

Report for ComReg

Conservation measures
to meet future demand
for geographic numbers

8 March 2016

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1 Executive summary

In December 2013, ComReg published a consultation paper (Document 13/121) and a related consultants' report (Document 13/122), prepared by Analysys Mason and Antelope Consulting, on the Evolution of Geographic Numbering. This report sets out more detailed proposals in respect of the conservation measures identified in these documents.

Although end user demand for telephone services that use geographic numbers is not significantly growing, it remains the case that CSP demand for geographic numbers is still increasing and running substantially above end user demand.

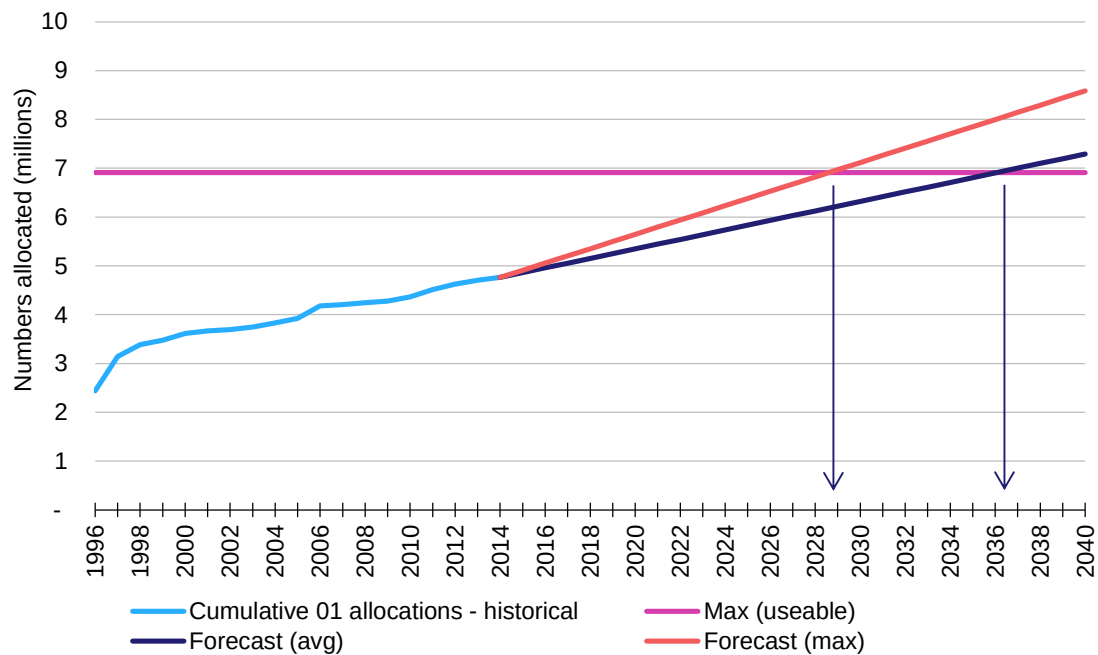
In most areas, the existing numbering plan has a significant quantity of geographic numbers available, which is much larger than the number of fixed voice subscriptions. However, as a result of the strong growth in demand for numbers there is a risk of number exhaustion (demand exceeding supply) in a number of areas including Galway, Limerick, Monaghan, and Tipperary.

Whilst the Dublin area (NDC 01) is not the worst case¹, even here, unless CSP behaviour does not change we forecast that Dublin could face number exhaustion in 15–20 years even without strong changes in underlying demand for services using geographic numbers (see Figure 1.1). We note that as previously estimated in ComReg Document 13/122, number exhaustion in Dublin, could have been as early as 2020. However, the recent recovery by ComReg of unused number blocks in the Dublin areas has alleviated the short term threat.

Major changes to geographic numbering in the future would impose very significant costs on industry and consumers alike. In earlier work for ComReg, Europe Economics estimated that a large scale number change in Dublin (such as adding an additional digit to all numbers) would have total costs of approximately EUR337 million. By comparison, we believe that conservation measures can change CSP behaviour such that large-scale and very expensive changes will not be required at all in most areas. We therefore consider it necessary that proportionate and low-cost measures are taken now to improve the efficiency of number utilisation, as even a modest improvement in utilisation could have a significant effect on the ability of supply to meet demand in the medium term.

¹ The Dublin 01 NDC has been used as an example in this report as a recent audit of geographic number use in Dublin means the situation in Dublin is well documented

Figure 1.1: Allocated 01(Dublin) geographic numbers by year of allocation and forecast based on average and maximum yearly allocation from 2010 to 2014 [Source: Analysys Mason, 2015]



In this report, we propose and recommend that the following specific conservation measures should be adopted:

- Recovery by ComReg of existing unused number blocks
- Returning ported-in numbers to the original block holder once these numbers are no longer in use
- The introduction of an overall utilisation target (such that additional numbers are not allocated unless the target is being met)
- Setting a guideline relating to upper bounds on numbers allocated to consumers and businesses
- Using the opportunity presented by current changes to the systems supporting geographic number portability (GNP) to undertake preparatory work to support number pooling, should it be necessary in the future.

In combination, these low-cost measures should limit inefficient demand for additional numbers and significantly reduce the risk of large-scale and costly future numbering changes.

We have also recommended monitoring, auditing and management actions to be undertaken by ComReg in support of these measures.

We do not propose charging for numbers. However, should the other recommended conservation measures as set out in this report prove ineffective and not lead to efficient use of numbers by CSPs, then ComReg may need to consider implementing such an approach at a later stage.

2 Introduction

As part of its statutory remit, the Commission for Communications Regulation (ComReg) manages the national numbering resource on behalf of the State. The effective management of that resource includes taking measures to ensure that there are enough numbers to meet current and future demand.

In December 2013, ComReg published a consultation paper (Document 13/121²) and a related consultants' report (Document 13/122³), prepared by Analysys Mason Limited (Analysys Mason) and Antelope Consulting LLP (Antelope Consulting), on the Evolution of Geographic Numbering. The consultation paper set out ComReg's proposals and initial views on the future of geographic numbering in the State. The paper noted that there is significant demand for geographic numbers in certain areas of the country, including Dublin, which threatens the future supply of such numbers in those areas.

The Analysys Mason and Antelope Consulting report looked at global trends, at national considerations for geographic numbering (particularly Dublin "01" numbers), at the current supply and utilisation of geographic numbers, and at estimated future demand for geographic numbers. The report set out eight proposals for increasing the supply of geographic numbers and an additional eight proposals for making better use of the existing stock of geographic numbers, in order to avoid having to make future number changes.

Of the eight measures considered for conserving the existing stock of geographic numbers, the Analysys Mason and Antelope Consulting report highlighted the following three as most effective:

- setting effective utilisation targets for communication service providers (CSPs)
- retrieving unused numbers
- number pooling between CSPs.

The other measures examined were:

- reducing the sizes of blocks in allocations
- shortening the interval between assignments
- maintaining the linkage of numbers to locations
- removing the distortions in demand due to tariffs
- charging for numbers.

² ComReg Document 13/121 - The Evolution of Geographic Telephone Numbering in Ireland - published 19 December 2013. http://www.comreg.ie/_fileupload/publications/ComReg13121.pdf.

³ ComReg Document 13/122 - The evolution of geographic numbering in Ireland, Consultants' report - published 19 December 2013. http://www.comreg.ie/_fileupload/publications/ComReg13122.pdf.

ComReg received seven responses to Consultation 13/121 (ComReg Document 14/41⁴). The responses indicated that CSPs generally agree with geographic number conservation measures in order to avoid the costs and disruption associated with future number changes. Many of the CSPs also indicated that any measures introduced should be reasonable, proportionate, coordinated, and should not result in the imposition of unnecessary administrative effort or cost.

This report sets out more detailed proposals in respect of the conservation measures identified in ComReg documents 13/121 and 13/122, and also considers a further option of levying fees for the use of geographic numbers.

Much of the analysis contained in this report considers the supply and utilisation of geographic numbers in the Dublin national destination code (NDC) area and, in general, the report also looks at the potential impact of the conservation measures in the context of the Dublin NDC area. However, we fully appreciate that other numbering areas in Ireland may face the threat of number exhaustion and could also benefit from the measures proposed – we therefore, wherever possible, also consider the potential impact of the measures in areas outside of Dublin.

The remainder of this document is laid out as follows:

- Section 3 examines the characteristics of geographic numbers and provides background to inform the proposals set out in this document.
- Section 4 presents the options considered for conserving the existing stock of geographic numbers.
- Section 5, based on the preceding analysis, looks at the likely costs and benefits of the options and sets out the measures we think should be adopted and our recommendations.

The report includes a number of annexes containing supplementary material:

- Annex A contains confidential information and is not included in the published version of this report
- Annex B provides details on possible approaches to charging for numbers
- Annex C provides a description of how number pooling operates in the United States
- Annex D provides a list of abbreviations used in this report

⁴ ComReg Document 14/41 - Publication of non-confidential submissions to ComReg Document 13/121 - published 02 May 2014. http://www.comreg.ie/_fileupload/publications/ComReg1441.pdf.

3 Use of geographic numbers

3.1 Introduction

In this section we examine the characteristics of geographic numbers and provide background to inform consideration of the proposals set out later in the document. We explain how CSPs manage geographic numbers currently and the particular challenges faced. We then consider why numbers continue to be in demand from consumers/businesses and CSPs, and what this demand is likely to mean for the availability of geographic numbers in the future.

3.2 Context

3.2.1 Definition and characteristics of geographic numbers

Geographic numbers are defined in the new Numbering Conditions of Use and Application Process⁵ as:

“a number from the national numbering scheme where part of its digit structure contains geographic significance used for routing calls to the physical location of the network termination point (NTP).”

The definition of geographic numbers reflects two key characteristics: location significance and tariff transparency.

Location significance

Geographic numbers are linked to a particular geographic location. ComReg Document 03/147⁶ shows the boundaries of NDC areas and minimum numbering areas (MNAs). The Republic of Ireland is divided into 49 area codes (excluding the 048 code for Northern Ireland), each covering a different part of the country.

Consumers and businesses highly value the location significance inherent in geographic numbers. The numbers can be seen as having meaning and worth for the end user of the number and for those calling the numbers.

Despite changes in technology that promote the use of numbers in non-location specific ways, such as mobile telephones and voice over Internet Protocol (VoIP) technology that allows nomadic use of numbers, end users still consider geographic significance as being important.

⁵ ComReg Document 15/136 – Numbering Conditions of Use and Application Process – published 22 December 2015. http://www.comreg.ie/_fileupload/publications/ComReg15136.pdf.

⁶ ComReg Document 03/147 – Geographic Telecommunications Numbering Areas – published 11 December 2003. http://www.comreg.ie/_fileupload/publications/ComReg03147.pdf.

Tariff transparency

Consumer end users and business end users also value geographic numbers because they generate trust through transparent tariff arrangements.

End users have a general idea of the cost of calling a geographic number from their landline and from their mobile telephones. Commonly the cost varies according to time of day and calls to geographic numbers often form part of inclusive call package allowances. Overall, the cost of calling geographic numbers is generally low (and understood by end users to be low) relative to the cost of calling numbers in other ranges.

3.2.2 Minimum numbering areas (MNAs)

The link of specific number ranges to specific geographic areas is currently provided through MNAs. Historically these areas were defined by reference to the areas served by specific *eir* local exchanges. This property of the MNAs is of value to some end users (those end users who can recognise which geographic numbers are in their own locality may use this information to choose local tradespeople, etc.).

Consistent with this, the MNAs define the maximum extent of the areas within which location portability⁷ can be provided (although it does not have to be provided).

In the case of some CSPs, MNAs are also relevant for billing as they can be used to define which calls are considered to be “local calls”. We note, however, that:

- this does not apply to all CSPs
- the type of tariff with local and national calls at different prices is expected to be less common over time
- there is no specific need for MNAs and tariffs to be linked (i.e. even those tariff plans which do distinguish local from national calls could do so based on different boundaries).

The allocation of number blocks to specific MNAs means that it is possible that the numbers in one MNA become exhausted while others nearby still have adequate supplies of numbers. In the long run therefore having too many MNAs can lead to inefficiency.⁸ We discuss this further below.

⁷ Location portability allows you to take your number with you when you move house or change business premises within the same MNA; some CSPs can only provide a more restricted offer (e.g. within a single exchange area rather than the MNA).

⁸ Because ComReg can allocate number blocks within the NDC to the MNAs as and when the demand arises, this particular inefficiency is not yet a significant issue.

