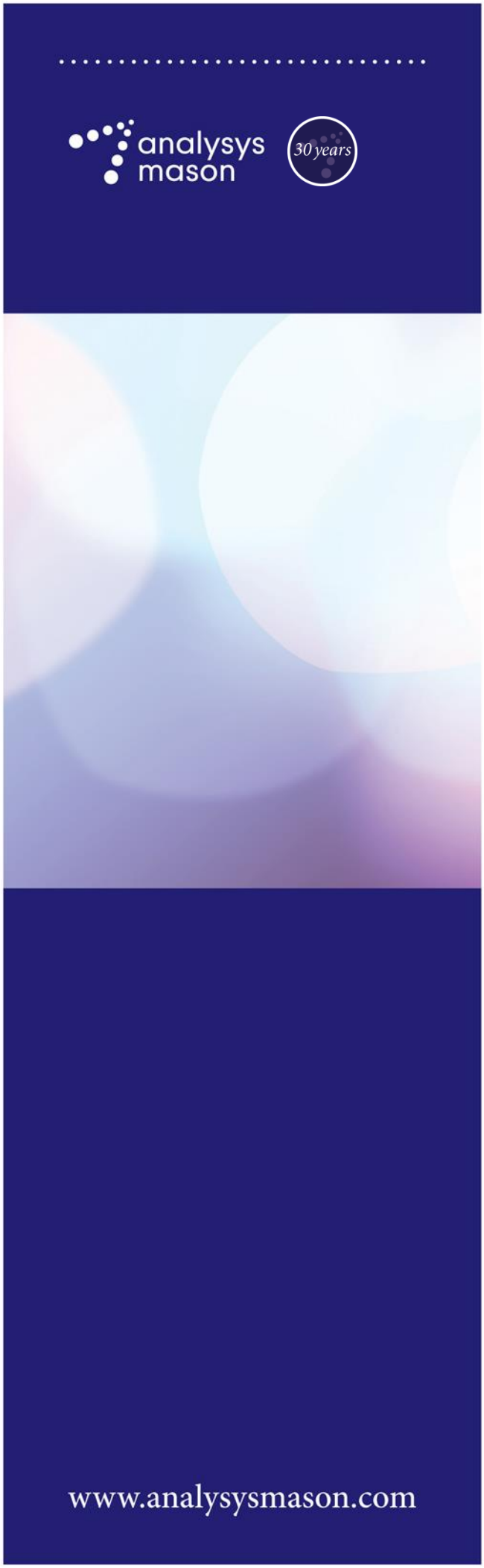

Report for ComReg

Conservation measures to meet future demand for mobile numbers

8 March 2016

Ref: 2003879-113

Contents

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1 Executive summary

In March 2013, ComReg published a consultation which mainly considered the issue of having a dedicated number range for machine-to-machine (M2M) communications (Document 13/33). ComReg published its response to consultation (Document 13/109) and a related consultants' report (Document 13/110), prepared by Analysys Mason and Antelope Consulting in November 2013.

The consultation indicated reluctance amongst many communication service providers (CSPs) to the proposal to open a new number range for M2M applications. The preference, expressed by most CSPs, was to continue to use mobile numbers for M2M applications. However, using mobile numbers for M2M applications raises the issue of the future availability of mobile numbers, which are a finite resource.

ComReg stated in its response to consultation that it would not introduce a new number range for M2M applications in the immediate future, but would instead engage with CSPs in order to discuss and agree upon conservation measures for mobile numbers, some of which were identified in the consultants' report (13/110). This report sets out more detailed proposals in respect of the conservation measures identified.

The volume of mobile numbers allocated to CSPs has been expanding over time despite limited growth in the number of active subscriptions. We estimate that continued growth at the current average allocation rate will lead to exhaustion of the five currently used 08X ranges[1] by 2023 (see Figure 1.1). This assumption is based on the recent status quo and does not include the possible substantial growth in demand which might come from additional applications not seen in recent years such as extra-territorial M2M.[2] Growth at the maximum allocation rate from the last five years could lead to significantly earlier exhaustion.

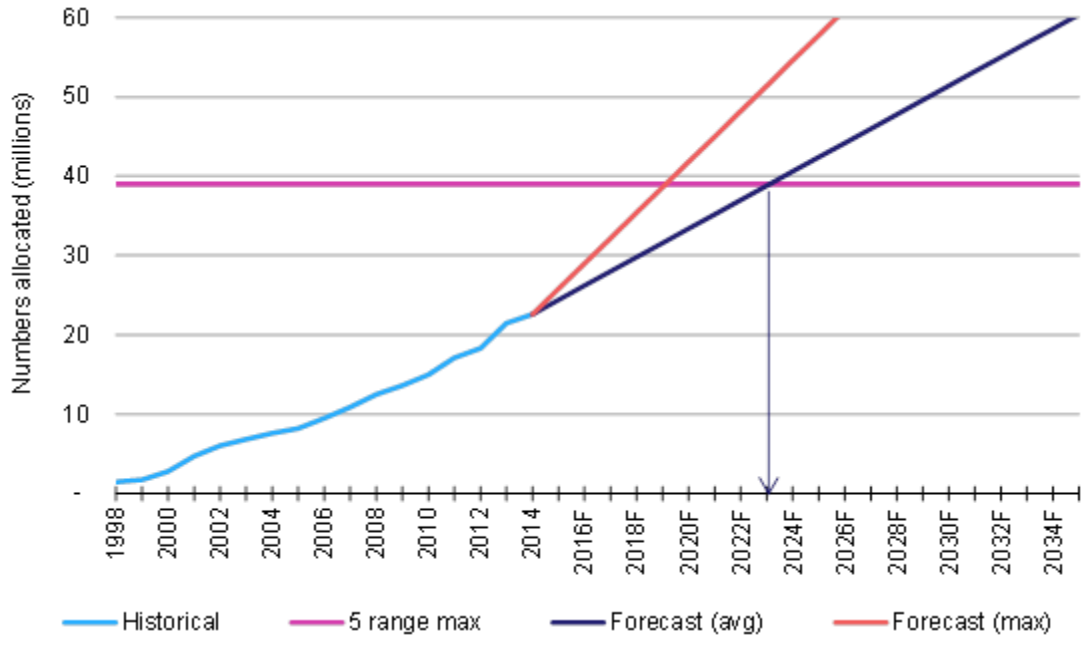
Major changes to mobile numbering in the future would impose very significant costs on industry and consumers alike. In earlier work for ComReg, Europe Economics estimated that a large-scale change to the Dublin geographic numbering plan would cost in the region of EUR337 million. If we adopt this estimate as the basis for approximating the cost incurred by all stakeholders if a significant change was made to the mobile numbering plan, the overall cost could be as high as EUR650 million. By comparison, we believe that conservation measures can change industry behaviour such that very expensive changes to the existing mobile numbering plan can be avoided.

The more efficient use of numbers also benefits CSPs by helping to reduce costs, in particular recurring licensing fees paid to equipment vendors, through less capacity being used in network database platforms.

1 Currently used mobile number ranges are 083, 085, 086, 087 and 089.

2 In an M2M context, the extra-territorial usage of numbers is where a national regulatory authority in one jurisdiction facilitates the permanent use of numbers from a mobile numbering range from that jurisdiction for use by M2M applications(s) in other jurisdictions – perhaps on a widespread or global basis.

Figure 1.1: Mobile number exhaustion forecast [Source: Analysys Mason, 2015]



We therefore consider it necessary that proportionate and low-cost measures are taken now to improve the efficiency of mobile number utilisation, as even a modest improvement in utilisation could have a significant effect on the ability of supply to meet demand. In this report, we propose and recommend that the following specific conservation measures should be adopted:

- Recovery by ComReg of existing unused number blocks
- More effective management of the quarantine process, returning numbers to "free for assignment" efficiently
- The repatriation of ported numbers that are no longer in use
- The introduction by CSPs of improved inventory/distribution management processes and systems so as to reduce the quantity of numbers "in-channel"
- The introduction of an overall utilisation target

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.

The option of charging for numbers has also been examined, but we do not recommend its introduction at this stage. However, should the recommended conservation measures prove ineffective, for example if the CSPs were to fail to implement the agreed measures to ensure that numbers were used more efficiently, ComReg may need to implement charging for numbers 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.

On 28 March 2013, ComReg published a consultation which mainly considered the issue of having a dedicated number range for machine-to-machine (M2M) communications (Document 13/33[3]). ComReg published its response to consultation (Document 13/109[4]) and a related consultants' report (Document 13/110[5]), prepared by Analysys Mason Limited (Analysys Mason) and Antelope Consulting LLP (Antelope Consulting) on 22 November 2013. The responses to the consultation and notes from bilateral meetings were published in Document 13/66R.[6]

The consultation indicated reluctance amongst many communication service providers (CSPs) to the proposal to open a new number range for M2M applications. The preference, expressed by most CSPs, was to continue to use mobile numbers for M2M applications. However, using mobile numbers for M2M applications raises the issue of the future availability of mobile numbers, which are a finite resource. ComReg stated in its response to consultation (Document 13/109) that it would not introduce a new number range for M2M applications in the immediate future, but would instead engage with CSPs in order to discuss and agree upon conservation measures for mobile numbers.

The initial conservation measures identified in the Analysys Mason and Antelope Consulting report were:

- setting effective utilisation targets for CSPs; and
- retrieving unused numbers.

