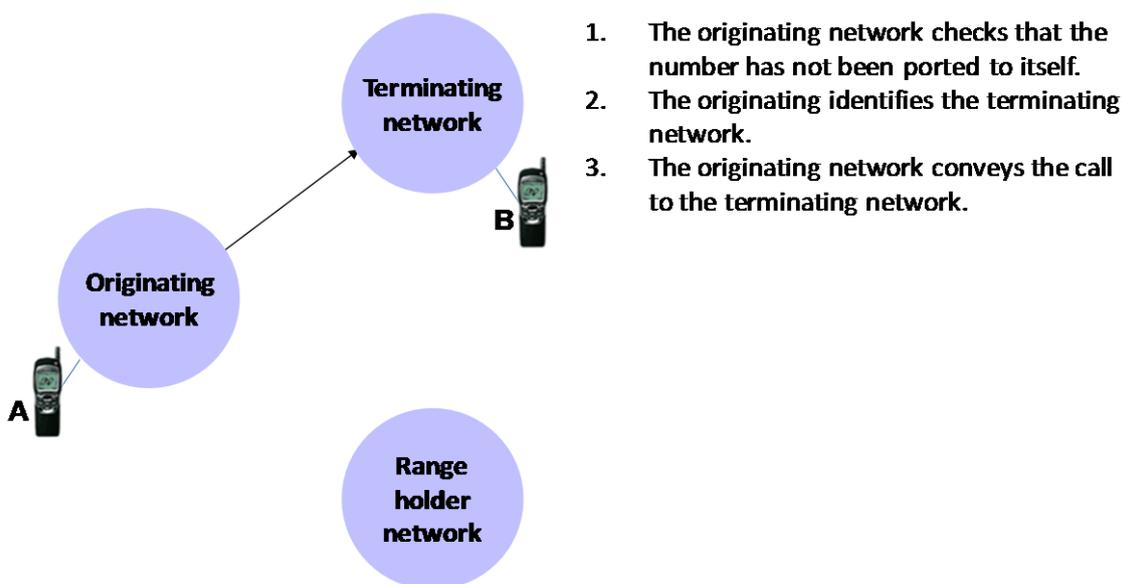
Figure 1 Indirect routing of calls to ported numbers



In indirect routing, therefore, the network of the range holder must be able to convey calls to the networks where there are ported numbers that have been allocated to the range holder.

The network implementation using 'direct routing' extends this principle: it requires that, when a network receives a call destined for a ported number, the call is conveyed to the network of the network operator to which the number has been ported, even if that network operator is not the range holder for the number. Figure 2 shows that direct routing is then more efficient than indirect routing.

Figure 2 Direct routing of calls to ported numbers



Networks such as international networks do not usually know whether numbers have been ported, so they route calls to the networks of the range holders. If there is number portability, the networks of range holders must therefore be capable of performing indirect routing. Introducing direct routing merely improves efficiency by avoiding indirect routing in those networks that know whether numbers have been ported.

Indirect routing and direct routing can co-exist; indeed they must do so. In Palestine, the Jawwal and Wataniya networks receive calls from international networks, Israeli networks and the Paltel network, which they would handle by indirect routing if there was number portability. Calls that they receive from each other they could handle by direct routing. Doing this is trivial in Palestine, because there are only two mobile network operators currently, but the same technique can be applied when there are several mobile network operators.

Messages are slightly different from calls, in that they use non-call-related signalling instead of call-related signalling. However, the network implementation with indirect routing and direct routing is applicable to non-call-related signalling as well as to call-related signalling.

6.2 Realisation

The network of a mobile network operator already requires a Home Location Register (HLR) that determines to where calls should be conveyed, at least when the calls are destined for numbers allocated to the network operator. To implement indirect and direct routing for ported numbers, the HLR is just augmented with a Signalling Relay Function (SRF) that checks whether numbers have been ported in or out, passing them to the HLR if they have been ported in and passing them to a gateway into another network if they have been ported out. The Flexible Number Register (FNR), which has been available from Ericsson since 2001 at least, is an implementation of the SRF with a data base of ported numbers; there are other implementations, such as those from Squire and Oracle (through its subsidiary Tekelec), but the Ericsson one is that most obviously appropriate to the Jawwal and Wataniya networks, with their existing Ericsson components.

The standard 3GPP TS 23.066 contains a full description of the implementation of indirect and direct routing, including the fields in the signalling that are affected. Figure 3, taken from that standard, shows the signalling required in the range holder network when the originating network does not know whether a number has been ported out from the range holder network and the number has in fact been ported out. The originating network passes the call to the range holder network, which then passes the call to the terminating network, attaching a Routing Number (RN) if necessary.