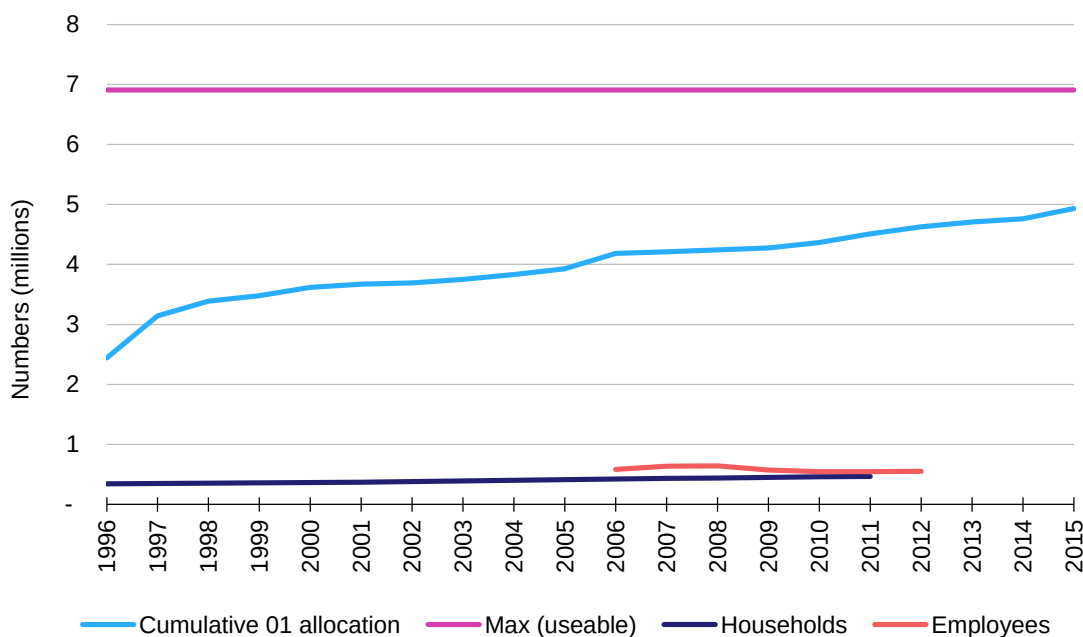
3.3 Demand for geographic numbers

Although it may appear unlikely that end users' demand for fixed telephony services using geographic numbers is growing at all, it remains the case that the allocation of geographic numbers is still increasing. Reasons for this increase are noted below.

There is good data available on the Dublin (01) area⁹. However, the conclusions are more generally applicable, and it should be noted that other local areas are in greater danger of number exhaustion; for example Galway, Limerick, Monaghan and Tipperary all face potential number shortages in the short term.

Looking at the Dublin area as an example, Figure 3.1 illustrates the historical growth trend in the allocation of 01 area geographic numbers. In the last five years, the average number of 01 numbers allocated per annum was 97 300 while the maximum (2011) was 147 000. From a total of 6 911 000 useable 01 numbers¹⁰ as of July 2015 (i.e. 01 numbers which are not reserved by ComReg), 4 931 500 or 71% had been allocated by ComReg.

Figure 3.1: Allocated 01 (Dublin) geographic numbers by year of allocation [Source: ComReg, Analysys Mason, 2015]



Growth in demand can occur:

⁹ Resulting from recent audit conducted by ComReg in relation to the 01 Dublin NDC

¹⁰ Of the 10 million subscriber numbers in the 01 NDC, 3 089 000 were reserved as of July 2015. 1 000 000 subscriber numbers beginning with 0 were reserved to prevent conflict with national numbers, 901 000 subscriber numbers beginning with 1 were reserved to prevent conflict with freephone, shared cost, premium rate, Internet dial and other codes, 1 000 000 subscriber numbers beginning with 3 were reserved to allow for expansion, 99 000 subscriber numbers beginning with 99 were reserved to prevent accidental dialling of emergency services. 79 000 subscriber numbers beginning with 5 and 10 000 subscriber numbers beginning with 8 were reserved for other reasons.

- As a result of geo-demographic changes locally, in areas where the residential population and/or the number of businesses are increasing, driving local demand for fixed-line numbers.¹¹
- From increasing take-up of lines. For example, increasing use by businesses and other organisations of direct dial-in (DDI). This facility allows every telephone in an organisation to have an individual number that can be dialled directly from the public network without need of the organisation's central switchboard. An organisation that uses DDI (or more generally a private automatic branch exchange, a PABX) has more numbers than phone lines, because not all of its extensions are likely to be used simultaneously.
- From increased numbers of CSPs. As new CSPs enter the market they require geographic numbers in each numbering area. If the numbering plan is divided into many comparatively small areas, then the service providers will need a block in each area even if they have only one end user in each area.
- From growth in market share of CSPs. CSPs with growing market share may need additional numbers. Geographic number portability (GNP) enables customers to change service provider but to keep their telephone number; this means that competing service providers may be able to work with fewer new blocks than would otherwise be the case. Encouraging the use of GNP is therefore one way to limit growth in demand for numbers. We discuss this more in Section 4.4 below.

The following sections consider other trends which are currently contributing to demand, or may lead to increased demand in the future.

3.3.1 Over-the-top (OTT) services

Over-the-top (OTT) services refer to those services where the Internet provides the transport medium and where the service is not provided, or managed, by the Internet service provider.

This includes voice calls from services such as Skype. The price (and indeed the incremental cost) of such services can be very low, even for international calls.

Some VoIP services do not use numbers, instead relying on application-specific identifiers such as user names (e.g. Skype's and Google's Gmail voice and video chat services). Other services or service variants such as SkypeIn do use phone numbers. There is no technical obstacle to associating any particular kind of number with a VoIP service, challenging the traditional tying of geographic numbers to specific geographic areas. Some overseas-based VoIP providers explicitly offer end users the ability to select a number from a range of countries – for example, a United States or Swiss number – for use anywhere in the world. The demand for geographic numbers in Ireland could grow if, for example, many members of the Irish diaspora wished to select a number from an existing national geographic range. However, the use of geographic numbers in Ireland for such services is subject to specific constraints imposed by ComReg. If this were not so then the capacity of popular geographic number ranges, notably in Dublin, could be exhausted and costly

¹¹ Demand is likely to be greatest in areas where job creation is centred. Should job creation be primarily in Dublin, and the eastern counties centred on Dublin, residential population and the number of businesses are likely to rise, further increasing the risk of number exhaustion in the Dublin NDC.

number changes could be required. On the other hand, in some respects the demand might fall: for example, foreign businesses that hitherto may have wanted virtual numbers in Ireland might now expect to make most sales online and might therefore prefer online interfaces (without telephone numbers) for customer enquiries. The social and economic motives for wanting virtual numbers, and the resulting demand, therefore needs to be monitored.

Nonetheless, our view, as set out in ComReg Document 13/122, still holds; the vast majority of current users of OTT VoIP services use free or ‘freemium’ products which do not rely on the use of numbers, meaning that OTT services do not currently represent a very large demand.

The IP-based number range (076) could be seen as an alternative to geographic number ranges. However, the evidence of use of the range so far might suggest the relief it would offer, although welcome, is likely to be relatively limited.

3.3.2 Other emerging trends

Disposable numbers

The ability to create virtual, disposable phone numbers through the use of smartphone apps such as Hushed and Burner is an emerging trend. These apps allow users to make calls and send texts from a ‘disposable’ number – and to receive calls and texts also. Users are individuals who are reluctant or unwilling to provide a long-lasting means of contact, such as their home telephone number, to people with whom they need to interact in the short term.

The Hushed app, live now on Google Play, is a fully integrated voice client for Android phones, which allows users to buy a 7-day, 30-day or 90-day phone number. Each number comes with incoming and outgoing capabilities as well as voicemail, making it a viable, more lightweight alternative to Google Voice, for example.

Burner is limited to North America – primarily the USA and parts of Canada. In comparison, Hushed claims to have worked from launch in 40 countries.

Users can obtain as many numbers as they would like via these apps and dispose of them at any time, rendering them out of service. Whilst it is too early to estimate the impact of these services; it could be argued that even a modest increase could become an issue.

Hushed and Burner are not the only apps offering such services; Flyp and Shuffle compete with these and other apps that are also available.

Such applications might lead to additional pressure on number ranges due to an increase in the quantity of numbers used per person and would also lead to a much larger quantity of numbers

being held in quarantine¹² (which is particularly inefficient in relation to numbers used for very short periods).

3.4 Geographic number management

3.4.1 Number administration and allocation process

ComReg administers telephone numbers in the Republic of Ireland and allocates blocks of contiguous numbers, usually in blocks of 1000 numbers, to CSPs.

Once a number block has been allocated to a CSP, the allocated numbers are then built onto CSPs' networks so that calls can be routed and delivered to the correct end user. When the process of building the numbers onto all CSPs' networks has been finalised, the CSPs can assign the numbers to their consumer and businesses customers.

3.4.2 CSP management of geographic numbers

A CSP can receive a number from four possible sources, as illustrated in the geographic number lifecycle shown in Figure 3.2:

- via a block allocation directly from ComReg (highlighted as (1) in Figure 3.2)
- via a 'sub-allocation' from another CSP¹³ (2)
- via a port-in from another CSP (3)
- via repatriation of a previously ported-out number (4).

Regardless of the source, once a number is 'built' on all CSPs' networks, it is available for assignment to end users. It can then enter active use. A small proportion of numbers may also be used for test purposes or reserved.

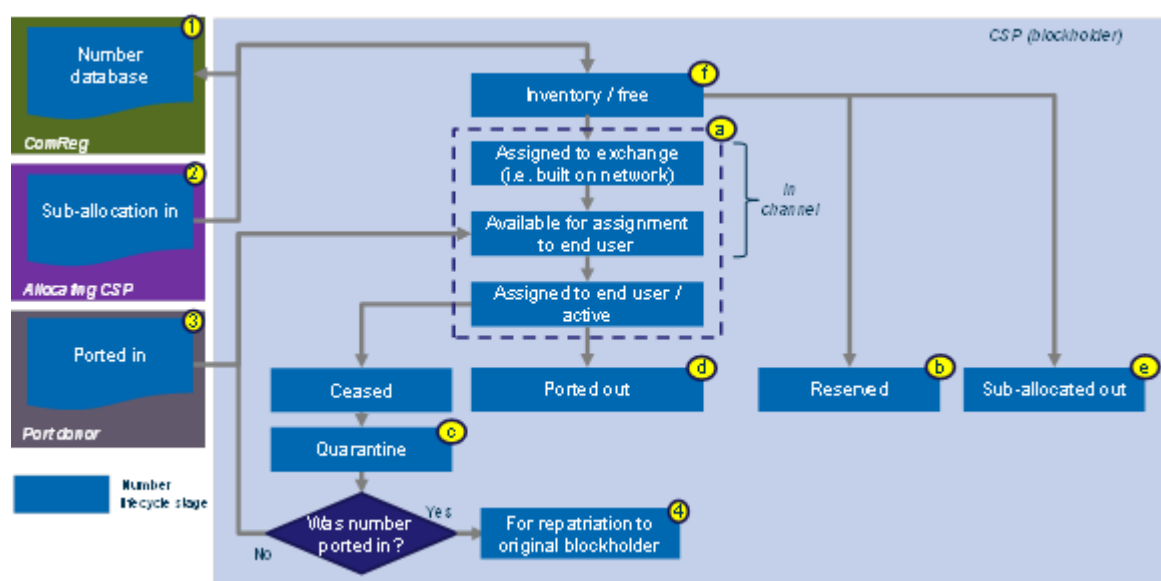
From active use, a number can be ported out if the end user wishes to move to another CSP. Alternatively, if the end user wishes to cease taking service from the CSP, the number is considered no longer in use. In this case, the number enters quarantine before becoming available for reassignment to an end user.

If an end user ceases service when using a number which was ported in, that number then becomes eligible for repatriation to the original block holder after the 13-month quarantine period has expired.

¹² When a number is surrendered by an end user or is otherwise recovered by the holder which assigned the number or by the undertaking to which the number was ported, the number will thereupon be placed in quarantine for a period of 13 months and will not be assigned to anyone other than the previous end user during the 13-month period of quarantine.

¹³ The CSP considered the Rights of Use holder remains responsible for ensuring the numbers allocated as used in accordance with ComReg's conditions.

Figure 3.2: Geographic number lifecycle [Source: Analysys Mason, 2015]



3.4.3 Key findings from number management audit

As part of this study, we examined audit data gathered by ComReg in 2015. A summary of the results is shown in Figure 3.3. Column headings reflect the stages in the number lifecycle shown above.