Two areas specifically identified as having unused numbers were:

- allocated mobile numbers that have never entered into use; and
- ported numbers that are subsequently ceased.

3 ComReg Document 13/33 – Numbering for Machine-to-Machine Communications – published 28 March 2013. http://www.comreg.ie/_fileupload/publications/ComReg1333.pdf.

4 ComReg Document 13/109 - Numbering for Machine-to-Machine Communications – Response to Consultation – published 22 November 2013. https://www.comreg.ie/_fileupload/publications/ComReg13109.pdf.

5 ComReg Document 13/110 – Numbering for Machine-to-Machine Communications – Consultants' Report – published 22 November 2013. http://www.comreg.ie/_fileupload/publications/ComReg13110.pdf.

6 ComReg Document 13/66R – Numbering for Machine-to-Machine Communications: Publication of responses to ComReg Consultation Document 13/33 & notes from bilateral meetings – published 29 November 2013. http://www.comreg.ie/_fileupload/publications/ComReg1366R.pdf.

Other measures examined in that report were: reducing the sizes of blocks in allocation, shortening the interval between assignments and the possibility of charging for numbers

This report sets out more detailed proposals in respect of the conservation measures identified in ComReg document 13/110, and also considers a further option of levying fees for the use of mobile numbers.

The remainder of this document is laid out as follows:

- Section 3 examines the characteristics of mobile 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 mobile numbers.
- Section 5 looks at the likely costs and benefits of the options considered in Section 4 and presents a summary of our assessment of their potential impacts. Based on the preceding analysis, we then set 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 list of abbreviations used in this report.

3 Use of mobile numbers

3.1 Introduction

In this section we examine the characteristics of mobile numbers and provide background to inform consideration of the proposals set out later in the document. We explain how mobile network operators (MNOs) and mobile virtual network operators (MVNOs) manage mobile numbers currently and the particular challenges faced. We then consider why numbers continue to be in demand and what this demand is likely to mean for the availability of mobile numbers in the future.

3.2 Context

3.2.1 Definition and characteristics of mobile numbers

Mobile numbers are defined in the new Numbering Conditions of Use and Application Process (ComReg Document 15/136[7]) as:

> "A Non-Geographic Number that is used as part of a mobile service."

All mobile telephone numbers in the Republic of Ireland begin with the digits 08 followed by another 8 digits, forming the digit structure:

Mobile network access code (08X) + 7-digit subscriber number

Irish mobile telephone numbering is part of a closed numbering plan, meaning that users must dial the full 10-digit number.

Mobile telephone numbers beginning with 083, 085, 086, 087 and 089 are presently used by MNOs (Three, Meteor and Vodafone) and MVNOs including Blueface, eir Mobile (formerly eMobile), Postfone, Tesco Mobile, 48, Virgin Media, and Lycamobile. There is for historical reasons a mapping between the CSP block holders and the network access codes which we discuss in more detail in Section 3.6.1 below.

Corresponding 8-digit mobile mailbox numbers are created by placing the digit '5' in front of the 7-digit subscriber number. As a result, the initial digit '5' of the 7-digit subscriber numbers is reserved to prevent misdialling of voicemail numbers. This and other ranges which are currently reserved, or may be reserved, are set out in Figure 3.1, Figure 3.2 and Figure 3.3 below. In addition, '0818' is designated to Universal Access Numbers.

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

Reserved number ranges which cannot be used

Number range	Total numbers	Purpose of reserving
08X 5XX XXXX	1 000 000	To avoid potential misdialling of voicemail numbers
08X 999 XXXX	50 000	To avoid potential misdialling of 999 emergency number
080 0XX XXXX	1 000 000	Reserved for potential future use for international access to Freephone services
084 4XX XXXX	1 000 000	To avoid potential conflict with UK local rate 0844 number*
085 0XX XXXX	1 000 000	Reserved for potential future use for international access to shared cost numbers
089 0XX XXXX	1 000 000	Reserved for potential future use for international access to shared cost numbers

Note *: 084 mobile network access code not currently in use by MNOs and MVNOs

Figure 3.1: Reserved number ranges which cannot be used [Source: ComReg, 2015]

Number ranges reserved for future expansion

Number range	Total numbers	Purpose of reserving
083 9XX XXXX	1 000 000	Reserved for future expansion (in addition to 08X 999 XXXX range)
085 9XX XXXX	1 000 000	Reserved for future expansion (in addition to 08X 999 XXXX range)
086 9XX XXXX	1 000 000	Reserved for future expansion* (in addition to 08X 999 XXXX range)
087 8XX XXXX	1 000 000	Reserved for future expansion
089 8XX XXXX	1 000 000	Reserved for future expansion

Note *: Parts of this number range are currently in use

*Figure 3.**2**: Number ranges reserved for future expansion [Source: ComReg, 2015]*

Number ranges which may be reserved for future expansion (not currently open for use)

Number range	Total numbers	Purpose of reserving
082 8XX XXXX	1 000 000	Potentially reserved for future expansion
084 8XX XXXX	1 000 000	Potentially reserved for future expansion
088 8XX XXXX	1 000 000	Potentially reserved for future expansion

Figure 3.3: Number ranges which may be reserved for future expansion [Source: ComReg, 2015]

3.2.2 Number portability

Full mobile number portability (FMNP) was launched in July 2003. With FMNP, numbers are fully portable between networks, meaning that users cannot reliably identify a network or service provider based on the 08X prefix. In other words, since the advent of mobile number portability, mobile phone number network access codes can no longer be relied on to determine the current CSP providing service – only the original CSP providing service.

Number portability has been relatively successful in Ireland. For example, in the quarter to March 2015, 92 606 numbers were ported between mobile CSPs with a total of 403 251 numbers having been ported over the preceding twelve-month period.

Figure 3.4 shows total numbers ported per year and indicates that porting has seen relatively high levels of take-up since introduction, whilst Figure 3.5 shows that porting is well distributed amongst the network-owning CSPs.

Figure 3.4: Total numbers ported per year [Source: ComReg, 2015]

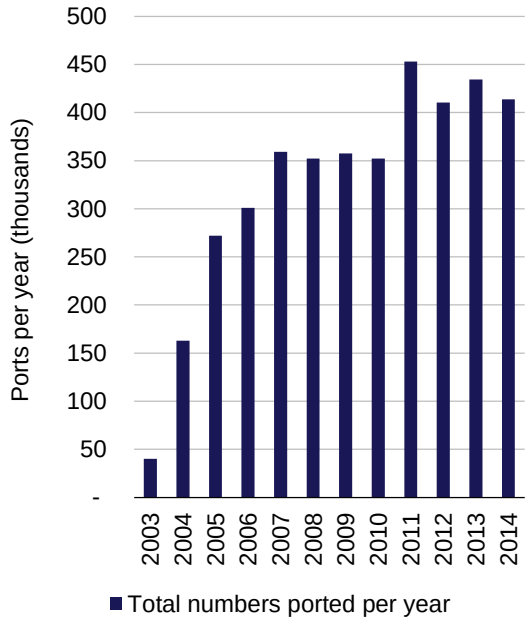
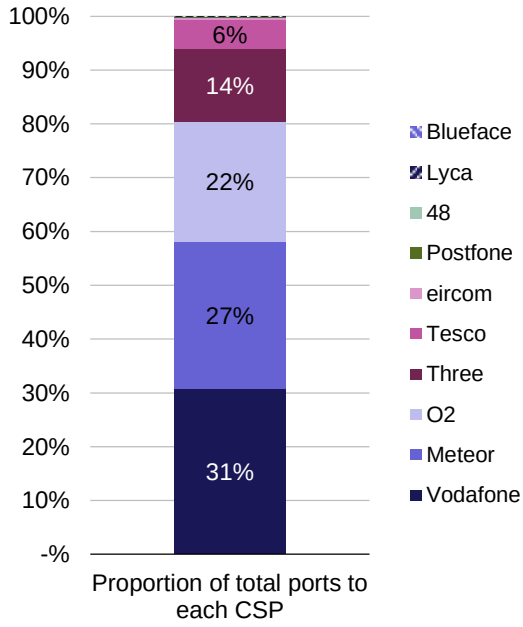


Figure 3.5: Proportion of total numbers ported to each CSP [Source: ComReg, 2015]



The relative success of FMNP suggests that users are becoming accustomed to 08X not having a particular significance in relation to identifying the CSP providing service. This is discussed further in Section 3.6.1.