If the range holder network is also the originating network the signalling involving the HLR and the SRF is essentially unchanged.

Figure 3 Signalling for a number that has been ported out from the range holder network

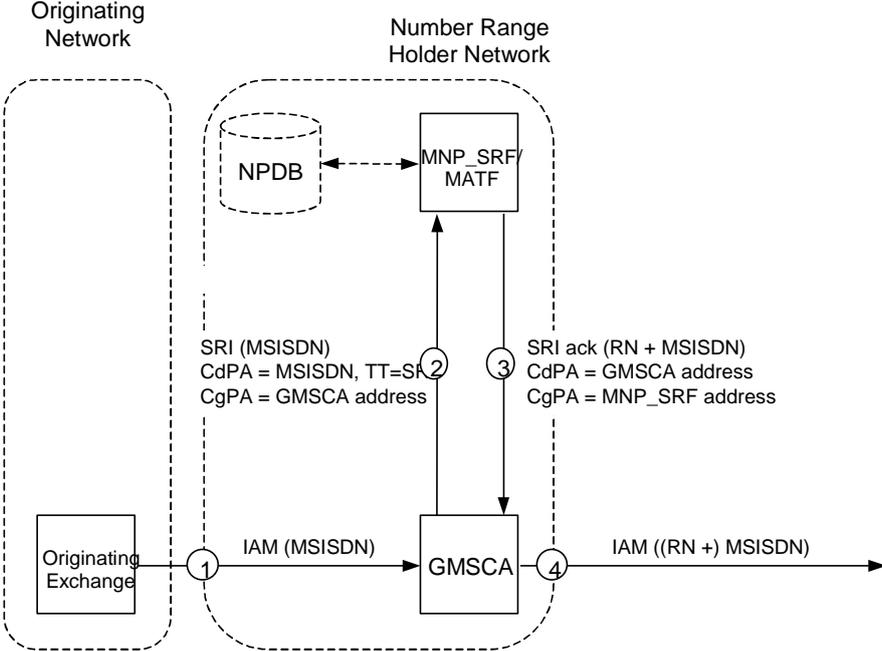
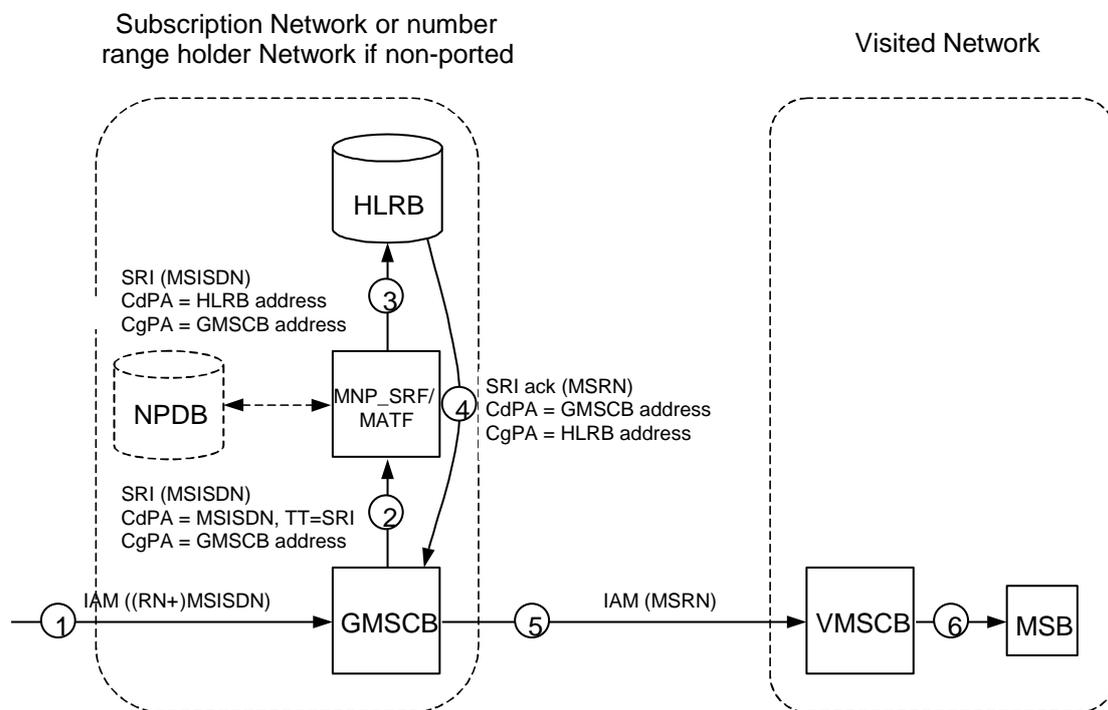


Figure 4 is taken from the standard with minor modification but uses the term 'subscription network' for 'terminating network'. It shows the signalling required in the terminating network (which might be the range holder network) when a number has been ported in or has not been ported out. The call can continue to a visited network with a Mobile Station Roaming Number (MSRN), just as if numbers are not ported. Of course, if the terminating network is unable to have numbers ported in or out then no special signalling is required.