Figure 3.3: Results of 01 area geographic number audits in 2015 (Confidential CSP data has been redacted) [Source: ComReg, 2015]

CSP	Allocated to CSP (1)	Assigned to end user /in-channel (a)	Reserved (b)	Quarantine (c)	Ported out (d)	Sub-allocated out (e)	Free (f)
2015 total	4 595 000	2 356 980	64 797	151 717	349 512	19 534	1 655 579

The 2015 audit template set out number allocations by block and called for CSPs to report their usage of all numbers in each block into one of six categories.¹⁴ Although definitions for these categories were not provided by the CSPs, we assume that CSPs¹⁵ have interpreted the audit headings as follows:

- **Allocated to CSP:** total numbers allocated to the CSP by ComReg
- **Assigned to end users:** total numbers which are in channel or active

¹⁴ The intention of ComReg's audit format was that a correctly completed response should show, for each block, the sum of numbers across all six categories to be equal to the block size (i.e. each number is in a single category). However this was not always the case due to some CSPs providing their data in a different format than that requested by ComReg, which means that the numbers do not sum correctly.

¹⁵ One CSP provided data under its own categorisation, which we have mapped to these categories.

- **Reserved:** total numbers which the CSP has reserved (e.g. to avoid clashes)
- **Quarantine:** total numbers which have been removed from active use and are being held for the required period before being made free for assignment
- **Ported out:** total numbers which have been ported to another CSP using the GNP mechanism
- **Sub-allocated out:** total numbers which CSPs have sub-allocated to other CSPs
- **Free for assignment:** total numbers which the CSP has stored on its database which could be assigned to end users.

Empty number blocks

The audit results for the 01 area from 2015 show there are a number of empty blocks which should be recovered by ComReg (see Figure 4.13).

Numbers free for assignment

Figure 3.3 highlights a significant quantity of numbers which block holders have reported as being free for assignment to end users. These numbers could be used before any new number allocations are required.

Ported-out numbers

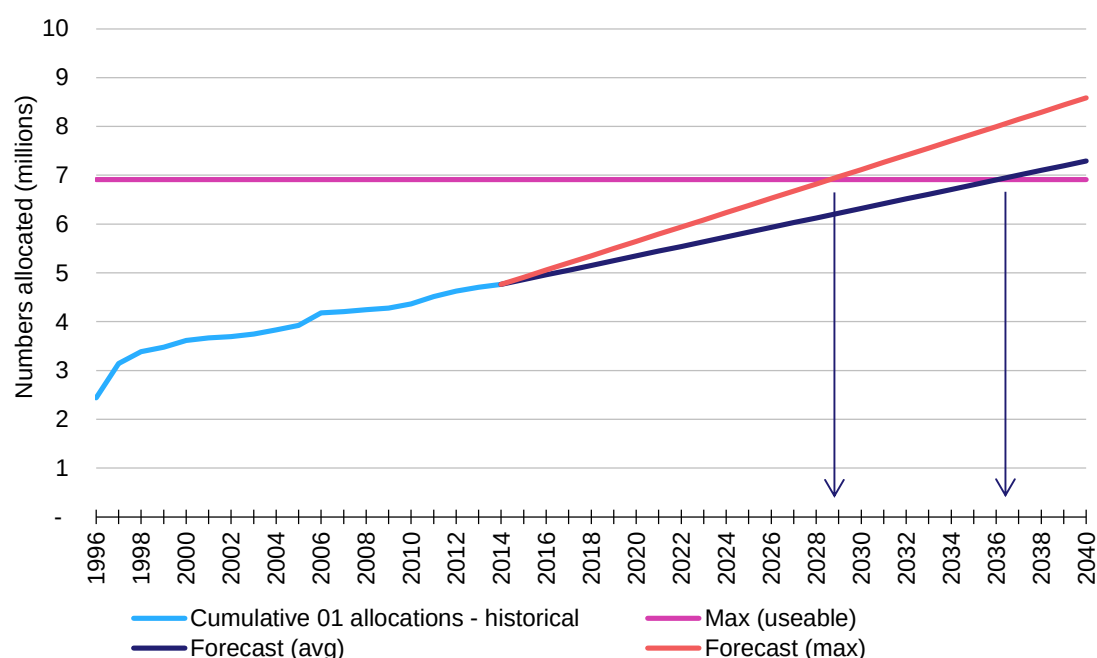
Figure 3.3 indicates the quantity of numbers currently ported out has reached approximately 350 000. During our engagement with industry parties, discussions with CSPs indicated that in some instances numbers which are ported in, which then cease and are quarantined, are not currently repatriated to the original block holder.

3.5 Threat of geographic number exhaustion

Even under the status quo, CSP demand for numbers is growing steadily, despite limited growth in the total number of fixed-line customers in this area (or in Ireland more generally). See, for example, Figure 3.1 above.

Forecasting based on average and maximum quantities of new numbers allocated per annum from 2010 to 2014 suggests an exhaustion date for 01 geographic numbers in the range 2029 to 2037 (see Figure 3.4). This forecast is an improvement on the forecast of 2020 set out in the earlier Analysys Mason and Antelope Consulting report (ComReg Document 13/122) largely due to the fact that a significant quantity of unused blocks have been recovered by ComReg in the intervening period (see Section 4.6.3).

Figure 3.4: Allocated 01 geographic numbers by year of allocation and forecast based on average and maximum yearly allocation from 2010 to 2014 [Source: Analysys Mason, 2015]



As we discuss in the next section, doing nothing will lead to significant costs in the medium term. Our view is that with immediate use of proportionate measures ensuring the efficient use of numbers, we can change this dynamic and avoid the need for the kinds of costly change discussed below.

3.6 Estimated cost of number changes

In this section we examine the costs of changes to the numbering plan to increase the supply of numbers. This is considered in the context of large-scale changes to the numbering plan in Dublin, costs of similar large-scale changes to the numbering plan in other areas, and alternative solutions.

3.6.1 Costs of large-scale changes to the plan in Dublin

In 2011, Europe Economics carried out a study into the costs and benefits of granting international access to Irish non-geographic numbers.¹⁶ One of the options for how to achieve this was renumbering Dublin geographic numbers. This option would have entailed inserting a 3 after the area code '01' and would result in an increase of available number combinations from 8 million to 80 million. The costs of this change were estimated by Europe Economics to total EUR337 million in 2011 terms, as set out in Figure 3.5 below.

¹⁶ 'International Access to Irish Non-Geographic Numbers'
http://www.comreg.ie/_fileupload/publications/ComReg1168a.pdf.

Figure 3.5: Costs of renumbering Dublin geographic numbers [Source: Europe Economics, 2011]¹⁷

Stakeholder	Impact	Estimated cost (EUR 000s, 2011 terms)
CSPs ¹⁸	• IT • Project management • Marketing • Changes to billing and databases • Possible decline in call volumes	112 385
Dublin businesses – adjustment costs	• Advertising and marketing • Reprinting and changes to stationery • Informing customers and contacts	148 939
Dublin businesses – lost business	• Lost business	40 506
Dublin residential end users	• Cost and inconvenience	13 132
Callers to Dublin numbers	• Cost of updating records and misdialling	22 079
ComReg	• Burden on ComReg assumed to be negligible	–
Total		337 041

This estimate provides an indication of the approximate level of costs that would be incurred by stakeholders if such a change was made.

3.6.2 Potential cost of large-scale changes to the plan in other areas

Using Europe Economics' study as a starting point, we have estimated the potential costs for a small sample of areas in Ireland undergoing a hypothetical numbering change in 2015. In carrying this out we have accounted for inflation and growth in population and the number of businesses to the extent that data was available to inform this. The number of lines and number allocations in Cork, Galway, Limerick and Waterford have been estimated using 2011 Census data on household, population, enterprise and employee numbers. This simple exercise yields the costs summarised in Figure 3.6 below.

¹⁷ Table 1, http://www.comreg.ie/_fileupload/publications/ComReg1168a.pdf.

¹⁸ Changes for VOIP providers were expected to extend to databases and IP platforms only.

Figure 3.6: Estimated costs of renumbering geographic numbers in a sample of areas [Source: Analysys Mason, 2015]

Stakeholder\Cost in 2015 EUR 000s	Dublin	Cork	Galway	Limerick	Waterford	All of Ireland
CSP costs ¹⁹	119 885	44 942	21 222	16 699	10 200	394 432
CSP lost revenues ²⁰	2723	930	420	310	180	8049
Region businesses adjustments	160 023	53 856	24 164	17 602	10 141	465 025
Region businesses lost revenues	41 354	8 373	3 577	2 686	1 774	120 175
Cost to region residents	14 291	5 350	2 520	1 980	1 205	47 047
Cost to callers to region ²¹	23 698	22 128	21 760	21 678	21 573	26 134
ComReg	–	–	–	–	–	–
Total (EUR 000s)	361 974	135 579	73 663	60 954	45 073	1 060 862

3.6.3 Costs of alternative solutions

The Analysys Mason and Antelope Consulting study published by ComReg² examined other possible numbering changes and their costs. While that report was focused on the impact in Dublin, similar conclusions can be drawn in other regions where numbers are at risk of exhaustion.

In addition to the status quo (Option 1) and the high-capacity and high-cost solution (expansion to 8 digits of all existing Dublin numbers) discussed above (Option 4), these included:

- **Option 2: Using the reserved initial digit 3 of Dublin end-user numbers.** While low cost, this option only provides a small amount of capacity 0.9 million numbers and its use precludes some future options (including using this digit as a means of transitioning to the high-capacity option above). This option could also be combined with Option 3 below.
- **Option 3: Closing the numbering range and using new Dublin end-user numbers beginning with 0 or 1.** The resulting costs should be quite low. However, the additional capacity gained is not very large, at 1.7 million numbers.

¹⁹ We have assumed that there are four VoIP CSPs and eight other (non-host) CSPs affected in each region as in Europe Economics' original study. Some elements of the CSP costs are fixed regardless of the number of lines affected. If multiple areas underwent a numbering change at the same time we would expect these costs could be shared, however this is not reflected in these values.

²⁰ We have applied a reduction to CSP revenues in line with total fixed voice retail revenues as reported by ComStat. <http://www.comstat.ie/data/data.472.1201.data.html>.

²¹ Assuming same propensity to call each of these regions from outside Ireland, which may result in a slight overestimate.

The report also considered variants of these two options that would result in a mix of 7- and 8-digit end-user numbers being used within 01; these variants have material costs for CSPs (whose systems would need to be upgraded to deal with 8-digit numbers) and create significantly more capacity than Options 2 and 3 (at 9 to 17 million numbers depending on the option chosen). Options with a mix of 7- and 8-digit numbers would also lead to greater risk of misdialling and/or confusion amongst end users.

There were also additional options considered in that report, but these were assessed to be less effective (in terms of capacity created per unit cost) than those discussed above.

3.6.4 Conclusion

There has been a substantial decline in the efficiency of use of geographic numbers over the last 15 years. As a result, some areas face potential number exhaustion in the short and medium term.

Increasing the supply of numbers carries significant costs for CSPs and for end users. Options which could provide access to significant additional quantities of numbers without the need to change the numbers of existing end users carry material costs for CSPs and could lead to misdialling and confusion for end users. In the worst case, the level of demand could require changes to the numbers used by existing end users and result in costs to end users of hundreds of millions of euros and costs to CSPs running to tens of millions.

As a result, doing nothing will have significant costs in the medium term. By comparison, conservation measures are much cheaper than measures to increase supply. The immediate use of low-cost and proportionate conservation measures ensuring the efficient use of numbers can change the current dynamic and avoid the need for costly future measures to increase supply.

4 Conservation measures

4.1 Introduction

In this section, we look at the challenges in managing geographic numbers effectively and examine the extent to which there may be scope to reduce barriers to efficient number use, and to incentivise and facilitate better utilisation of the existing supply of geographic numbers. Realising such opportunities would reduce the need to provide new supplies of numbers and would thus reduce the associated disruption and costs.

The conservation measures proposed are designed to manage CSPs' demand for geographic numbers without the need for more disruptive action to increase the supply of numbers. We therefore favour the use of conservation measures as they incur the least cost and disruption and are particularly beneficial for end users as such measures cause no adverse impact. Certainly, they benefit end users by ensuring that sufficient and appropriate numbers are available in all geographic areas thereby promoting competition in the provision of communications services.

4.2 Addressing poor utilisation of existing number resource

The main characteristic of the conservation measures proposed is that they seek to address the underlying problem of geographic number management – poor utilisation of the existing number resource.

4.2.1 Calculating utilisation

There are a number of possible approaches to calculating utilisation, with each approach having advantages and disadvantages. Below we consider two approaches.

Utilisation measure 1

We define 'utilisation measure 1' for a CSP as total numbers assigned to end users as a proportion of total numbers allocated to the CSP by ComReg.

$$\text{Utilisation measure 1} = \frac{\text{Total numbers assigned to end users}}{\text{Total numbers allocated to CSP by ComReg}}$$

This approach has few inputs and is easily understood. In addition, the data required for the calculation is straightforward to obtain and interpret – ComReg maintains a database on total numbers allocated to each CSP while the total numbers assigned to end users can be gathered using CSP audits.