3.3 Demand for mobile numbers

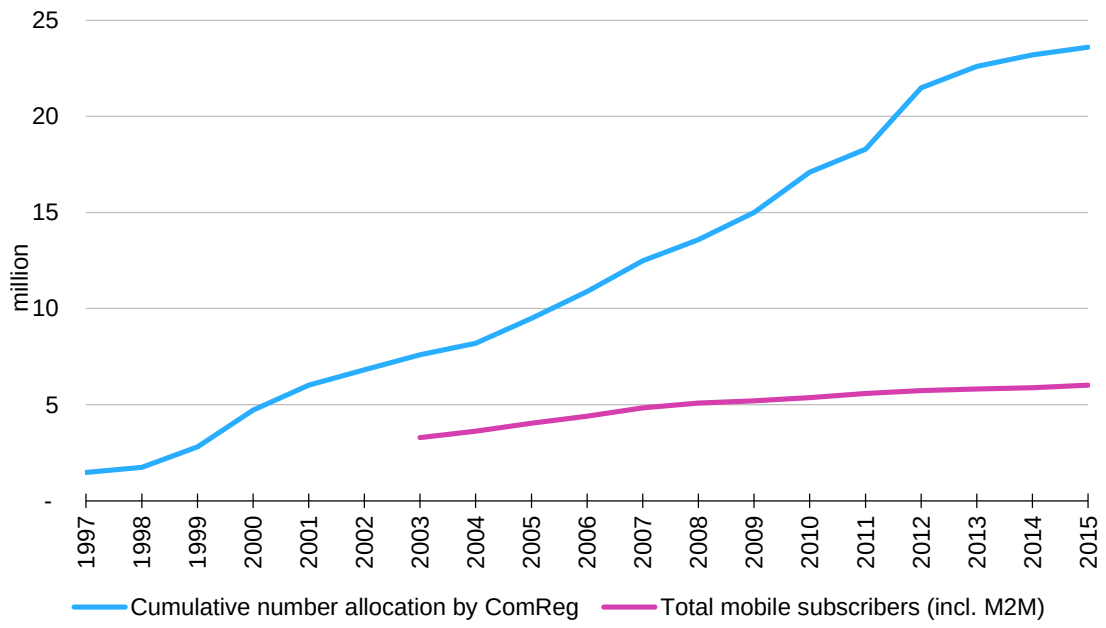
3.3.1 Current demand

At the end of Q1 2015, in the mobile number ranges (083, 085, 086, 087 and 089) 23.6 million numbers had been allocated.

At the end of Q1 2015, according to the ComReg Quarterly Key Data Report (ComReg Document 15/49), in Ireland there were a total of **5 770 638** mobile subscriptions, including mobile broadband and M2M.

Not only is this rather inefficient, as illustrated in Figure 3.6, but it also clearly demonstrates the demand for mobile numbers, from MNOs and MVNOs, has increased enormously over the last decade in comparison to the number of actual mobile subscriptions.

Figure 3.6: Number allocation versus mobile subscribers [Source: ComReg, 2015]



At an industry level, the effective utilisation of numbers, defined as:

$$Effective\ utilisation = \frac{Total\ number\ of\ mobile\ subscriptions}{Total\ numbers\ allocated\ by\ ComReg}$$

has decreased substantially since 2006. Whilst certain practices can account for some part of the increased demand for mobile numbers, such as the pre-assignment of numbers to various sizes of SIM cards (standard, micro and nano) in the prepaid distribution chain to cater for different handsets – some of which were never used, these alone cannot explain this phenomenon. Equally, it is not because the mobile market has changed significantly during this period:

- For example, the proportion of prepaid subscribers (for which less efficient means of allocation of numbers to SIMs may be prevalent, see Section 3.4.2) has not increased dramatically during this time: in reality the proportion of prepaid subscribers has been falling since 2008.

- In a similar manner, an increase in the number of MVNOs might have offered some explanation to the trend, as their small size can lead to inefficiencies in utilisation. However, they do not represent a large enough segment of the market to have contributed significantly to the sizeable growth in numbers allocated by ComReg and the consequent dramatic decline in utilisation efficiency over this period.

The main causes of the historical inefficiency in number utilisation are first examined in Section 3.4.3 of this report.

3.3.2 Future demand for mobile services

Demand from M2M communications

In previous analysis conducted on behalf of ComReg,[8] Machina Research predicted there would be 25 million M2M online connections in Ireland by 2020, and these connections would include 6 million connections to cellular networks where telephone numbers would be needed.

Our forecast of cellular M2M device connections in Western Europe is shown in Figure 3.7, whilst Figure 3.8 shows our forecast for growth in Ireland – which is lower than the Machina Research prediction, as we consider growth will be lower in certain sectors.

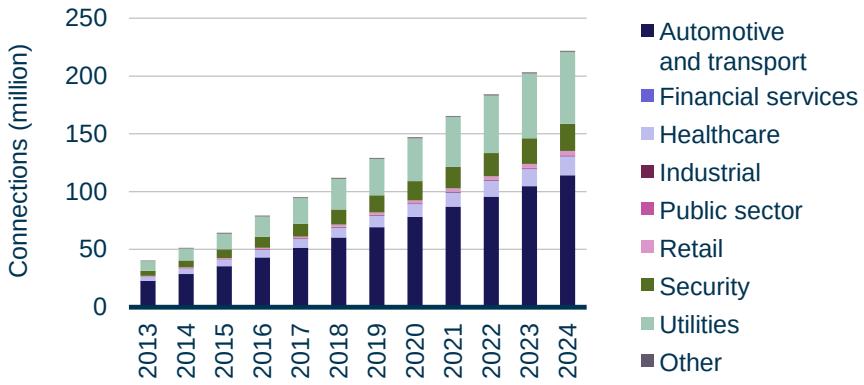


Figure 3.7: Cellular M2M device connections by sector, Western Europe, 2013–24 [Source: Analysys Mason, 2014[9]]

8 Cited in ComReg consultation *Numbering for Machine-to-Machine Communications* (ComReg Doc. 13/33), March 2013.

9 *M2M device connections and revenue: worldwide forecast 2014–2024*, Analysys Mason, November 2014.

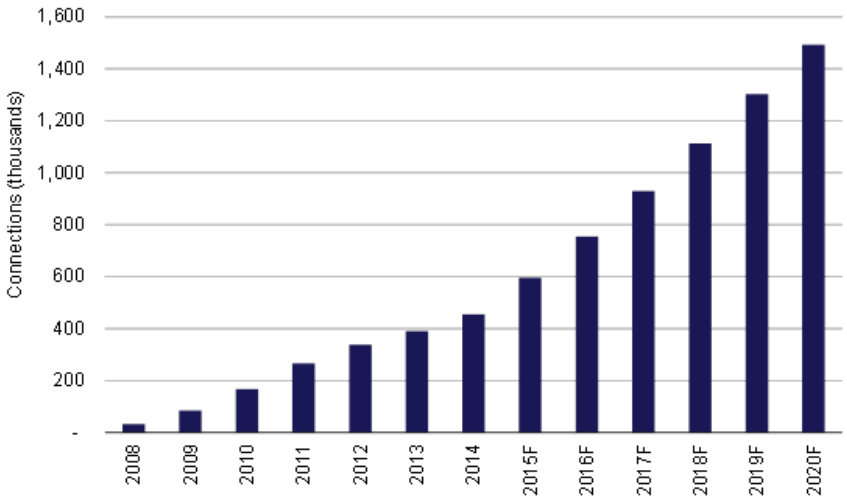


Figure 3.8: Forecast M2M connections, Ireland 2008–20 [Source: Analysys Mason, 2015]

The existing supply of mobile telephone numbers should allow for the possibility of even the 6 million connections previously forecast by Machina Research. However, this does not take into account any potentially very large requirements from extra-territorial use of Irish M2M numbers.[10] Significant extra-territorial M2M demand for numbers from the ComReg numbering plan could place considerable pressure on the existing mobile number ranges; businesses offering these services may choose to be located in Ireland and wish to use Irish numbers for a variety of reasons Even as few as three to four requests for a significant quantity of numbers for extra-territorial requirements, perhaps each in the region of 5 million numbers, would lead to the exhaustion of the five currently used 08X ranges.

A vigorous move to the use of IP addresses for M2M communications could ultimately reduce the demand for telephone numbers for M2M communications but, until that happens, the situation regarding possible shortages arising from extraterritorial M2M demand should be kept under regular review.

Other emerging trends potentially creating demand

► *Disposable numbers*

One emerging trend is the ability to create virtual, disposable phone numbers through the use of smartphone apps such as Hushed and Burner. 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, available 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

[10] In an M2M context, the extra-territorial usage of numbers is where a national regulatory authority in one jurisdiction facilitates the permanent use of numbers from a mobile numbering range from that jurisdiction for use by M2M applications(s) in other jurisdictions – perhaps on a widespread or global basis.

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, which means that these numbers would then spend a minimum of 13 months in quarantine[11] before being returned to "free for assignment". Whilst it is too early to estimate the impact of these services, it could be argued that even a modest increase in their use could become an issue.

Hushed and Burner are not the only apps offering such services; there are others including Flyp and Shuffle.

If they became popular, 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 quarantine (which is particularly inefficient in relation to numbers used for very short periods).

► *Wi-Fi first*

"Wi-Fi first" refers to mobile devices and services that use Wi-Fi networks as the primary network, relegating the mobile network to being the secondary choice.

Making calls over Wi-Fi has been possible for some while, but it is only in recent years that networks, handsets and voice-encoding software have become sufficiently advanced for the quality of such calls to be widely acceptable.

"Wi-Fi first" was first introduced in 2012 by Free, a French MNO, to fill in the coverage gaps in its mobile network. Similar services have been introduced by three American start-ups: Republic Wireless, Scratch Wireless and FreedomPop.

Republic Wireless's subscribers have to buy special handsets that can switch calls smoothly between Wi-Fi and the mobile network, whereas FreedomPop's customers simply install an app on whichever handset they prefer, and it routes their calls through a Wi-Fi connection wherever available.

Take-up of these new services has, to date, been relatively modest. Republic Wireless claims to have 350 000 customers and FreedomPop claims nearly 1 million. In the case of Republic Wireless, the limiting factor appears to be the requirement to buy its special handsets. In the case of FreedomPop, some users have complained about dropped connections and poor customer service. In both cases, subscribers need to keep their handsets' Wi-Fi connections permanently switched on, which imposes additional strain on the devices' batteries.