If the terminating network is also the originating network the signalling involving the HLR and the SRF is essentially unchanged.

Figure 4 Signalling for a number that has been ported in to the terminating network or that has not been ported out from the terminating network



6.3 Development

Though the SRF of Ericsson can be supported by hardware separate from that of the HLR, this should not be necessary; at most an upgrade in capacity should be needed to support the SRF alongside the HLR. The software for the SRF is well established and should be straightforward to integrate into the HLR. The time needed for this integration and testing activity is unlikely to be the main matter holding up the introduction of MNP.

For a live implementation some parameters and conventions (such as the values for RNs and the uses of RNs between networks) must be agreed and documented by the network operators. Arranging these details is a suitable task for a working group of an industry forum.

6.4 Performance

Introducing MNP would add delays, both to the signalling paths of many calls and to the voice paths of some calls. However, these delays should not be unacceptable, given the location of the network elements of Jawwal and Wataniya.

The first source of delays is that there is extra processing and communication when the Gateway Mobile Switching Centre (GMSC) interrogates the HLR and SRF, as depicted in Figure 3 and

Figure 4. However, these delays to the signalling are tiny, especially when the HLR and SRF are collocated: at worst they would increase the time for the interrogation from about 10 ms to about 20 ms.

The second source of delays is that the use of indirect routing lengthens both the signalling paths and the voice paths for some calls. Figure 5 illustrates this in the case when there are three networks, X, Y and Z, such that X has not implemented MNP but Y and Z have done so; thus X might be an international network, an Israeli network or the Paltel network, and Y and Z might be the Jawwal and Wataniya networks (or the Wataniya and Jawwal networks) respectively.

Figure 5 Effects of porting on delays

Originating network of the calling number ('A')	Range holder network of the called number ('B')	Subscription network of the called number ('B')	Action	Effect on delay
Y	Y	Y	No porting of B	No change
Y	Y	Z	Porting of B to Z with use of direct routing	Increase due to traversing Z
Y	Z	Z	No porting of B	No change
Y	Z	Y	Porting of B to Y with use of direct routing	Decrease due to not traversing Z
X	Y	Y	No porting of B	No change
X	Y	Z	Porting of B to Z with use of indirect routing	Increase due to traversing Z

As Figure 5 indicates, porting would decrease delays in some cases and increase delays in others. Whether, overall, delays for calls from Y or Z to Y or Z are increased or decreased depends on which of Y and Z is more successful at enticing the customers of the other. Delays for calls from X are increased only when X normally sends calls to Y and customers port to Z numbers in ranges held by Y (and similarly with Y and Z interchanged). However, the increases in the delays presumably do not make the calls unacceptable, as there are already calls with such delays: if X normally sends calls to Y then customers that port to Z numbers in ranges held by Y experience delays that are almost identical with those experienced by customers that do not port from Z numbers in ranges held by Z.

In brief, the worst that could happen through introducing MNP is that there would be an increase in the proportion of calls from international networks, Israeli networks and Paltel that have the longest delays found currently. If those delays would be unacceptable after porting was introduced then they must be unacceptable now.

7 Recommendations

1. MITI should move forward with the introduction of MNP.
2. MITI should encourage the creation and continuation of mobile virtual network operators.
3. MITI should require the publication of comparative coverage maps to a common standard.
4. MITI should seek to reduce differences between prices for on-net calls and prices for off-net calls (and to reduce mobile interconnection rates, if necessary).
5. The mobile service providers should audit (and modify, if necessary) their support systems to ensure that mobile numbers are not used as reference identifiers when no longer assigned.
6. The mobile service providers should take steps to procure, integrate and test the SRFs.
7. MITI and the mobile service providers should establish working groups that might cover:
 - The formats and contents of the messages needed during the porting process.
 - The value and feasibility of having a clearing house based on a simple work flow management system.
 - Processes for delaying and cancelling porting.
 - Limits on the times taken by actions in the porting process, inside and outside the working day.
 - Checks on the integrity of the distributed data.
 - Limits on floods of requests.
 - Variations of the porting process for large quantities of numbers.
 - Contents of the messages needed by call-related and non-call-related signalling.
 - Inter-provider tests of the porting process, the support systems and the network implementation.