The approach does not make allowance for numbers that are ported out. There are also other categories not available to be assigned to end users: reserved, quarantined, and sub-allocated²².

When calculated using this approach, CSP utilisation can therefore never reach 100% as the geographic number lifecycle means that there will always be some numbers in the reserved, quarantined, ported out or sub-allocated categories. However, it should be noted that the recent 01 NDC area audit found that the volume of numbers falling into these categories in the 01 NDC area was relatively small at only 8% of total allocated numbers.

This measure has a further disadvantage because CSPs report as “assigned to end users” some numbers that are not actually being used by end users – which we might describe as “in-channel”²³. Using this measure would result in a lower calculated utilisation measure 1 for CSPs who efficiently reduced the quantity of numbers “in channel”, which would be a perverse outcome.

Utilisation measure 2

Given the inaccuracies which can arise from utilisation measure 1, another more complex utilisation measure may be warranted. For the purposes of this report, this is defined as ‘utilisation measure 2’ and is calculated for each MNA area:

$$\text{Utilisation measure 2} = \frac{\text{Total subscribers} - \text{Total active ported in numbers}}{\text{Total numbers allocated to CSP by ComReg} - \text{Total numbers ported out}}$$

Total subscribers differs from the value the CSPs report as “numbers assigned to end users” because it excludes numbers that are “in channel”.

This measure allows for the impact of porting and takes account of actual subscriber numbers.

One issue that is not addressed by this approach is the use of sub-allocation. CSPs that have been allocated blocks of numbers are responsible to ComReg for their use but may not have (for example) data on the number of end users of the CSPs using sub-allocation. Of the seven respondents to the 01 NDC audit, only BT, UPC and Verizon reported sub-allocated out numbers (20 000 in total), while only Magnet reported sub-allocated in numbers (fewer than 1000). Due to its infrequent use, sub-allocation has a relatively small impact on utilisation measure 2 for the major CSPs but may be important to ensure efficient use by smaller CSPs.

²² In order to be aligned with the Authorisation Regulations, the new Numbering Conditions of Use and Application Process refer to the transfer of number rights of use between undertakings. The previously used terms and concepts “sub-allocation” or “secondary allocation” are not supported by legislation and are no longer used.

²³ These numbers may be those, assigned to exchanges and available for assignment to end users.

4.2.2 Current utilisation levels

As highlighted earlier in this report, what appears to be a sufficient supply of numbering resource to meet demand becomes fragmented in order to promote geographic meaning, reflect technical routing capabilities and support competition.

ComReg has allocated significantly more numbers to CSPs than both residential and business end users actually use. As part of this review, we obtained information from the major fixed-line CSPs on utilisation of allocated numbers in the 01 area. We found that on average 51% of geographic numbers allocated to these CSPs were utilised (using measure 1).

We were unable to calculate utilisation using measure 2 due to lack of data on subscribers in the NDC code for which we have audit data and on active ported in numbers by CSP. However we have estimated the overall utilisation measure 2 for numbers in the 01 area at 35%²⁴.

Figure 4.1 sets out allocated numbers, numbers assigned to end users and utilisation for each of the seven CSPs audited as part of ComReg's recent 01 number audit.

Figure 4.1: Number utilisation – ComReg's 01 number audit (Confidential CSP data redacted) [Source: Analysys Mason, 2015]

CSP	Allocated numbers	Numbers assigned to end users	Utilisation measure 1	Utilisation measure 2
Total	4 595 000	2 356 980	51%	35%

4.3 Possible measures available to increase utilisation

Without changing existing end users' telephone numbers, the measures available to ComReg to improve utilisation are:

- encouraging use of number portability (see Section 4.4 below)
- possible changes to MNAs (see Section 4.5 below)
- recovering existing unused blocks (see Section 4.6 below)
- encouraging use of numbers identified as free for assignment (see Section 4.7 below)
- repatriating ported-in numbers that have ceased/are no longer in use (see Section 4.8 below)
- introducing a utilisation target (see Section 4.9 below)
- setting upper bounds on numbers allocated to consumer and business end users (see Section 4.10 below)
- using number pooling (see Section 4.11 below)
- charging for numbers (see Section 4.12 below).

Each of these measures is now considered in greater detail.

²⁴ For the purposes of the 01 utilisation calculation using measure 2, we have assumed 1.8million subscribers and 350 000 numbers ported out.

4.4 Encouraging use of number portability

As noted above, one of the causes of increased demand for geographic numbers is the increasing market share of certain providers (and the corresponding decreasing market share of other CSPs). Whether or not this leads to an increase in the quantity of numbers required depends on whether geographic number portability (GNP) is used:

- If GNP is not used, then the gaining CSP will allocate a new number and the losing CSP will (after quarantine) gain a number free for assignment. As the losing CSP can rarely completely empty a block of numbers, allowing the block to be reallocated to another provider, the net effect of such churn from one CSP to another can be an increase in the total quantity of numbers required if the losing CSP has a market share that is declining over the medium term.
- By contrast, if GNP is used then there is no net increase in the quantity of numbers required.

Whether or not to use number portability is a choice for end users. The role of ComReg and CSPs is to inform end users that it is available and ensure that the processes by which it is provided are sufficiently timely and functional that it remains an attractive option. No specific issues have been raised by stakeholders during this project in relation to ways in which number portability could be made more attractive to end users; accordingly we do not propose specific measures to increase the use of GNP at this stage.

4.5 Possible changes to MNAs

As noted above, the allocation of number blocks to specific MNAs means that it is possible that the numbers in one MNA become exhausted while others nearby still have adequate supplies of numbers. In the long run, therefore, having too many MNAs can lead to inefficiency.²⁵

Merging MNAs within some or all NDC areas (e.g. merging the three Dublin MNAs under 01) would allow numbers to be deployed more widely, removing this potential source of inefficiency. Having geographically larger MNAs also potentially allows location portability over a wider area for those CSPs that could support it, which might itself have a marginal effect on demand for numbers. It would somewhat reduce the geographic “meaning” for existing numbers; and it might mean that some existing tariffs would have to be changed or unlinked from the MNAs.

We do not believe that merging existing MNAs in the same NDC areas would be necessary or proportionate at this stage in order to alleviate potential number exhaustion; we do not propose it as a potential measure. However, the usefulness of the MNA concept and the possibility to move to a single MNA in each NDC area remains an issue which ComReg might choose to examine in more detail in the future.

²⁵ Because ComReg can allocate number blocks within the NDC to the MNAs as and when the demand arises, this particular inefficiency is not yet a significant issue.

4.6 Recovery of existing unused blocks

In general terms, ComReg holding the unused blocks centrally will be more efficient, as long as the process by which numbers are put into use can be efficiently managed so as not to cause delays in either obtaining new allocations from ComReg²⁶ or building these out on all CSPs' networks. This may require action by ComReg and the CSPs to ensure that these can be achieved in a timely fashion.

4.6.1 Proposed measure

The audit results from 2015 show that a significant number of empty blocks could be recovered.

A possible measure would be:

ComReg should require all CSPs holding blocks which are empty to return them to ComReg for future reallocation. One free block may be retained in each MNA if the CSP has fewer than 1000 numbers (or 10% of the CSP's number of active end users in that MNA, whichever is the larger) that are "free for assignment" in that MNA.

4.6.2 Estimated cost

We consider this to be a low-cost measure. The administrative costs would be minimal. When the released blocks are reassigned, there will be some costs incurred by CSPs in the rebuilding of the relevant number ranges to facilitate routing of calls to the new block holder – however, we would also anticipate these costs to be low (in terms of man-hour effort per CSP).

Proposed measure	Set-up costs	Ongoing costs	Comments
Recovery of existing unused blocks	Low	Nil	In accordance with measure described in Section 4.6.1

Figure 4.2: Estimated cost – recovery of unused blocks
[Source: Analysys Mason, 2015]

4.6.3 Potential impact

Audit and unused number block withdrawal can contribute significantly to the ongoing availability of number blocks and can improve number resource utilisation rates.

975 000 numbers were returned by eir in July 2015. Figure 4.3 clearly demonstrates the positive impact of a recent return from eir, formerly eircom, of numbers in the 01 range. We recognise, however, that this is largely a one-off gain; future audits are unlikely to see a similar level of block returns.

²⁶ We believe that there are no issues of timeliness in this part of the process.

Figure 4.3: Impact of de-allocation of eir's 975 000 01 numbers in July 2015 [Source: Analysys Mason, 2015]

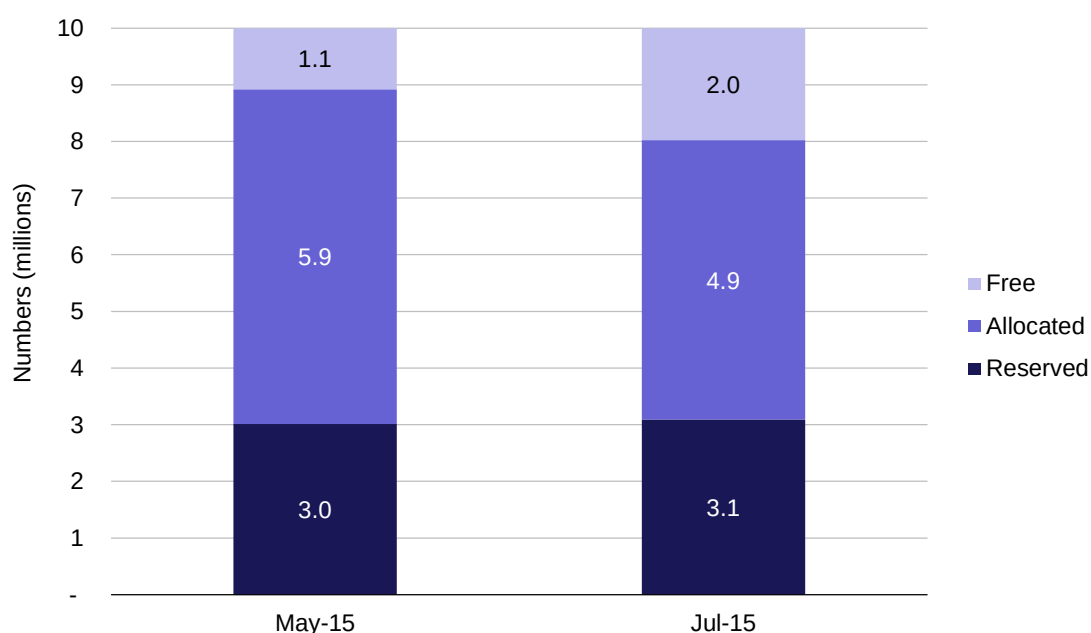


Figure 4.4 below shows that this measure would result in the recovery of approximately 300 000 numbers in the 01 NDC; a similar proportion of numbers may be available in other areas.

CSP	Allocated numbers	Numbers in empty blocks
Total	4 595 000	297 100

Figure 4.4: Audit data - numbers in empty blocks (Confidential CSP data has been redacted) [Source: Analysys Mason, 2015]

4.6.4 Monitoring and governance requirements

We propose ComReg would monitor block utilisation as part of its regular number auditing and recover unused blocks.

4.7 Use of numbers identified as free for assignment

4.7.1 Proposed measure

Figure 3.3 highlights a significant quantity of numbers which block holders have reported as being free for assignment to end users.

It would therefore seem reasonable for ComReg to require CSPs to use these numbers more effectively, and not allocate new blocks until the quantity of numbers that are free for assignment has fallen substantially.

A suitable targeted measure would be:

ComReg should indicate that CSPs may only request additional numbers through administrative allocation when the CSP does not hold more than 1000 numbers in that MNA that are “free for assignment” (or 10% of the CSP’s number of active end users in that MNA, whichever is the larger).

4.7.2 Estimated cost

Not allocating CSPs new blocks until the quantity of free-for-assignment numbers has fallen substantially would be a very low cost measure to implement and should not impose any great difficulty on existing CSPs as they all currently have substantial quantities of numbers which, by their own acknowledgment, are currently free for assignment to end users.

Proposed measure	Set-up costs	Ongoing costs	Comments
Using numbers identified as free for assignment	Very low	Very low	In accordance with measure described in Section 4.7.1

Figure 4.5: Estimated cost – using numbers identified as free for assignment [Source: Analysys Mason, 2015]

4.7.3 Potential impact

Simply using these numbers would, in the short term, remove the demand for additional numbers from CSPs that have numbers free for assignment (unless in exceptional cases).

We expect that this measure would reduce the “run rate” in consumption of numbers within the 01 NDC. However, we do not have sufficient data to make a good estimate of the size of this reduction.