11 "Quarantine" is a period during which a number is not re-used, which it intended to minimise the risk of receiving calls intended for another person. Its role in the number lifecycle is explained in Section 3.4.2

At this stage, it is questionable whether Wi-Fi first services will ever reach mass adoption, but they could enjoy a measure of success among the young and the cost-conscious.

However, if these services do become popular in Ireland, some additional pressure on number ranges could become apparent but only if users demand new numbers from Wi-Fi first service providers – if number portability were used then the impact on demand for numbers would be minimal.

MNOs themselves are also likely to make more use of Wi-Fi. For example, once EE, Britain's largest MNO, is subsumed into BT, the biggest broadband provider, it will be easier for EE to offload calls, texts and data to BT's many Wi-Fi hotspots. Similarly, devices that run on 5G, the next generation of mobile-telecoms technology, are likely to come with the ability to use the nearest base station, whether cellular or Wi-Fi.

3.4 Mobile number management

3.4.1 Distribution of mobile numbers from ComReg

ComReg administers telephone numbers in the Republic of Ireland and allocates blocks of contiguous numbers, generally in blocks of 100 000 numbers, to MNOs and MVNOs. Once a number block has been allocated to a CSP the allocated numbers are then built onto all CSPs networks so that calls can be routed and delivered to the correct mobile subscriber.

3.4.2 CSP management of mobile numbers

Mobile number lifecycle

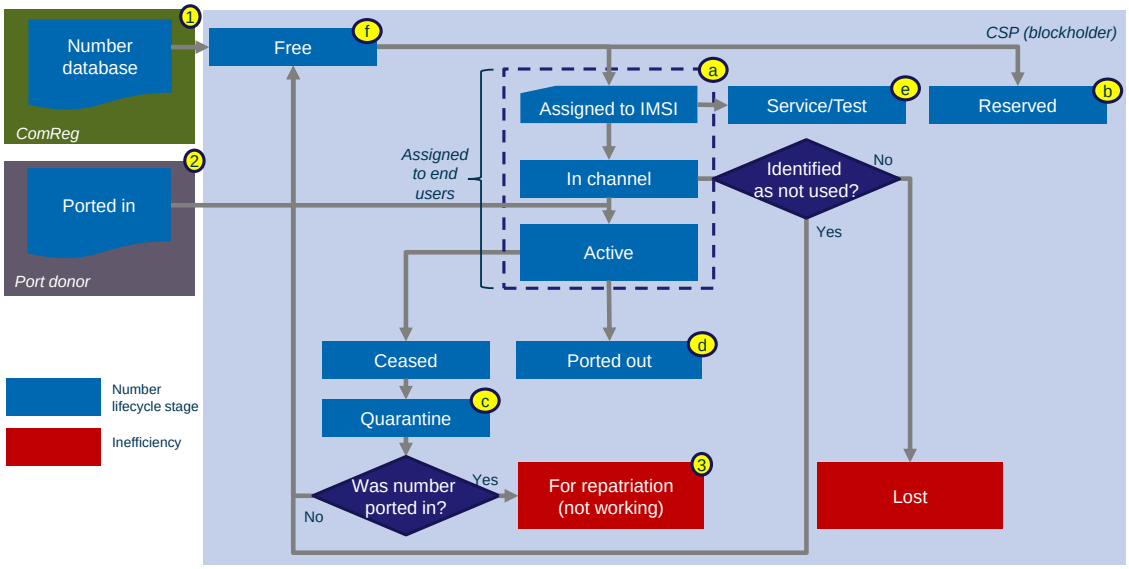
The lifecycle of a mobile number is illustrated in Figure 3.9.

From active use, a number can be ported out if the subscriber wishes to move to another service provider. Alternatively, if the subscriber wishes to cease taking service from a service provider, the number will no longer be required. In this case, the number enters quarantine before once again becoming available for assignment to subscribers. If an end user using a number which was ported-in ceases service, then that number becomes eligible for repatriation to the original block holder.

A service provider can receive a number from three possible sources:

- via a block allocation directly from ComReg
- via a port-in from another CSP
- via repatriation of a previously ported-out number.

Figure 3.9: Mobile number lifecycle [Source: Analysys Mason, 2015]



Inventory management

MNOs maintain a growing volume of subscriber-related data. Data pertaining to subscriber profiles, billing and device details is often fragmented and split across different systems and in varying formats within such systems, such as home location registers (HLRs),[12] customer care systems, and prepaid or postpaid billing platforms.

In many MNO environments, SIMs and mobile telephone numbers[13] are also managed through multiple systems and processes. SIM card logistics are frequently handled manually; number allocation to the SIM is partially manual, and number management is in many cases supported by spreadsheets and can often be distributed across several systems. This can lead to process difficulties in which numbers are inadvertently held at various stages of the lifecycle illustrated above.

Pre-provisioning

The method that Irish MNOs use for distributing prepaid SIM cards involves pre-provisioning in the network and the allocation of MSISDNs to SIM cards well before they are sold and used. As SIM volumes and network growth rates have increased, this pre-provisioning process has led to inefficient usage of mobile number resources: large volumes of MSISDNs are tied up with SIM card inventory in the distribution channels and are not in active use by subscribers.

The pre-provisioning approach assigns an MSISDN to each and every SIM card in the supply chain. Depending on the efficiencies of the supply chain, the number of inactive SIM cards can be

12 In LTE network architectures, the HSS (Home Subscriber Server) replaces the HLR and the AuC (Authentication Centre) – two functions being already present in pre-IMS 2G/GSM and 3G/UMTS networks.

13 Within the industry, often referred to as MSISDNs (Mobile Station International Subscriber Directory Numbers).

a significant proportion of the numbers assigned, lowering the utilisation. This increases costs for the CSP (as SIMs cost money, but also because having the numbers already set up in the network uses up HLR resources which also have costs).

In addition, wastage can be a problem. We understand that some cards are lost, damaged or become obsolete in the supply chain (e.g. if they are the wrong format of card for the latest devices), while others are simply never used (for example, when a tariff or price plan is replaced by a new version). The impact of this can be greatly exacerbated if a CSP wishes to distribute large numbers of free SIM cards without handsets. This can result in a significant wastage of SIM cards and hence lower number utilisation.

If CSPs could improve their SIM logistics and tracking, this would not only serve to improve the utilisation of mobile telephone numbers, but could also introduce cost savings as improved resource circulation and allocation, addressing existing business process inefficiencies, could reduce many of the costs involved in managing the supply and demand of SIM cards.

3.4.3 Key findings from number management audit

As part of this study, we examined historical number audit data gathered by ComReg in 2010, and more recent data on CSP number usage under various categories gathered in 2015. A summary of the results is shown in Figure 3.10 and Figure 3.11. In both tables, confidential CSP data has been redacted. Column headings reflect the stages in the number lifecycle shown above.

CSP	Allocated (ComReg database) (1)	Assigned to end users (a)	Reserved (b)	Quarantine (c)
Confidential CSP data redacted				
2015 Total	**23 091 000**	**10 959 063**	**79 396**	**4 819 379**
2010 audit	**15 626 063**	**7 434 049**	**276 753**	**1 859 685**

Figure 3.10: Results of mobile number audits [Source: ComReg, 2015]

CSP	Ported out (d)	Service / Test (e)	Free for assignment (f)
Confidential CSP data redacted			
2015 Total	**2 119 716**	**115 032**	**7 620 708**
2010 audit	**1 164 166**	**64 265**	**2 463 739**

Figure 3.11: Results of mobile number audits [Source: ComReg, 2015]

The 2015 mobile 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 CSPs[15] have interpreted the audit headings as follows:

- **Assigned[16] to end users:** total numbers which are in-channel or active
- **Reserved:** 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 MNP mechanism
- **Service/test:** total numbers which the CSP is using for testing/non-revenue purposes
- **Free for assignment:** total numbers which the CSP has stored on its database which could be assigned to end users.

The column titled 'Allocated (ComReg database)' sets out total numbers allocated to each CSP by ComReg as per ComReg's database on 24-Jun-15.

Empty number blocks

The audit results from 2015 show that a significant number of empty blocks could be recovered (see Figure 3.12 below).

Underutilised number blocks

The audit results from 2015 also show that a significant number of highly underutilised blocks could be used more efficiently (see Figure 3.12).

Figure 3.12: Numbers in empty and underutilised blocks (Confidential CSP data redacted) [Source: Analysys Mason, 2015]

CSP	Allocated numbers (ComReg database)	Numbers in empty blocks (0% utilisation)	Total numbers in underutilised blocks (Utilisation >0%, <10%)	Assigned-to-end-user numbers in underutilised blocks
Confidential CSP data redacted				
Total	**23 091 000**	**1 620 000**	**3 740 000**	**37 651**
Free numbers in underutilised blocks				**3 702 349**

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, 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.

16 The ComReg audit template used the heading "allocated to end users", however we have used the term "assigned" in relation to end users.

Numbers free for assignment

Figure 3.11 highlights a significant quantity of numbers which block holders have reported as being free for assignment to end user. These numbers could be used before any new number allocations are required.

Ported-out numbers

Figure 3.11 indicates the quantity of numbers currently ported out has reached approximately 2 million. In the 2010 audit, the quantity of ported-out numbers was reported as 1 164 166 – meaning the quantity continues to increase, with almost 1 million numbers being added to this category in the last four to five years. Although some of this growth in ported-out numbers may have arisen from growth in the use of porting, during our engagement with industry, discussions with the MNOs confirmed that ported-in numbers which are then no longer used are not currently repatriated to the original block holder. Based on the data provided to us by the MNOs, we estimate that between 700 000 and 1 million numbers fall into this category and could be returned to the original block holder.