4.7.4 Monitoring and governance requirements

We propose ComReg would assess utilisation in a way similar to its new application process for mobile numbers contained in Appendix 4 of ComReg 15/136 (Numbering Conditions of Use and Application Process). If utilisation thresholds are not met, CSPs could be asked to provide detailed forecasts and justifications to substantiate the timing of any new applications.

4.8 Repatriation of ported-in numbers to original block holder

4.8.1 Proposed measure

During the project, certain CSPs confirmed that ported-in numbers, which then cease and are quarantined, are in some instances not currently repatriated to the original block holder. The systems supporting GNP are currently in the process of being replaced, which offers an opportunity to improve this.

A possible measure would be:

In the interests of efficient number management, all ported-in numbers which are no longer in use should be repatriated within one year of leaving quarantine. If it is possible to automate this within the future GNP solution at low cost, ComReg should work with industry parties to ensure that the solution purchased supports repatriation of ported-in numbers once these have left quarantine.

4.8.2 Estimated cost

Repatriation of ported-in numbers which have ceased should be a low-cost measure as the existing GNP solution already supports this process, and we expect that any new GNP solution will have this as a core part of its existing functionality.

Proposed measure	Set-up costs	Ongoing costs	Comments
Repatriation of numbers to original block holder	Low	Low	In accordance with measure described in Section 4.8.1

Figure 4.6: Estimated cost – repatriation of numbers [Source: Analysys Mason, 2015]

4.8.3 Potential impact

Repatriation will reduce demand for numbers in future; the extent of the reduction in demand will depend on which CSPs need additional numbers and which are in receipt of the repatriated numbers. The effectiveness of the measure in reducing demand may therefore vary over time. For example, if CSP A needed new numbers due to additional demand but the repatriation was to CSP B, which has more numbers than it needs, then there would be limited gains from this measure. Conversely, if CSP A were in receipt of the repatriated numbers, then there would be a significant benefit.

4.8.4 Monitoring and governance requirements

Perhaps the most practical means of monitoring the repatriation of ported-in numbers to the original block holder would be for ComReg to monitor the quantity of numbers due for repatriation and not yet repatriated as part of its annual audit report.

4.9 Introduction of an overall utilisation target

4.9.1 Discussion

As well as setting specific targets in relation to the quantity of numbers held under different categories (e.g. unused blocks, free for assignment, ported), ComReg could set an overall utilisation target.

Number utilisation in other jurisdictions

A number of jurisdictions have adopted utilisation thresholds to encourage more efficient use of geographic numbering resources; a sample of which is shown in Figure 4.7.

Jurisdiction	Utilisation threshold
Bulgaria	60%
Germany	75%
Italy	50%
Latvia	30%
Portugal	60%
Switzerland	50%
Russian Federation	75%
North America	75% (growth numbering resources)
Singapore	80% (per exchange)
Hong Kong	70%
Saudi Arabia	65% (for individual exchanges)

Figure 4.7: Number utilisation in other jurisdictions [Source: Analysys Mason, 2015]

► Bulgaria

In Bulgaria the Communications Regulation Commission (CRC), in its terms of use for national numbering resources, sets an utilisation threshold of 60% for both geographic and mobile numbers²⁷.

► Germany

In Germany, the Federal Network Agency (Bundesnetzagentur or BNetzA) has set a minimum utilisation threshold for national geographic subscriber numbers. In new requests, applicants must indicate the extent to which allocated numbers have been utilised and this must exceed 75%²⁸.

► Italy

In Italy AGCOM may decline requests for additional numbers if existing allocations are less than 50% utilised²⁹.

► Latvia

In Latvia under Public Utilities Commission Council Decision No. 1/18 the Commission may decline requests for additional numbers if existing allocations are less than 30% utilised³⁰.

²⁷ http://www.crc.bg/files/_bg/NAREDBA_1_xx122015.pdf

²⁸ http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Nummerierung/Rufnummern/032/Zuteilungsregeln032NationaleTeilnehmerrufnummern.pdf?__blob=publicationFile&v=2 (in German)

²⁹ Allegato A alla delibera n. 8/15/CIR, paragraph 4.7 (in Italian)

► *Portugal*

In Portugal ANACOM has set a minimum utilisation threshold. ANACOM may decline requests for additional numbers if existing allocations are less than 60% utilised³¹.

► *Switzerland*

In Switzerland BAKOM only allocates additional blocks of E.164 numbers if the service provider can prove that it has already assigned an average of 50% or more of already allocated numbers³².

► *Russian Federation*

Russian legislation requires CSPs to maintain an utilisation level of 75%³³.

► *North America*

The Federal Communications Commission (FCC) rules and regulations are located in Title 47 of the Code of Federal Regulations (CFR), and Part 52, Subpart B, deals specifically with numbering administration:

“(h) *National utilization threshold*: All applicants for growth numbering resources³⁴ shall achieve a 60% utilization threshold, calculated in accordance with paragraph (g)(3)(ii) of this section, for the rate center in which they are requesting growth numbering resources. This 60% utilization threshold shall increase by 5% on June 30, 2002, and annually thereafter until the utilization threshold reaches 75%.”

► *Singapore*

For DDI numbers, the minimum utilisation threshold is set at 80% per exchange. For public cellular mobile telephone services (PCMTS) numbers, the utilisation threshold is also set at 80%. CSPs may only request additional numbers through administrative allocation when the utilisation of their existing allocated numbers is higher than or equal to the threshold³⁵.

► *Hong Kong*

The Hong Kong national regulatory authority (NRA) raised the threshold of the number utilisation rate for allocating additional numbers from 60% to 70% in order to encourage more efficient use

³⁰ <http://likumi.lv/ta/id/278327-noteikumi-par-numeracijas-lietosanas-tiesibam> (in Latvian)

³¹ http://www.anacom.pt/render.jsp?categoryId=5388#.Vo_dLLkrGow

³² <https://www.admin.ch/opc/de/classified-compilation/19970410/index.html#a20>

³³ <http://base.garant.ru/12136140/>

³⁴ Resources are defined as *initial numbering resources*, and *growth numbering resources* – i.e. additional allocations beyond initial resources.

³⁵ National Numbering Plan, Infocomm Development Authority of Singapore, Issue 9 – 22 July 2013.

of telecommunications numbers. The current utilisation threshold of 70% was adopted after a review conducted in December 2008.³⁶

► Saudi Arabia

Licensees are required to meet the utilisation targets set out in Figure 4.8 before applying to the Communications and Information Technology Commission (CITC) for new number allocations. If utilisation targets are not met, licensees must provide detailed forecasts and justifications to substantiate the timing of new applications.

Service	Utilisation target
Geographic	65% for individual exchanges
Public mobile	65%
M2M	75%
National freephone	75%
International freephone	75%
Premium rate service (PRS)	75%

Figure 4.8: Saudi Arabia's utilisation targets
[Source: CITC National Numbering Plan, KSA, August 2011]

A number of other European regulators have internal guidelines on this point that are not in the public domain.

4.9.2 Possible measure

Based on the utilisation targets set in other jurisdictions, which mostly range between 60% and 80% and have in a number of cases risen over time, ComReg could introduce a similar utilisation target in relation to the allocation of geographic numbers.

In coming to a proposed utilisation threshold we have taken into account the benchmark data, as well as data on utilisation achieved by real CSPs. However, as utilisation can be defined in slightly differing ways, it would be important for ComReg to clearly define how it would intend to measure utilisation. A possible measure would therefore be:

ComReg should, only make available additional geographic numbers through administrative allocation when the CSP's utilisation measure 2 in that MNA is 65% or greater. This utilisation threshold would increase to 75% over time, rising at 2.5% per annum.

For the avoidance of doubt, the provision of (small) initial allocations within each MNA range will not be affected.

³⁶ Telecommunications Regulatory Affairs Advisory Committee - Better Utilisation of the 8-digit Numbering Plan, TRAAC Paper No. 4/2014, November 2014.

4.9.3 Estimated cost

The costs of this measure are minimal, being limited to the cost of generating the data required to monitor it.

Proposed measure	Set-up costs	Ongoing costs	Comments
Introduction of overall utilisation target	Very low	Very low	In accordance with measure described in Section 4.9.1

*Figure 4.9: Estimated cost – introduction of overall utilisation target
[Source: Analysys Mason, 2015]*

4.9.4 Potential impact

We consider that even a modest improvement in utilisation could have a significant effect on the ability of supply to meet demand. CSPs with low utilisation would not receive additional allocations, which would reduce demand (apart from exceptional cases).

Figure 4.10 indicates an estimated³⁷ volume of numbers which would not have been allocated to CSPs had an overall utilisation target of 65%³⁸ been in place since 2005.

Figure 4.10: Estimated impact of 65% utilisation target – [Source: Analysys Mason, 2015]

MNA	Estimated volume not allocated over the period 2005–15 if a utilisation target had been in place
Dublin Central	380 000
Dublin North	50 000
Dublin South	44 000
Total	474 000

The implication of these figures is that it may be possible to reduce the level of demand in the Dublin MNAs by approximately 50 000 numbers per year.

We acknowledge that CSPs putting in place the improved processes and systems to manage numbers more effectively (in order to reach this threshold level) is likely to take some time.

4.9.5 Monitoring and governance arrangements

As highlighted in Section 4.7.4, we propose ComReg would assess utilisation in a way similar to the application process contained in Appendix 4 of ComReg 15/136 (Numbering Conditions of Use and Application Process).

³⁷ We have had to make assumptions about the past quantities of numbers assigned to end users and the past level of porting out.

³⁸ Due to the lack of data needed to calculate utilisation measure 2, this calculation has been based on utilisation measure 1. Had sufficient data been available to enable the use of utilisation measure 2, it is likely that a greater quantity of numbers would not have been allocated.

At this point, it is perhaps interesting to note that Ofcom, having acknowledged that the numbering landscape is becoming increasingly sophisticated and CSPs' demand for numbers is increasing, has recently introduced a new number management system (NMS). In replacing its previous numbering database with the new web-based NMS, Ofcom expects to deliver improved number management capabilities including:

- automated number application and administrative processes
- integrated communications services between Ofcom and CSPs
- self-service online account management for CSPs
- workflow management for numbering processes
- analytics and reporting for effective number management and forecasting.

In the future, it may be appropriate for ComReg to consider the introduction of a similar system to improve its own number management capabilities.

4.10 Upper bounds set in numbering conditions of use

As noted above, the total number of fixed telephony subscriptions in Ireland is not growing strongly. However, assignment to end users of radically higher quantities of numbers per line could cause number exhaustion and the need for expensive numbering plan changes, without providing significant additional utility for current telephony customers. The former National Numbering Conventions (ComReg 11/17)³⁹ specifies that no more than two geographic numbers may be assigned to end users:

“Geographic number allocations shall not exceed a maximum of two numbers per registered user (in the case of consumers) or per business line”.

These numbering conditions of use have recently changed. In a recent consultation ComReg 15/60, an alternative version was put forward:

“A holder may assign a maximum of two Geographic Numbers to a residential customer.”

“A holder may assign a maximum of two Geographic Numbers per employee to a business customer.”

We understand that CSPs' comments on this point have raised (amongst others) the following specific objections:

- this is not currently an issue leading to specific concern
- unnecessary constraints on assignment could be damaging
- testing assignment in aggregate (i.e. total numbers/total lines) would be a more flexible approach

³⁹ https://www.comreg.ie/_fileupload/publications/ComReg1117.pdf.

- “per employee” measures in particular will be difficult to enforce as the number of employees fluctuates and is not easily measured at the point of sale or later
- the measure should be a “guideline” not a hard and fast rule
- ComReg could take additional measures at a later date should abuse of this rule/guidance occur.

We agree that existing PSTN and ISDN voice services are not generating strong growth in numbers per line. From discussions with the CSPs, it appears that for existing fixed voice services the combination of the CSPs’ sales process and their internal technical teams setting up the required numbers do lead to appropriate quantities of numbers being assigned; these quantities are on average approximately one number per line for residential users and fewer than 2 numbers per employee for business lines (see for example eircom’s comments in ComReg 14/41). We also note that CSPs with new business ideas may in future create demand that is qualitatively different to current usage.

We agree that unnecessary constraints on assignment could be damaging, but note that the costs of exhaustion due to over-allocation would also be damaging.

We agree that testing allocations in aggregate (i.e. total numbers/total lines) would be a more flexible approach.

We agree that the measure could be a “guideline” and not a rule per se.

We agree that ComReg could take additional measures at a later date should abuse occur, although the nature of numbering is that it is much more difficult to improve the efficiency of use of numbers that have already been allocated (some of which will have been assigned to end users) than it is to improve efficiency of use of numbers that have not yet been allocated.