Numbers in quarantine

The 2015 audit has identified significantly more numbers in quarantine than we would expect given the typical churn rate in Ireland, which we consider is presently between 10–15% per annum. The quantity of numbers in quarantine in the 2015 audit is also significantly greater than the quantity identified in the 2010 audit, despite similar rates of churn being reported over this period. Both of these points suggest that the processes for returning numbers that are no longer in use to "free for assignment" are broken.

Numbers within distribution chain ('in channel')

To estimate the quantity of numbers currently within each CSP's distribution chain (i.e. assigned to SIMs but not yet being used by end users), often described by industry parties as being 'in channel', we have compared the quantity of numbers reported as "assigned to end users" with the total number of subscriptions in the market, as illustrated in Figure 3.13.

Figure 3.13: Estimate of 'in-channel' numbers (Confidential CSP data redacted) [Source: Analysys Mason, 2015]

CSP	Assigned to end users (A)	Subscribers (incl. M2M and MBB)	Ported-in numbers (active)	Port-adjusted subscribers (B)	In-channel numbers (A - B)	In-channel as a proportion of port-adjusted subscribers
Confidential CSP data redacted						
Total	**10 959 063**	**5 611 347**	**1 416 472**	**4 194 875**	**6 764 188**	**161%**

Note: 'Port-adjusted subscribers' refers to subscribers minus active ported-in numbers.

The confidential data shows that some CSPs have significantly greater quantities of 'in-channel' numbers than others, meaning that adoption of current best practice would allow significant improvements for these CSPs. It may also be possible for all CSPs to improve these ratios.

3.5 Threat of mobile number exhaustion

As indicated in Section 3.3, the volume of mobile numbers allocated has been expanding over time despite limited growth in the number of active subscriptions in Ireland.

The current status of the 08X ranges currently used for mobile is set out below.

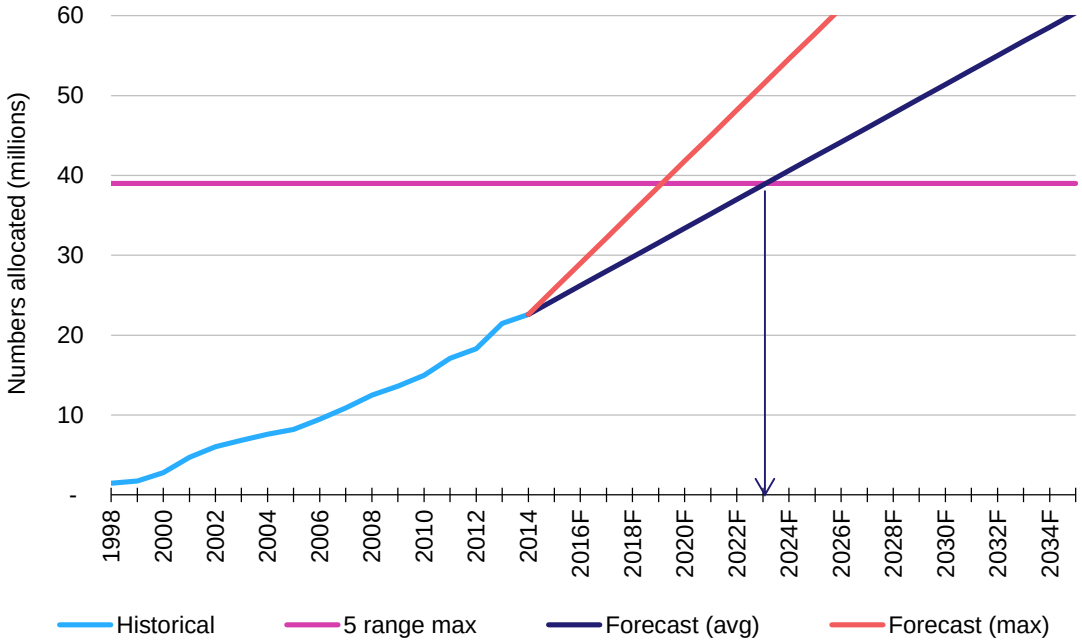
Figure 3.14: Status of 08X ranges currently used for mobile [Source: Analysys Mason, 2015]

Range	Total numbers	Reserved to avoid clashes	Reserved for expansion	Max available for allocation
083	10 000 000	1 010 000	990 000	8 000 000
085	10 000 000	2 010 000	990 000	7 000 000
086	10 000 000	1 010 000	990 000	8 000 000
087	10 000 000	1 010 000	1 000 000	7 990 000
089	10 000 000	1 010 000	1 000 000	7 990 000
Total	**50 000 000**	**6 050 000**	**4 970 000**	**38 980 000**

We estimate that continued growth at the average allocation rate from the last five years (see Figure 3.6) will lead to exhaustion of the five currently used 08X ranges[17] by 2023. This assumption is based on the recent status quo and does not include the possible substantial growth in demand potentially coming from additional applications not seen in the last five years such as extraterritorial M2M. Growth at the maximum allocation rate from the last five years could lead to significantly earlier exhaustion.

[17] Currently used mobile ranges are 083, 085, 086, 087 and 089.

Figure 3.15: Exhaustion forecast [Source: Analysys Mason, 2015]



In Figure 3.15, the 5-range maximum quantity of numbers, c.39 million, is the sum of the un-reserved numbers in each of the currently used mobile ranges as derived in Figure 3.14.

In order to understand the extent to which additional demand for numbers will be a problem, we need to understand the capacity available and the means of adding incremental capacity. This is considered in the next section.

3.6 Means of adding incremental capacity

We have considered three potential means of introducing additional capacity, each with noticeably different associated costs and benefits:

- allow for move away from existing de-facto mapping of 08X network access code to CSP
- incremental expansion within the 08 range
- change the length of mobile numbers in Ireland.

We now discuss each of these options in greater detail.

3.6.1 Move away from existing de-facto mapping of 08X network access code to CSP

At the moment, there is a de-facto approach of certain CSPs applying for allocations from certain number ranges (e.g. Three uses the 083 range). This mapping exists for legacy historic reasons and continues simply because it is convenient for CSPs.

Although historically the number ranges have been used as convenient shorthand by end users (e.g. prepaid customers requesting a "086 top-up" at retail outlets), it is already the case that owing to MNP, customers' numbers do not indicate the CSP providing service.

This mapping approach is not currently causing a number shortage. However, as the market share of an MNO stops reflecting the volume of numbers available within that MNO's historical network access code range, this approach could lead to partial exhaustion.

Allowing all CSPs to use all mobile ranges also reflects practice in other countries including the UK. We therefore recommend that:

ComReg should make it clear to all Irish CSPs that it is already the case that all mobile blocks can be allocated to any mobile CSP and that as a result CSPs' systems should not assume that the existing de-facto mapping of CSPs' to network access codes will continue forever.

Ensuring that this approach eventually comes to a natural end is a relatively low-cost way to make sure that the capacity already available is used effectively. We believe the following considerations support our recommendation:

- the administrative costs of making such a change would be minimal
- number portability means that having a number that is not in the historical range for a given CSP will become increasingly common, meaning that CSPs will probably not use the network access code as part of their branding
- although there may be some costs to the CSPs of updating their internal systems to be able to route calls correctly, we understand that some of these changes have already been made as a result of the Three/O2 merger.

3.6.2 Further opening of 08X ranges

In the medium term, as we have described above, some additional parts of the 08 range could be used for mobile. Not all of the 08X network access codes are fully available as some are partially used for fixed non-geographic services such as 081X.

The lack of other existing uses should allow 082, 084 and 088 to be used relatively straightforwardly. It is also possible that parts of 080 and 081 could be used, although this may start to cause confusion for end users as other parts of these ranges are used for other services (International access to Freephone in 080 and universal services in 081X). However, as M2M numbers are very unlikely to be dialled by end users, this potential confusion is less of an issue and it would be feasible in principle for some parts of the 081 range to be used as mobile numbers for M2M.

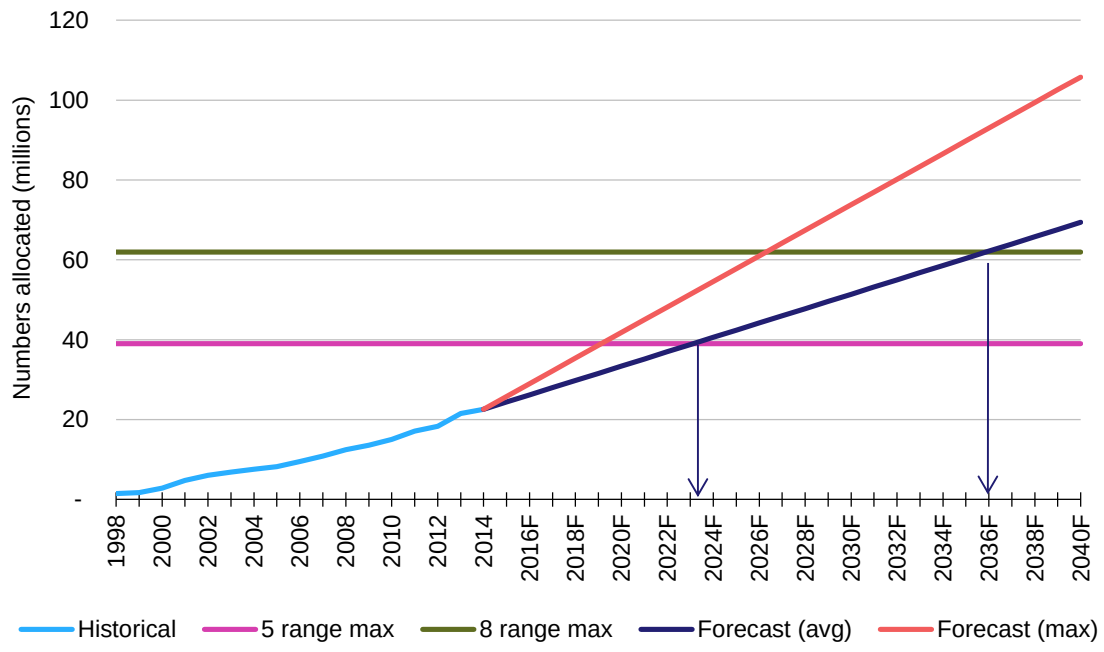
As set out in Figure 3.16, across the 080, 081, 082, 084 and 088 ranges, approximately 39 million additional numbers are potentially available for allocation. If avoiding 080 and 081, roughly 23 million additional numbers are potentially available.

Figure 3.16: Numbers potentially available for incremental expansion in the 080, 081, 082, 084 and 088 ranges [Source: Analysys Mason, 2015]

Range	Total numbers	Reserved to avoid clashes	Reserved for expansion	Available for allocation
080	10 000 000	1 010 000	1 000 000	7 990 000
081	10 000 000	2 010 000	-	7 990 000
082	10 000 000	1 010 000	1 000 000	7 990 000
084	10 000 000	2 010 000	1 000 000	6 990 000
088	10 000 000	1 010 000	1 000 000	7 990 000
Total	**50 000 000**	**7,050,000**	**4 000 000**	**38 950 000**

Making available the 082, 084 and 088 ranges for mobile would increase the total unreserved numbers for mobile from 39 million (see Figure 3.14) to 62 million. In that scenario, we estimate that continued growth at the average allocation rate from the last five years will lead to exhaustion by 2036. Growth at the maximum allocation rate from the last five years could lead to significantly earlier exhaustion.

Figure 3.17: Exhaustion forecast with incremental expansion in the 08X ranges [Source: Analysys Mason, 2015]



In combination with the change recommended above, opening additional 08X ranges would have relatively low costs:

- administrative costs would be low/minimal

- costs to CSPs would be low, the same as opening up any new block
- the high costs of changing end users' existing numbers would be avoided
- end users would still be likely to expect that the numbers were mobile numbers, and it is unlikely many existing devices would need updating (or only to the extent that would have been caused by starting to use 089 for mobile in the recent past, for example).

3.6.3 Change the length of mobile numbers in Ireland

Should the available capacity within the 08 range be exhausted, then a long-term solution would involve adding an additional digit or digits for all mobile users. This would expand the capacity available in the mobile range from e.g. 62 million (if 082, 084 and 088 are included) to c. potentially 700 million numbers.

However, changing customers' existing numbers has high costs for CSPs, consumer end users, business end users and the regulator, and is unpopular; it is therefore to be avoided if possible.

In 2011, Europe Economics carried out a study into the costs and benefits of granting international access to Irish non-geographic numbers.[18] 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', gaining a factor of ten in the numbers available. The total costs of this change (to all stakeholders) were estimated by Europe Economics to total EUR337 million in 2011 terms.

We can adopt this estimate to provide an indication of the approximate level of costs that would be incurred by stakeholders if such a change was made to Irish mobile numbers. If we use the same figures as the Europe Economics report for:

- the per-number cost to CSPs to implement and manage the change (EUR10/number),
- the per-business costs for the changes (assuming that all Irish businesses have at least one mobile subscription):
  - 1–10 employees EUR2293
  - 10–249 employees EUR7699
  - 250+ employees EUR31 482
- and per-consumer costs of EUR13/end user,

then the total costs of changing the length of mobile numbers in Ireland could be EUR650 million.

3.6.4 Conclusion regarding ability to add substantial incremental capacity

While there are means of adding incremental capacity, to add an order of magnitude more will be very expensive. Avoiding the need for such an expensive change – even one forecast to occur in

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

over a decade's time – is a worthwhile goal today. The case is made stronger given that there are possible significant changes in demand such as might be caused by extraterritorial M2M.

We therefore propose the immediate use of low-cost and proportionate measures ensuring the efficient use of numbers and avoiding the need for costly change. Such measures are discussed in Section 4 below.

4 Conservation measures

4.1 Introduction

In this section, we look at the challenges in managing mobile 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 mobile numbers. Realising such opportunities would lessen 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 MNO and MVNO demand for mobile numbers without the need for more costly and 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 subscribers as such measures cause no adverse impact.

4.2 Addressing poor utilisation of existing number resource

The main characteristic of the conservation measures proposed is that they address the underlying problem of mobile number management – poor utilisation of the existing number resource by CSPs.

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.

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

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.

This measure has the disadvantage that numbers categorised by mobile CSPs as 'assigned to end users' typically differ significantly from subscribers (e.g. because in-channel numbers are reported in the 'assigned to end users' category). The measure also does not take account of other factors including:

- MVNO subscribers using numbers in the host MNO numbering ranges ("MVNO light")
- ported-out and ported-in numbers.

Utilisation measure 2

Given the inaccuracies which can arise from the simple utilisation metric, another utilisation measure may be warranted. For the purposes of this report, this is defined as 'utilisation measure 2'.

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

Total subscribers differs from the value the CSPs report as "numbers assigned to end users" because it excludes numbers that are "in channel". CSPs' total number of subscribers can be obtained (for example) from the ComReg quarterly report.

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

4.2.2 Current utilisation levels

Figure 4.1 shows current average levels of utilisation based on ComReg number audit and quarterly report data for utilisation measures 1 and 2 as defined in the previous section.

CSP	Utilisation measure 1	Utilisation measure 2
Confidential CSP data redacted		
Average	**42%**	**18%**

Figure 4.1: Utilisation measures [Source: Analysys Mason 2015]

4.3 Possible measures available to increase utilisation

In this section we consider the possible measures which could be applied to improve utilisation. Possible measures that do not involve changes to existing mobile number ranges are:

- recovery by ComReg of existing unused blocks
- full use of those numbers identified as free for assignment
- more effective management of the quarantine process, returning numbers to "free for assignment" efficiently
- repatriation of ported-in numbers that are no longer in use
- introduction of improved inventory/distribution management processes and systems:
  - to help reduce the quantity of numbers needed in the distribution chain, and
  - to allow more effective retrieval of unused numbers that are 'lost' in the distribution chain and never put into service
- overall utilisation target

- charging for numbers.

Each of these measures is now considered in greater detail.

4.4 Recovery of existing unused blocks

4.4.1 Proposed measure

The audit results from 2015 show that empty blocks containing over 1 million numbers could be recovered.

This makes sense provided that this does not lead to such low number holdings that a new allocation request would quickly become inevitable.

A possible measure would be:

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

One free block may be retained if the CSP has fewer than 200 000 numbers that are "free for assignment".

4.4.2 Estimated cost

We consider recovery of unused blocks to be a relatively low-cost measure as the administrative costs would be minimal.

Proposed measure	Set-up costs	Ongoing costs	Comments
Recovery of existing unused blocks	Low	Nil	In accordance with measure described in Section 4.4.1

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

4.4.3 Potential impact

In accordance with the results shown in Figure 3.12, this measure would result in the recovery of 1.6 million numbers.

4.4.4 Monitoring and governance requirements

ComReg would frequently monitor block utilisation as part of its regular mobile number auditing.

4.5 Use of numbers identified as free for assignment

4.5.1 Proposed measure

Figure 3.11 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 free numbers has fallen substantially.

A suitable targeted measure would be:

> ComReg should indicate that, as a general rule[19], CSPs may only request additional numbers through administrative allocation when they do not hold more than 200 000 numbers that are "free for assignment".

4.5.2 Estimated cost

Not allocating CSPs new blocks until the quantity of free-for-allocation numbers has fallen substantially would be a low-cost measure 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 4.5.1

Figure 4.3: Estimated cost – using numbers identified as free for assignment [Source: Analysys Mason, 2015]

4.5.3 Potential impact

Simply using these free numbers would allow considerable growth in subscribers before new numbers were needed. Assuming no new entrants, total subscribers could increase by up to 2.9 million before a further number allocation by ComReg was required.[20]

19 This does not mean that small CSPs with no justified need for 200 000 numbers free for assignment should be granted additional numbers – all requests need to be justified. Also, additional numbers could be provided even where there were numbers in excess of this threshold free for assignment in special circumstances, such as imminent large promotions.

20 In practice, the available capacity would be somewhat lower than this due to the need for some numbers in "free for assignment" – but the order of magnitude shows that very significant subscriber growth could be managed within the existing allocated pool of numbers.

4.5.4 Monitoring and governance requirements

ComReg will assess utilisation as part of its new application process 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.

4.6 More effective management of quarantine process

4.6.1 Proposed measure

As set out in Section 3.4.3, there are significantly more numbers in quarantine than expected given the annual customer churn rates in Ireland. The rise in the quantity of quarantined numbers may be due to the processes currently being used to move numbers from "quarantine" to "free for assignment" not working as effectively as they should in some instances.