4.10.1 Proposed measure

A suitable guideline (at an aggregate level), could be stated as:

As a guideline, CSPs are to assign geographic numbers to residential and business voice service users in a similar way to their past assignments to like customers.

These past assignment policies led to residential customers being assigned a maximum of two Geographic Numbers, and business customers being assigned on average less than two Geographic Numbers per employee.

CSPs’ ratios of average quantities of numbers assigned per line should remain similar to or lower than the historical ratios achieved for comparable residential and business PSTN and ISDN voice services in the past.

A possible measure is:

ComReg asks CSPs applying for geographic numbers to apply such an assignment guideline.

ComReg asks CSPs applying for geographic numbers to undertake that staff involved in specifying and building these assignments will be trained to apply the guideline.

4.10.2 Estimated cost

The guideline can be applied by ComReg as part of the number allocation process. As the guideline and any training needs for sales and provisioning staff will reflect existing practice, it will carry no net costs.

Proposed measure	Set-up costs	Ongoing costs	Comments
Setting a guideline relating to upper bounds on numbers allocated to consumers and businesses	Nil	Nil	As described in Section 4.10.1

Figure 4.11: Estimated cost – setting upper bounds [Source: Analysys Mason, 2015]

4.10.3 Potential impact

This measure has (by design) no effect on existing CSPs and existing voice services. It does, however, offer some protection against the introduction of new types of services that may use geographic numbers in new ways, which may require large quantities of numbers and which could lead to exhaustion and the need for costly changes to the plan in some MNAs in the short term.

4.10.4 Monitoring and governance arrangements

ComReg will need to monitor whether CSPs are following the guideline (at an aggregate level) and are providing suitable training for their staff related to this point.

We suggest that relevant data should be gathered within the annual numbering audit.

4.11 Number pooling

Number pooling is a technique by which unused numbers are transferred from one CSP to another that needs them (either as an initial allocation or to support growth in customer numbers). In other words, it is a technique that allows exhaustion to be avoided in those circumstances where the problem is not the total demand for geographic numbers but the distribution of that demand across CSPs.

Number pooling commenced in the USA in 2002. In the USA, numbering resources are assigned to a shared reservoir and a neutral third party, the *pool administrator*, is responsible for retrieving

the relevant information from those CSPs currently holding underutilised blocks of numbers and re-assigning these blocks to CSPs that have already exhausted or will soon exhaust their supply of numbers. Further description of how number pooling has been implemented in the USA is provided in Annex C.

However, at this point, we consider a simpler approach could be adopted in Ireland – one which we believe could be readily supported by the proposed replacement to the existing GNP solution as long as this requirement is taken into account. Such an approach would involve individual block transfers between CSPs with existing customers ported such that they remain with the original CSP.

One way in which this could be implemented would be to allow ComReg to initiate a process whereby a block would no longer be assigned to new end users by the current block holder; existing (non-ported out) end users within that block would be “ported” to the same CSP; and the block would subsequently be transferred between the original holder and a CSP designated by ComReg as the new block holder. The net effect would be as if the block was transferred and the ports back implemented simultaneously.

4.11.1 Proposed measure

At this stage our proposal is not to put pooling into operation (which would require a set of processes and testing of the required interfaces within CSPs’ systems), but to ensure that the capability to use this technique exists within the future GNP solution currently in the process of being procured.

A possible measure would be:

ComReg should work with industry parties to ensure that the capability to use number pooling exists within the future GNP solution currently in the process of being procured (e.g. via support for ComReg-initiated bulk self-porting and support for block transfer⁴⁰).

4.11.2 Estimated cost

We expect that it will be possible to obtain the required additional functionality within the proposed replacement to the existing GNP solution and the initial testing and verification of the functionality itself with little additional cost. Ongoing costs associated with this proposed measure are likely to be low.

Putting together a set of operational processes to use this functionality⁴¹ can be delayed until the first use of the pooling capability is envisaged. This stage (if it goes ahead) may incur additional

⁴⁰ We are not suggesting that the block transfer transaction itself necessarily needs to be within the GNP solution, just that the GNP solution needs to work if a block is transferred.

⁴¹ For example, these processes would have to define who would initiate the pooling and identify the donor and recipient CSPs.

costs; using pooling may also incur ongoing costs depending on the quantity of numbers required to be ported 'back' to the donor CSP.

Proposed measure	Set-up costs	Ongoing costs	Comments
Preparatory work to support number pooling should it be necessary in the future	Low	Nil	Preparatory work as described in Section 4.11.1

Figure 4.12: Estimated cost – number pooling
[Source: Analysys Mason, 2015]

4.11.3 Potential impact

Because number pooling in effect uses number portability to free up the unused space in an already partially used block, it is best suited to blocks that are only lightly used. Our analysis in the 01 area shows that in some instances this is the case (see Figure 4.13). Although less efficient when the blocks are more heavily utilised, more blocks become available for use at these higher levels.

The analysis shown in the table below assumes a threshold for “underutilised” blocks of 10%.

Figure 4.13: Yield from number pooling in 01 NDC area based on a block utilisation requirement of 10%
[Source: Analysys Mason, 2015] [Confidential data redacted to annex]

CSP	Allocated numbers	Numbers in empty blocks	Numbers in underutilised blocks (A)	In-use numbers in underutilised blocks (B)
Total	4 595 000	297 120	284 800	10 454
Yield from pooling (underutilised blocks): (A-B)				274 346

Implementing a number pooling policy in the 01 NDC area based on a block utilisation requirement of 10% would effectively allow an additional 274 346 numbers to be used, based on the assumption that empty blocks would be recovered separately.

Whilst this is not a very large additional capacity, this conclusion depends on the selected utilisation threshold; further capacity could be created if the utilisation threshold were to be increased.

Pooling is also an attractive short-term solution if exhaustion were to occur suddenly, either solving the issue or allowing time to conduct an orderly numbering change if one is required. We note that given the current situation, the first use of pooling (if it were to be put into operation) might well not be in the Dublin area.

4.11.4 Monitoring and governance arrangements

ComReg will need to contribute to the process by which the future GNP solution is specified and procured to ensure that the low-cost items necessary to support a means of implementing a port and block transfer solution are implemented and tested.

In order to determine whether it is necessary to put number pooling into operational use, we propose ComReg would also observe individual utilisation levels within different numbering areas – particularly those which are nearing or are already close to exhaustion. This can be achieved as part of its ongoing monitoring.

In addition, if pooling were to be put into use, ComReg would need to work with industry parties to define a set of processes around its use.

4.12 Charging for geographic numbers

4.12.1 Current practices

There is currently no charge made to CSPs in Ireland for holding numbers.

However, the practice of charging for numbers is widespread in European countries. In 2010, Ofcom found that 25 of 32 CEPT countries had introduced a numbering charge. This is summarised in Figure B.1 in Annex B.

An earlier survey by the ITU⁴² in 2004 found that the practice was less widespread in Africa, the Americas and Asia-Pacific than in Europe at that point in time, but nonetheless 44% of respondent countries had introduced some form of charging for number allocation.

4.12.2 Rationale for charges

The rationale for introducing charges can either relate to:

- recovery of administrative costs related to the operation of the national numbering plan and the management of number resources, or
- seeking allocative efficiency. That is to say, providing incentives to CSPs to either:
 - proactively return unused number blocks
 - improve utilisation of existing blocks (potentially including sub-allocation to other CSPs)
 - reduce demand for new blocks.

Both rationales are commonly cited by NRAs.

We note that, under the Authorisation Directive, fees to ensure optimal use of a scarce resource must be objectively justified, transparent, non-discriminatory and proportionate.

⁴² https://www.itu.int/dms_pub/itu-t/oth/02/07/T02070000040001MSWE.doc.

4.12.3 Example charges when set on basis of encouraging efficient use

United Kingdom

As a result of a review of geographic telephone numbering in 2012⁴³ and alongside other number preservation measures, Ofcom introduced a pilot scheme in 2013 to charge for geographic numbers in 30 area codes with a scarcity of number blocks available for allocation.

In these 30 area codes of the pilot scheme, CSPs incur a GBP0.10 charge per number per annum on all numbers in blocks allocated to them. Further details are provided in *Annex B*.

Denmark

The Danish Business Authority levies an annual charge on CSPs with number allocations from the Danish national numbering plan.⁴⁴ The annual charge for 2015 is set at DKK20 000 (approximately EUR2700) for a typical block of 10 000 geographic or mobile numbers. Further details are presented in *Annex B*.

Australia

The Australian Communications and Media Authority (ACMA) administers the Annual Number Charge (ANC) scheme in Australia.⁴⁵ The scheme charges an annual levy to all CSPs based on their number allocation on a certain census date. The amount due from a CSP is calculated based on the volume of numbers denied by that CSP's allocation as a share of the total volume of numbers denied by allocations to all CSPs such that the total amount of the levy sums to an annual revenue target (AUD60 million in 2015). In essence, the Australian system charges more for shorter numbers since the use of shorter numbers denies the use of a greater quantity of longer numbers in the overall numbering plan. For example, if number A is one digit longer than number B, then the allocation of number B will incur a charge ten times that of number A because it denies the allocation of ten shorter numbers. Further details are presented in *Annex B*.

4.12.4 Options for charging structures

Options for charging structures for fixed geographic numbers are considered in *Annex B*.

⁴³ <http://stakeholders.ofcom.org.uk/binaries/consultations/geo-numbers/statement/numbers-statement.pdf>.

⁴⁴ <http://www.ictregulationtoolkit.org/Documents/Document/Document/1570>.

⁴⁵ <http://www.acma.gov.au/Industry/Telco/Carriers-and-service-providers/Licence-fees-annual-levies-and-charges/important-information-about-anc>.

4.12.5 Candidate charging options for Ireland

Based on the discussion in Annex B, we suggest that if charging for numbers were to be adopted as a measure to improve incentives for efficient number utilisation and to reduce the risk of future expensive changes to the numbering plan then it should have the following form:

- an annual charge
- per number
- charging only for numbers in specified ranges targeted to the issue (e.g. geographic areas in scarcity, mobile)
- charging in proportion to use of plan resource within the range (i.e. charge more for shorter numbers)
- charging the original CSP allocated the number, with exceptions
- charging ported-out numbers not to the donor but to the recipient CSP
- mobile and fixed geographic charge levels might be different
- the initial price should be set based on benchmarks, with review after three years to see whether utilisation has increased
- the charging mechanism adopted should not increase the total regulatory costs of efficient CSPs.

One uncertainty remains, whether to:

- charge for all allocations
- charge only for allocations made under specific circumstances (e.g. if the CSP has an insufficiently high utilisation ratio).

4.12.6 Costs to implement

The exact level of costs to the NRA, and to CSPs, depends on the precise characteristics and extent of the number charging scheme selected. Ofcom indicated that its proposed pilot scheme in 30 area codes was expected to cost in the region of:

- GBP50 000–100 000 (EUR70 000–140 000) for one off costs
- GBP40 000–80 000 per annum (EUR50 000–100 000) for ongoing costs.

One might expect ComReg's costs to be similar to those faced by Ofcom.

Ofcom's existing geographic number management costs were estimated to be around GBP570 000 (EUR780 000) per annum so the ongoing increase in administrative costs was an increase in the region of 7–14%.⁴⁶ No indication was given that these estimates would rise if a nationwide scheme were to be implemented.

CSPs would also face slightly higher administrative costs.

⁴⁶ Paragraph 6.71, <http://stakeholders.ofcom.org.uk/binaries/consultations/geographic-numbers/summary/geographic.pdf>.

Inefficient CSPs would face net costs relating to the lower of the charges faced or the internal costs of improving their efficiency to avoid the cost.

This would be a medium level of cost.

Proposed measure	Set-up costs	Ongoing costs	Comments
Charging for numbers	Medium	Medium	As described in Section 4.12

Figure 4.14: Estimated cost – charging for numbers [Source: Analysys Mason, 2015]

4.12.7 Potential impact

Charging for numbers has the same desirable incentive properties as charging for other scarce resources such as spectrum. Those who use more of the resource pay more and are thereby encouraged to use the resource more efficiently.

Having said this, it is difficult to predict whether charging for numbers in a specific way would change CSP behaviour, which is perhaps one of the reasons why Ofcom has undertaken its trial. Specific uncertainties include:

- There may be different impacts for the two possible options we have proposed (charging for all allocations, or charging CSPs for allocations made when their utilisation is below the target level).
- It should be expected that the charge level set will also affect the outcome. If the charge were low, it is unlikely that it would significantly affect the behaviour of fixed CSPs. If the charge were high, we believe that CSPs would seek to make more efficient use of numbers and reduce their demand for new numbers.