Given the 13-month duration of quarantine, the quantity of numbers held in quarantine at any one time will be approximately 13/12 of the annual churn rate. In addition, there may be seasonal effects related to major periods of mobile sales which will lead to fluctuations in the numbers in quarantine throughout the year; we have allowed for a further uplift to account for this to set a target level of numbers in quarantine of 16/12 of the annual churn rate.

A possible measure would be:

> ComReg should require industry parties to monitor and report the level of numbers in quarantine.
>
> ComReg should require industry parties to ensure that ex-quarantine numbers are returned to "free for assignment". The maximum level of numbers held in quarantine should be 16/12 of the annual churn rate times the number of active subscribers.

We make a separate, but aligned recommendation, in relation to ported-in numbers below.

4.6.2 Estimated cost

The costs associated with this measure should be relatively low, as no external interactions are involved.

Proposed measure	Set-up costs	Ongoing costs	Comments
More effective management of quarantine process	Very low	Very low	In accordance with measure described in Section 4.6.1

Figure 4.4: Estimated cost – management of quarantine process [Source: Analysys Mason, 2015]

4.6.3 Potential impact

This measure will lead CSPs to fix the processes that are leaving numbers in quarantine, and as a result will return several million numbers to "free for assignment". In turn, this will delay CSP requests for new numbers from ComReg. This in turn would effectively delay number exhaustion.

4.6.4 Monitoring and governance requirements

Perhaps the most practical means of monitoring the quantities of numbers in quarantine would be for ComReg to monitor this quantity as part of the data required in Appendix 4 of the new Numbering Conditions of Use and Application Process (ComReg 15/136). ComReg would also need to understand CSP churn rates.

4.7 Repatriation of ported-in numbers to original block holder

4.7.1 Proposed measure

As indicated in Section 3.4.3, discussions with the MNOs confirmed that ported-in numbers, which then cease and are quarantined, are not currently repatriated to the original block holder.

This repatriation process is already documented in Section 3.3 (Number Repatriation) of the Mobile Number Portability Process Manual[21] adopted by the mobile industry in Ireland:

> "When a MSISDN has been cancelled by the Customer, or recovered or replaced by the Recipient Operator (RO), the RO will hold that number in quarantine (including for potential re-use by the ceased Customer in the case of cancellation). Periodically (and subsequent to the quarantine period having expired) MSISDNs will be repatriated to the Blockholder by the RO via the National Porting Database (NPD). Repatriation will occur during porting hours, on Saturday mornings only. The exact time and date to be agreed by the relevant parties in advance."

A possible measure would be:

> In the interests of efficient number management, the number repatriation process, as described in the Mobile Number Portability Process Manual, should be put into action. We further recommend that Mobile Number Portability Committee (MNPC) members agree whether the process is implemented on a periodic as-needed basis, or is fully automated as part of the existing MNP process arrangements.

[21] Mobile Number Portability Process Manual, Issue 6.01, Q1 2012.

4.7.2 Estimated cost

Some costs are associated with the introduction of this measure – however, through our engagement with industry parties, we understand the functionality required is already present in the existing MNP IT Communications Specification (MNP31). This therefore implies implementation costs are limited to:

- the costs associated with the required interoperability testing amongst CSPs participating in MNP to verify the correct and accurate operation of the repatriation process – we understand the cost of the test effort required may be in the region of EUR50 000 for each of the CSPs participating in MNP, with a similar level of test effort required also of the MNP solution provider
- the associated cost, where applicable and in any case likely to be minimal, of manually implementing the process if industry parties determine a fully automated approach is not warranted.

Proposed measure	Set-up costs	Ongoing costs	Comments
Repatriation of numbers to original block holder	Low	Low	In accordance with measure described in Section 4.7.1

Figure 4.5: Estimated cost – repatriation of numbers [Source: Analysys Mason, 2015]

4.7.3 Potential impact

Based on the data provided to us by the MNOs, we estimate that between 700 000 and 1 million numbers fall into this category and could be returned to the original block holder. Regular implementation of the repatriation process would clearly also prevent the build-up of numbers falling into this category.

4.7.4 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 these quantities as part of its new application process contained in Appendix 4 of ComReg 15/136 (Numbering Conditions of Use and Application Process).

4.8 Improved inventory management

4.8.1 Proposed measure

Comparing the 2015 audit results with the number of subscribers in ComReg's quarterly report indicates that 6.7 million or 26% of allocated mobile numbers were in the distribution chain, or 'in channel'.

The analysis in Section 3.4.3 also appears to show that some CSPs have significantly greater quantities of 'in-channel' numbers than others.

If all CSPs could reach levels of efficiency that were similar to the most efficient large CSP in Ireland with respect to the quantities of 'in-channel' numbers, then it is possible that approximately 2 million numbers could be made available for reuse.

A possible measure would be:

> ComReg should encourage all CSPs to optimise their inventory management systems and processes and effectively manage the quantities of mobile numbers held within the distribution chain ('in channel') at an efficient level at any given time. One possible means to achieve this would be a 'use by' date on SIM packaging; another mechanism would be to recover numbers assigned to SIMs that had not been activated after a certain time period from manufacture (e.g. four years).

In addition, we consider it prudent for:

> ComReg to encourage all CSPs to undertake a one-off search/reconciliation process to recover and recycle MSISDNs which have in the past been allocated to SIM cards, but which have never been and will not be activated.

Potential actions to optimise inventory management

We acknowledge that network CSPs need to provision SIM cards to accommodate prepaid customer growth, to promote their business and to support marketing campaigns, and we do not suggest imposing excessive restrictions on MSISDN distribution, or the introduction of unnecessary supply chain and logistics barriers. Instead, we consider the following practical measures could serve to improve utilisation rates without placing unnecessary burden, or significant costs, on CSPs:

- Improved monitoring of the supply chain, taking into account sales forecasts, product launch timescales, required lead times, and SIM provisioning schedules.
- Having a "recycling process" to make numbers available again for use. Such an approach could be implemented by using an expiry or sell-by date on the SIM card or the packaging associated with the SIM card and handset. An alternative would be to use some kind of time cut-off based on the date of manufacture of the SIM.

CSPs can still achieve the goals set by their sales, marketing, supply chain and logistics teams while using numbers more efficiently. In addition, the measures should allow CSPs avoid the need to unnecessarily provision records in advance in the HLR, for example, or take up valuable space in other network elements.

While provisioning at point-of-sale (POS) is another potential approach, we appreciate it requires a large investment in POS systems and infrastructure. Equally, if an CSP is or intends to support sales via non-specialised retailers, such as supermarkets and other outlets, then this approach probably becomes unviable – as the cost of putting POS systems into third-party retailers, and training their staff, becomes prohibitive.

We also note the availability of dynamic SIM allocation, or dynamic SIM provisioning, solutions offered by companies such as *Evolving Systems* and *Hewlett Packard Enterprise*. These solutions allow SIM card provisioning to be delayed until the subscriber first switches on his or her phone – at which time the subscriber is automatically allocated a number. MNOs with predominantly prepaid subscribers, such as MTN South Africa, have used these solutions to more effectively manage their prepaid number inventory and save costs incurred by stocking large volumes of pre-activated prepaid SIM cards. However, given the declining proportion of prepaid subscribers, such solutions may not be so attractive to MNOs in Ireland.

4.8.2 Estimated cost

The costs associated with the introduction of this measure will vary between CSPs, but should be relatively low if the actions proposed are adopted in a considered and efficient manner.

Proposed measure	Set-up costs	Ongoing costs	Comments
Improved inventory management	Low	Low	In accordance with measure described in Section 4.8.1

Figure 4.6: Estimated cost – improved inventory management [Source: Analysys Mason, 2015]

4.8.3 Potential impact

As highlighted above, if all CSPs could reach levels of efficiency similar to the most efficient large CSP then it is possible that a significant quantity of numbers could be freed up from the distribution chain and made available for reuse. This would not only facilitate better utilisation of the existing supply of mobile numbers, but it could also help to reduce costs by delivering efficiencies through the reduction of the number of SIMs in inventory.

The main cost impacts of maintaining high levels of SIMs in inventory are:

- *Higher fees payable to the network equipment vendor*. CSPs typically pay a licensing fee for each resource taken up in a network database by an IMSI. The main network database is the HLR but this licensing model can apply to other equipment such as the AuC platform.
- *Network database equipment approaching capacity*. In such instances, a CSP would have to purchase and operate additional network database platforms in order to support the total number of records pre-provisioned in the network for each SIM card (whether active or not).

Hewlett Packard (HP) indicates the average total cost of ownership (TCO) over time per SIM is USD6.00 when including shipping costs, HSS/OSS/BSS, capex and opex, numbering fees, and other expenses.[22] Whilst we acknowledge the costs attributable to HSS/OSS/BSS are a relatively small part of the overall TCO[23] and numbering fees do not currently apply in Ireland, by optimising their inventory management CSPs would:

- reduce the number of MSISDNs paired with inactive SIMs, thus controlling number consumption
- avoid unproductive HLR/HSS and BSS/OSS capacity costs, improve network resource use, and maximise network efficiencies.

4.8.4 Monitoring and governance requirements

Whilst ComReg would have no direct involvement in measuring the efficiency or effectiveness of CSPs' inventory management systems, ComReg would need to introduce an additional audit measure to ensure the quantities of mobile numbers held within the distribution chain ('in channel') are maintained at an efficient level at any given time.

4.9 Overall utilisation target

4.9.1 Discussion

ComReg could set an overall utilisation threshold.