4.12.8 Monitoring and governance arrangements

To put this into practice, ComReg would need to take several actions:

- it would need to set prices for numbers (which we suggest above would at least initially be based on a benchmark)
- it would need to calculate the bill for each of the CSPs for their use of numbers.

5 Conclusions and recommendations

5.1 Review of measures

The costs and benefits of the possible number conservation measures put forward in this report are summarised in Figure 5.1 below. Each measure has estimated costs and either makes available additional numbers or deters various kinds of inefficient demand for additional numbers.

Figure 5.1: Costs and benefits of potential measures discussed in Section 4 [Source: Analysys Mason, 2015]

ID	Proposed measure	Set-up costs	Ongoing costs	Scale of potential impact (illustrated in 01 area)
1	Recovery of existing unused blocks	Low	Nil	Makes additional capacity available where it is needed (300 000 in 01 area)
2	Using numbers identified as free for assignment	Very low	Very low	Deters inefficient demand in cases where CSPs have numbers available
3	Repatriation of numbers to original block holder	Low	Low	Varies over time. Positive impact if repatriated numbers can be put into use by original block holder
4	Introduction of overall utilisation target	Very low	Very low	Deters additional demand caused by inefficiency in use of numbers (might reduce future demand by 50 000 per year in 01 area)
5	Setting a guideline relating to upper bounds on numbers allocated to consumers and businesses	Nil	Nil	Reduces risk of exhaustion driven by significantly different service types
6	Preparatory work to support number pooling should it be necessary in the future	Low	Nil	Maintains the option of number pooling in the future (could make available 280 000 or more in 01 area)
7	Charging for numbers	Medium	Medium	Estimated to be low if charges low or if in addition to measures above

Measures 1–6 all have nil, low or very low initial costs and nil, low or very low ongoing costs. All of Measures 1–6 broadly support the others. As noted in the table above, many of these measures are targeted at different aspects of the problem.

Within this set of options, Measure 2 (targets on free for assignment) and Measure 4 (target on utilisation) can be seen as partial alternatives, because their effects partially overlap. Measure 4 will cause CSPs to focus on the entire number lifecycle, including reusing numbers currently “free for assignment”; by comparison, Measure 2 on its own will address “free for assignment” but will not make CSPs focus on other elements of the number lifecycle such as quarantine. Accordingly, we prefer Measure 4 over Measure 2 as it will generate improvements throughout the number lifecycle

Of the low-cost measures, Measure 3 (repatriation) leads to the lowest benefit per unit cost; this is mainly because repatriation to a CSP with falling demand will not reduce demand for new number allocations. Nevertheless, over time the issue of failed repatriation can become more significant as the quantity of unrepatriated numbers will continue to increase, and the introduction of a new GNP solution is an appropriate time at which to make sure that this process is effective.

Charging for numbers (Measure 7) has the same desirable incentive properties as charging for other scarce resources such as spectrum. Those who use more of the resource pay more and are thereby encouraged to use the resource more efficiently.

However, charging for numbers is higher cost than the other measures, and in terms of its effects, we believe the lowest cost means by which CSPs can improve the efficiency of number usage are already addressed by Measures 1, 3, 4, 5, and 6. As a result, we recommend that charging for numbers should not be implemented at this stage. This conclusion would need to be re-examined if Measures 1, 3, 4, 5 and 6 were proving ineffective.

In summary, we believe Measures 1, 3, 4, 5 and 6 are all appropriate and proportionate at this stage.

5.2 Conclusions

Although end users' demand for telephone services that use geographic numbers is not significantly growing, it remains the case that the allocation of geographic numbers is still increasing and running substantially above end-user demand.

Major changes to geographic numbering in the future would impose very significant costs on industry and consumers alike. It is therefore necessary that proportionate and low-cost measures are taken now to improve the efficiency of number utilisation. Even a modest improvement in utilisation could have a significant effect on the ability of supply to meet demand in the medium term.

CSPs are in a position to control the efficiency of use; those CSPs that have existing inefficiently used numbers do not need new allocations.

Analysys Mason has concluded that the following specific conservation measures need to be adopted at this stage:

- recovery of existing unused blocks
- repatriation of ported-in numbers to original block holder once they leave quarantine
- introduction of overall utilisation target
- setting a guideline relating to upper bounds on numbers allocated to consumer and business end users
- preparatory work to support number pooling should it be necessary in the future.

In addition, should the demand for number blocks continue to rise such that exhaustion is likely, we recommend that ComReg should then examine the cause of this growth. If the increase is

driven by underlying demand, then number changes may be needed in that area. If this increase in demand for numbers is mostly as a result of the redistribution of demand between CSPs, and not due to increases in underlying demand in the relevant area, ComReg should consider putting geographic number pooling into operation in that area.

We have also recommended monitoring, auditing and management actions to be undertaken by ComReg in support of these measures.

We do not propose charging for numbers. However, should the other recommended conservation measures prove ineffective, ComReg may need to consider implementing such an approach at a later stage.

5.3 Recommendations

In the sections below we set out each of our recommendations, which will apply to all CSPs.

5.3.1 Retrieval of unused blocks

Recommendation(s):

ComReg should require all CSPs holding blocks which are empty to return them to ComReg for future reallocation.

One free block may be retained in each MNA if the CSP has fewer than 1000 numbers (or 10% of the CSP's number of active end users in that MNA, whichever is the larger) "free for assignment" in that MNA.

5.3.2 Repatriation of numbers to original block holder

Recommendation(s):

In the interests of efficient number management, all ported-in numbers which have ceased should be repatriated within one year of leaving quarantine. If it is possible to automate this within the future GNP solution at low cost, ComReg should work with industry parties to ensure that the solution purchased supports repatriation of ported-in numbers once these have left quarantine.

5.3.3 Introduction of mandatory geographic number utilisation target

Recommendation(s):

ComReg should only make available additional geographic numbers through administrative allocation when the CSP's utilisation measure 2 in that MNA is 65% or greater. This utilisation threshold should increase to 75% over time, rising at 2.5% per annum.

For the avoidance of doubt, the provision of (small) initial allocations within each MNA range will not be affected.

5.3.4 Upper bounds set in numbering conditions of use

A suitable guideline (at an aggregate level), could be stated as:

As a guideline, CSPs are to assign geographic numbers to residential and business voice service users in a similar way to their past assignments to like customers.

These past assignment policies led to residential customers being assigned a maximum of two Geographic Numbers, and business customers being assigned on average less than two Geographic Numbers per employee.

CSPs' ratios of average quantities of numbers assigned per line should remain similar to or lower than the historical ratios achieved for comparable residential and business PSTN and ISDN voice services in the past.

Recommendation(s):

ComReg should ask CSPs applying for geographic numbers to apply such an assignment guideline.

ComReg should ask CSPs applying for geographic numbers to undertake that staff involved in specifying and building these assignments will be trained to apply the guideline.

5.3.5 Ensure support for number pooling in the future

Recommendation(s):

ComReg should work with industry parties to ensure that the capability to use number pooling exists within the future GNP solution currently in the process of being procured (e.g. via support for ComReg-initiated bulk self-porting and support for block transfer⁴⁷).

5.3.6 Monitoring, auditing and management

In order to fulfil its commitments in relation to effectively managing numbering resources, ComReg needs to:

- regularly obtain the information needed to accurately forecast the country's numbering needs
- facilitate the allocation of the various types of number resources to CSPs

⁴⁷ We are not suggesting that the block transfer transaction itself necessarily needs to be within the GNP solution, just that the GNP solution needs to work if a block is transferred.

- monitor CSPs for compliance with the national numbering plan and associated regulations.

In order to monitor these recommendations, some small changes may be needed to the existing processes in relation to monitoring and auditing, and additional data may need to be gathered by ComReg (and provided by CSPs) in relation to applications for new numbers.

We understand that ComReg may publish relevant statistics annually.

Recommendation(s):

CSPs applying for geographic number allocations for a given MNA should provide data on the numbers currently allocated in that MNA. This may be via an additional appendix to the number application form (which would be the fixed equivalent of Appendix 4 of ComReg15/136). We suggest the required data includes: numbers allocated to CSP by ComReg; number of empty blocks; subscribers, numbers assigned to end users; numbers ported out; numbers ported in; numbers reserved for test purposes; numbers in quarantine; numbers free for assignment; and utilisation measure 2.

ComReg should undertake annual monitoring of geographic numbers in MNAs subject to conservation measures. Additional data points of interest in the annual reports will be: numbers ported in awaiting repatriation; confirming that the CSP is adhering to the guideline on upper bounds.

Annex A Confidential annex

The contents of this section have been removed from the published version of this report.

Annex B Charging for numbers

B.1 General

Figure B.1 below shows charging in European countries as reported by Ofcom.

Figure B.1: Summary of information provided by CEPT country NRAs on charging for geographic numbers
[Source: Ofcom, 2011⁴⁸]

Country	When a charge was introduced	Block size	Lump sum fee in GBP	Annual fee, cost/number in GBP
Austria	No charge	–	–	–
Belgium	1998	1K in areas with shortage, 10K otherwise	per block £23.7	0.9p or 4.8p
Bulgaria	1998	100, 1K, 10K		10.6p
Croatia	2003	1K	per application £7	27.3p
Cyprus	2003	1K, 10K	per thousand numbers £15	1.2p
Czech Republic	2000	1K	per block (any size) £176	3.5p
Denmark (2)	2002	10K		20.8p
Estonia (3)	2004	Any size, including single numbers		27.3p
Finland ⁴⁹	2009	Unknown		12p
France	1998	10K		1.8p
Germany	1998 but cancelled in 2006		–	–
Greece	2001	1K, 10K	per number 2.6p	2.2p
Hungary	2001	1K		21.6p
Iceland (3)	2003	1K		5.7p
Ireland	No charge	–	–	–
Italy	1998	10K		1.0p
Latvia	No charge	–	–	–
Lithuania	2003	Any size, including single numbers	per allocation (any size) £37	6.2p
Luxembourg (3)	1999	1K, 10K	8.8p per number (7)(8)	8.8p

⁴⁸ Table A5.1, page 140, <http://stakeholders.ofcom.org.uk/binaries/consultations/geographic-numbers/summary/geographic.pdf>.

⁴⁹ Finland introduced a numbering fee since the original table was produced by Ofcom. <https://www.viestintavirasto.fi/en/internettelephone/numberingoftelecommunicationsnetworks/numberingfees.html>.

Country	When a charge was introduced	Block size	Lump sum fee in GBP	Annual fee, cost/number in GBP
F.Y.R. of Macedonia	not provided	1K, 10K, 100K		9.2p
Malta	not provided	10K		2.2p (9)
Netherlands	1997	1K	per block, £15.8, minimum £158	0.4p (10)
Norway	introduced 1996-1998	1K		0.5p (11)
Portugal	2009	10K	per application £176	1.8p
Romania	2007	10K		0.8p
Slovak Republic	2004	10K, 100K, 1M	per allocation (any size) £43.6	0.06p
Slovenia	2004	1K, 10K, 100K, 1M		2.6p
Spain	1998	1K, usually 10K		2.6p
Sweden	2004	100, 1K, 10K		1.3p
Switzerland	1996	10K	per 10K block £276 (12)	1.3p
Turkey	2004	1K, 10K, 1M		6.8p

B.2 Example charges when set on basis of encouraging efficient use

United Kingdom

As a result of a review of geographic telephone numbering in 2012⁵⁰ and alongside other number preservation measures, Ofcom introduced a pilot scheme to charge for geographic numbers in 30 area codes with a scarcity of number blocks available for allocation. The scheme started in 2013 and is to be reviewed after two years of operation.

In these 30 area codes of the pilot scheme, CSPs incur a GBP0.10 charge per number per annum on all numbers in blocks allocated to them. Numbers that are sub-allocated to another CSP under a commercial arrangement still incur the charge but numbers allocated to another CSP or to payphones as a result of a regulatory requirement (such as porting-out or USO) are exempt. Revenues from the charge are paid to HM Treasury.

Ofcom⁵¹ stated that:

⁵⁰ <http://stakeholders.ofcom.org.uk/binaries/consultations/geo-numbers/statement/numbers-statement.pdf>.

⁵¹ Paragraph 3.16, <http://stakeholders.ofcom.org.uk/binaries/consultations/geo-numbers/statement/numbers-statement.pdf>.

“The rationale, and objective justification, for introducing a charge for geographic numbers is to ensure that CPs have an economic incentive to use geographic numbers efficiently, with the aim of avoiding or postponing the need to introduce measures to increase number supplies. There is little economic incentive to use the available supply of numbers efficiently now, since we allocate geographic numbers to CPs on a ‘first-come first-served’ basis at no charge. This increases the risk that number supply measures will be needed in more area codes in the future. Whereas introducing number supply measures is a reactive measure, number charging is a preventative measure, i.e. to prevent or delay the introduction of these number supply measures.”

Denmark

The Danish Business Authority levies an annual charge on CSPs with number allocations from the Danish national numbering plan.⁵² The number charge is fixed annually in the Finance Act. For numbers in the national numbering plan, the amount collected reflects the number of combinations that they occupy in the numbering plan (i.e. short numbers pay more and longer numbers pay less per number). The annual charge for 2015 is set at DKK20 000 (approximately EUR2700) for a typical block of 10 000 geographic or mobile numbers.

The charges are collected annually once the Finance Act is passed but a refund is made for any remaining quarters if a number block is returned. However, only complete blocks may be returned and unused blocks can be withdrawn. Like the UK scheme, sub-allocated numbers need to be paid for by the original assignee.

The scheme offers an incentive to CSPs to minimise their use of number blocks, to return unused blocks and to minimise applications for new allocations. In addition, in considering the space occupied in the numbering plan the scheme incentivises CSPs to consider ranges that are more efficient in their use of numbering plan space.

Australia

The Australian Communications and Media Authority (ACMA) administers the Annual Number Charge (ANC) scheme in Australia.⁵³ The scheme charges an annual levy to all CSPs based on their number allocation on a certain census date. The amount due from a CSP is calculated based on the volume of numbers denied by that CSP’s allocation as a share of the total volume of numbers denied by allocations to all CSPs such that the total amount of the levy sums to an annual revenue target (AUD60 million in 2015). In essence, the Australian system charges more for shorter numbers since the use of shorter numbers denies the use of a greater quantity of longer numbers in the overall numbering plan. For example, if number A is one digit longer than number

⁵² <http://www.ictregulationtoolkit.org/Documents/Document/Document/1570>.

⁵³ <http://www.acma.gov.au/Industry/Telco/Carriers-and-service-providers/Licence-fees-annual-levies-and-charges/important-information-about-anc>.

B, then the allocation of number B will incur a charge ten times that of number A because it denies the allocation of ten shorter numbers.

Certain numbers are exempt or subject to a discount, but in general the shorter the number the higher the charge it attracts.

ACMA levies an application fee per number or per application in addition to the ANC.⁵⁴

In combination, these fees disincentivise CSPs from applying for numbers for which there is not a strong business case and also incentivise CSPs to surrender numbers or number ranges that are no longer required.

B.3 Discussion of possible approach to charging

In this section we discuss various possible options for charging for numbers.

B.3.1 Type of charge

A number of formats could be considered for charging:

- *Application charge.* This is a *one-off* disincentive to apply for number allocations. It does not provide incentives to return blocks; it only provides incentives not to request additional ones. There is also a relatively low administrative burden associated with this approach. However, moving to such an approach disadvantages new entrants as existing CSPs have an existing stock of 'free' numbers.
- *Annual charge.* This approach provides a *continued* disincentive to hold unused numbers (i.e. it encourages CSPs to make the most efficient use of the blocks that they hold rather than applying for new blocks). The charge could be calculated based on an annual census day (the Australian approach) or based on daily data (the UK pilot's approach), or something in between (e.g. in Denmark the period for calculations is quarters). The choice of period must however be balanced with the administrative burden it presents (to the NRA and to CSPs) and the ability to collect accurate data.

Draft approach: Annual charge based on annual census day

B.3.2 Charge for new allocations, or all allocations

Options are:

- *Charge only for new number allocations after a certain date.* Restricting charging to only newly allocated numbers restricts incentives only to reducing demand for new applications.

⁵⁴ Freephone and local rate numbers are charged per number. Geographic and mobile numbers are charged per application. <http://www.acma.gov.au/Industry/Telco/Numbering/Numbering-Plan/numbering-faq#3>.

This might be attractive, but it is discriminatory in that new entrants would face charges not faced by existing CSPs for the majority of their numbers.

- *Charge only for allocations made under specific circumstances (e.g. insufficient utilisation ratio).* This could focus the charges on the marginal consumption of numbers without discriminating against new CSPs. As an approach, it would allow the utilisation threshold to be a softer constraint in that an inefficient CSP would be able to obtain new numbers but would have to pay to do so, giving it an incentive to improve its utilisation.
- *Charge for numbers allocated.* Charging for existing and new number allocations applies incentives for efficiency across all numbers allocated.

Draft approach: Charge for all allocations

Alternative: Charge for allocations made under specific circumstances (e.g. insufficient utilisation ratio)

B.3.3 Charge for all numbers or only charge in specific ranges

Options:

- *Charge for all numbers.* Charging for numbers more widely is simpler to administer and can provide early incentives to minimise usage in areas where scarcity has not yet been formally recognised (whereas the prospect of charges being about to be introduced could encourage stockpiling, itself exacerbating scarcity)
- *Charge only for specific ranges of numbers.* If scarcity is restricted to only certain ranges, charging could be proportionately targeted on those ranges

Draft approach: Charge in specified ranges (e.g. geographic areas in scarcity, mobile)

B.3.4 Charge the same in all ranges, or according to the range

Potentially different charges could be levied in different number ranges. The charge needed to cause efficient allocation may be different as the ways in which numbers are managed are different:

- the CSPs may face different alternative means of improving their utilisation levels
- the costs avoided as a result of efficient management may be different in different ranges.

Thus, in principle, different levels of charge per number could be considered, e.g. in mobile and fixed geographic ranges.

Draft approach: This is related to how the charges are set, but in principle we think that **mobile and fixed geographic cases might have different levels of charge**

B.3.5 One charge in range, or in proportion to use of numbering plan resource

Options:

- *One charge for any kind of number in the range.*
- *Charge according to the number of combinations used up (i.e. charge more for shorter numbers and less for longer numbers).* This is the approach taken in Australia and Denmark. This not only improves incentives to use numbers efficiently but also adds a long-term incentive to use longer numbers for applications that do not need to be memorable or dialled by people. It also reflects the potentially higher value that short codes may have over standard geographic numbers and the lower value that longer digit lengths (e.g. for M2M applications, should a range using longer numbers be provided in the future) may have.

Draft approach: Charge in proportion to use of plan resource within the range (i.e. charge more for shorter numbers)

B.3.6 Sub-allocation

If sub-allocation of numbers within blocks is allowed, the number charging regime must take a position as to whether the original holder or sub-allocated holder is charged.

- *Original holder charged.* In this case when numbers are sub-allocated from one provider to another they must agree their own commercial terms to take account of number charging. There is no increased administrative burden for the NRA but there may be complexities in implementation for CSPs. Incentives for improved number block utilisation remain with the original block holder (but may be passed through if the sub-allocation charges pass through the numbering charges).
- *Sub-allocated numbers tracked and charged.* In this case the NRA must work with the CSPs to monitor sub-allocation of numbers such that the correct fee is charged. This may have a higher administrative burden for all parties. The party to which sub-allocation is made would face incentives for efficient use.

Draft approach: Charge original block holder, with exceptions

B.3.7 Porting

Options include:

- *Not taking porting into account/charge the donor CSP,* which would punish the donor CSP for meeting a regulatory obligation
- *Charging the recipient CSP.* This also gives an incentive to return ported-in numbers that have ceased and left quarantine.

Draft approach: Charge the ported-out numbers not to the donor CSP but to the recipient CSP

B.3.8 Charging unit

The charging unit selected can be.

- per number
- per number block.

If taking account of porting in the manner noted above, it is inevitable that charging will be per number.

Draft approach: Charge per number

B.3.9 Size of charge

The level of charge selected needs to be enough to provide appropriate incentives. A process to review and increase/decrease the charge would also be needed.

Options:

- based on benchmarks set in other countries charging on the basis of encouraging efficient use
- based on the level of cost that needs to be avoided and the size of the incentive needed (e.g. the costs of alternative means of reducing demand by improving utilisation).

Draft approach: Set initial price based on benchmarks of other countries whose approach is based on encouraging efficient use (rather than cost recovery), with review after three years to see whether utilisation has increased

B.3.10 Measures to focus impact on inefficient use

These charges would be aimed to incentivise efficient usage of the numbering resource.

If efficient CSPs face additional costs as a result of charging for numbers, then it is likely that this step change in costs would be passed through to end users to some extent. If the charge can be targeted on inefficient usage, this likelihood is reduced as the efficient CSPs will set the market price.

We believe therefore that it could be appropriate to seek a mechanism that does not increase the total regulatory costs of efficient CSPs. We note however, that other regulators that set charges based on seeking allocative efficiency have not taken this approach.

Draft approach: Use a charging mechanism that does not increase the total regulatory costs of efficient CSPs

Annex C Number pooling in the United States

C.1 Background and context

National roll-out number pooling commenced in the USA on 15 March 2002, in the 100 largest metropolitan statistical areas (MSAs). There is currently no number pooling in Canada.⁵⁵

Part 52, Subpart C, of the FCC CFR deals specifically with number pooling (block utilisation, or contamination threshold highlighted in **bold**):

§52.20 Thousands-block number pooling.

...

(b) *General requirements.* Pursuant to the Commission's adoption of thousands-block number pooling as a mandatory nationwide numbering resource optimization strategy, all carriers, except those exempted by the Commission, must participate in thousands-block number pooling where it is implemented and in accordance with the national thousands-block number pooling framework and implementation schedule established by the Commission.

(c) *Donation of thousands-blocks.* (1) All service providers required to participate in thousands-block number pooling shall donate thousands-blocks with **ten per cent or less contamination** to the thousands-block number pool for the rate center within which the numbering resources are assigned.

(2) All service providers required to participate in thousands-block number pooling shall be allowed to retain at least one thousands-block per rate center, even if the thousands-block is ten per cent or less contaminated, as an initial block or footprint block.

(d) *Thousands-Block Pooling Administrator.* (1) The Pooling Administrator shall be a non-governmental entity that is impartial and not aligned with any particular telecommunication industry segment, and shall comply with the same neutrality requirements that the NANPA is subject to under this part.

(2) The Pooling Administrator shall maintain no more than a six-month inventory of telephone numbers in each thousands-block number pool.

⁵⁵ The Canadian Steering Committee on Numbering lists various proposals for discussion, ranging from number pooling to consolidation of rate centres to forcing overlay plans for all subsequent area code expansion, but to date number pooling has not been implemented.

C.2 Implementation of number pooling in the USA

In the USA, number pooling is a numbering management process by which numbering resources are assigned to a shared reservoir, and provides a means of exchanging unused parts of originally assigned number blocks between CSPs.

The numbering resource in the shared reservoir is available in blocks of numbers for assignment to competing CSPs participating in geographic number portability. When a largely unused number block is reassigned to a competing CSP, the individual numbers which are presently in use are ported back to the CSP which previously provided the block to the shared reservoir.

Administration

In the USA, number pooling requires the oversight of an administrator to establish the pool, allocate the resources from the pool, monitor the utilisation of the pool, determine the rate of growth, determine its projected exhaustion, and plan for its relief in accordance with industry guidelines.

The role of pooling administrator is currently performed by Neustar. However, with Telcordia Technologies (trading as iconectiv) now selected by the FCC to serve as the next number portability administrator, it is possible that Neustar will not continue to act as pooling administrator.

It is also worth noting that guidelines would describe the specific methods and procedures through which numbers will be assigned in a number pooling environment.

Operational support systems (OSS)

Operational support systems (OSS), especially those associated with service provisioning, are directly affected by the implementation and use of pooling and would have to be modified to accommodate number pooling. Number pooling would also increase the quantity of numbers treated as ported numbers. This could increase the storage requirements for NP databases and billing systems.

Annex D List of abbreviations used in this report

Figure D.1: Terms used [Source: Analysys Mason, 2015]

Abbreviation	Full term
ACMA	Australian Communications and Media Authority
ANC	Annual Number Charge
AUD	Australian Dollar
CEPT	European Conference of Postal and Telecommunications Administrations
CFR	Code of Federal Regulations
CITC	Communications and Information Technology Commission (Saudi Arabia)
CSP	Communication service provider
DDI	Direct Dial-in
DKK	Danish Krone
EUR	Euro
FCC	Federal Communications Commission (USA)
GBP	British Pound
GNP	Geographic Number Portability
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union
M2M	Machine to Machine
MNA	Minimum Numbering Area
MSA	Metropolitan Statistical Area (USA)
NANPA	North American Numbering Plan Administration
NAP	Numbering Advisory Panel
NDC	National Destination Code
NMS	Numbering Management System
NP	Number Portability
NPAC	Number Portability Administration Center (USA)
NRA	National Regulatory Authority
NTP	Network Termination Point
OSS	Operational Support Systems
OTT	Over-the-top
PABX	Private Automatic Branch Exchange
PCMTS	Public Cellular Mobile Telephone Services
PSTN	Public Switched Telephone Network
VoIP	Voice over Internet Protocol