Number utilisation in other jurisdictions

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

Figure 4.7: Mobile number utilisation thresholds applied in other jurisdictions [Source: Analysys Mason, 2015]

Jurisdiction	Utilisation threshold
Bulgaria	60%
Germany	50%
Italy	50%
Latvia	30%
Portugal	60%
Switzerland	50%
Russian Federation	75%

22 Optimize SIM costs, HP Dynamic SIM Provisioning Solution, Hewlett-Packard Development Company, 2015.

23 For instance, next-generation subscriber data management (SDM) platforms support a single logical subscriber database with multiple front-end applications such as HLR, EIR, AAA and MNP. They are often implemented on COTS hardware platforms with a lower price per subscriber.

Jurisdiction	Utilisation threshold
New Zealand	40%

► *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 numbers[24].

► *Germany*

In Germany, the Federal Network Agency (Bundesnetzagentur or BNetzA) has set a minimum utilisation threshold for numbers used for mobile services. In new requests, applicants must demonstrate the utilisation of all previously allocated blocks is greater than 50%[25].

► *Italy*

In Italy AGCOM may decline requests for additional numbers if existing allocations are less than 50% utilised[26]. This applies to both fixed and mobile numbers.

► *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% utilised[27].

► *Portugal*

In Portugal ANACOM has set a minimum utilisation threshold and may decline requests for additional numbers if existing allocations are less than 60% utilised[28]. This applies to all E.164 numbers.

► *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 numbers[29].

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

25 https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Nummerierung/Rufnummern/Mobile%20Dienste/NummernplanMobileDienste.pdf?__blob=publicationFile&v=8 (in German)

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

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

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

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

► *Russian Federation*

Russian legislation requires CSPs to maintain an utilisation level of 75%[30].

► *New Zealand*

The New Zealand Number Administration Deed (NAD)[31] Number Allocation Rules[32] sets out a 40% utilisation threshold for the allocation of additional non-geographic number blocks[33]. According to the rules, applicants may only request new blocks to meet growth in demand. Proven demand is considered to be when at least 40% of the capacity of already allocated code blocks is being utilised.

4.9.2 Possible measure

Based on the utilisation targets set in these other jurisdictions, ComReg could introduce a similar utilisation target in relation to the allocation of mobile numbers.

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 numbers through administrative allocation when the CSP's utilisation measure 2 is 45% or more.

Note: for the avoidance of doubt, the provision of initial allocations will not be affected by this recommendation.

The proposed threshold level takes in to account the benchmarks shown above and also the efficient quantities of numbers required in the various number lifecycle categories (free for assignment, in-channel, and quarantine).

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.

30 http://base.garant.ru/12136140/

31 The Number Administration Deed (NAD) is an industry-based mechanism for the centralised and independent administration of New Zealand's telecommunication numbering resources

32 Telecommunications Numbering Plan – Number Allocation Rules, New Zealand NAD, April 2014

33 Non-Geographic Service Code Blocks are allocated for use as a prefix to end-user numbers, without a geographic structure, which can originate or terminate calls over the PSTN. Services without a geographic structure include cellular, paging and similar services.

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

Figure 4.8: 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).

Had a "utilisation measure 2" target or threshold of 45% been in place, allocations totalling 13.8 million between 2005 and 2015 would have been refused.

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 requirements

ComReg would assess utilisation in a way similar to its new application process contained in Appendix 4 of ComReg 15/136 (Numbering Conditions of Use and Application Process).

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 and the capabilities of CSPs.

4.10 Mapping of 08X network access code to CSP

4.10.1 Measure

As highlighted in Section 3.6.1, historically the 08X network access code has been used as convenient shorthand by end users (e.g. prepaid customers requesting a "086 top-up" at retail outlets), it is already

the case that owing to MNP, customers' numbers do not now necessarily indicate the CSP providing service.

Although it currently has no impact on number exhaustion, in the long run this mapping will need to come to an end as once the respective market shares of the MNOs ceases to reflect the volume of number allocations available within each network access code range, then this approach could cause exhaustion.

Allowing all CSPs to use all mobile ranges also reflects practice in other countries including the UK. We therefore recommend that:

> ComReg should build on the changes already occurring (e.g. the Three/O2 merger and MNP) and should make it clear to all CSPs that it is already the case that all mobile blocks can be allocated to any mobile CSP and that as a result CSPs' systems should not assume that the existing de-facto mapping of CSPs to network access codes will continue.

4.10.2 Estimated cost

The administrative costs of moving away from the existing de-facto mapping would be minimal. There may be some costs to the CSPs in updating their call routeing, but we understand that some of these changes have already been made as a result of the Three/O2 merger.

Proposed measure	Set-up costs	Ongoing costs	Comments
Ending de-facto mapping of O8X network access code to CSP	Low	Very low	In accordance with measure described in Section 4.10.1

Figure 4.9: Estimated cost – ending mapping of 08X network access code [Source: Analysys Mason, 2015]

4.10.3 Potential impact

Ensuring that the historical mapping of a 08X network access code to a particular CSP eventually comes to a natural end will ensure the capacity already available can continue to be used effectively.

4.10.4 Monitoring and governance requirements

ComReg would monitor industry practice to ensure the gradual phasing out of the mapping of a 08X network access code to a particular CSP.

4.11 Charging for mobile numbers

4.11.1 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 a table in Annex B.

An earlier survey by the ITU[34] 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.

4.11.2 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.

4.11.3 Example charges when set on basis of encouraging efficient use

United Kingdom

As a result of a review of geographic telephone numbering in 2012[35] 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 the 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.

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

35 http://stakeholders.ofcom.org.uk/binaries/consultations/geo-numbers/statement/numbers-statement.pdf.

Denmark

The Danish Business Authority levies an annual charge on CSPs with number allocations from the Danish national numbering plan.[36] 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.[37] 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.

4.11.4 Options for charging structures

Options for charging structures for mobile numbers are considered in Annex B.

4.11.5 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

36 http://www.ictregulationtoolkit.org/Documents/Document/Document/1570.

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

- 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).

4.11.6 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:

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

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%.[38] 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.

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.

In comparison to the other proposed conservation measures discussed above 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 4.9.5

Figure 4.10: Estimated cost – charging for numbers [Source: Analysys Mason, 2015]

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

4.11.7 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 impact of the two possible options we have proposed (charging for all allocations, or charging CSP 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 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.

4.11.8 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 of 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
1	Recovery of existing unused blocks	Low	Nil	According to the audit data, this measure would result in the recovery of 1.6 million numbers
2	Use of numbers identified as free for assignment	Very low	Very low	Deters inefficient demand for new blocks in cases where CSPs have numbers available for assignment; demand could grow by up to 2.9 million subscribers before new number allocations would be needed
3	More effective management of quarantine process	Very low	Very low	Will return several million numbers to "free for assignment". Making this change will delay CSP requests for new numbers from ComReg, and in turn would effectively delay number exhaustion
4	Repatriation of numbers to original block holder	Low	Low	Based on the data provided to us by the MNOs, we estimate that between 700 000 and 1 million numbers fall into this category
5	Improved inventory management	Low	Low	It is possible that up to 2 million numbers could be made available for reuse
6	Introduction of overall utilisation target	Very low	Very low	Deters additional demand caused by inefficiency in use of numbers
7	Ending de-facto mapping of O8X network access code to CSP	Low	Very low	Ensures the capacity already available can continue to be used effectively
8	Charging for numbers	Medium	Medium	Estimated to be low if charges low or if in addition to measures above

Measure 1 – the recovery of unused blocks is relatively cost-free, and good number management policy (where CSPs hold numbers that are "free to assign"), and should be undertaken. However, recovery of unused blocks alone does not solve the problem as the quantity of numbers recovered is not large enough to significantly delay costly measures to increase number supply.

Measures 3, 4 and 5 are concerned with the efficient management of the processes currently in place to make sure that numbers flow through the number lifecycle effectively.

Measures 1, 3, 4 and 5 are mutually supportive; their effects are cumulative and they do not reduce each other's effectiveness. By comparison, the effects of Measure 2 and Measure 6 partially overlap:

- Measure 6 will cause CSPs to focus on the entire lifecycle, including reusing numbers currently "free for assignment" (which is the focus of Measure 2)
- by comparison, Measure 2 on its own will not make CSPs focus on other elements of the number lifecycle such as quarantine, because it focuses on reducing the quantity of numbers that are "free for assignment".

Accordingly, we prefer Measure 6 over Measure 2 as it will generate improvements throughout the number lifecycle.

Measures 1,3,4,5 and 6 all have low or very low initial costs and nil, low or very low ongoing costs.

Charging for numbers (measure 8) 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 demand for mobile numbers is not significantly growing, it remains the case that the allocation of mobile numbers is still increasing and running substantially above subscriber demand.

Major changes to mobile 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 hold 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

- more effective management of the quarantine process, returning numbers to "free for assignment" efficiently
- repatriation of ported-in numbers that have ceased/are no longer in use
- introduction of improved inventory/distribution management processes and systems
- introduction of an overall utilisation target.

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, for example if the CSPs were to fail to implement the agreed measures to ensure that numbers were used efficiently, ComReg may need to implement charging for numbers.

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

5.3 Recommendations

5.3.1 Recovery of unused blocks

Recommendation(s):

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

One free block may be retained if the CSP has fewer than 200 000 numbers that are "free for assignment".

5.3.2 More effective management of the quarantine process

Recommendation(s):

ComReg should require industry parties to monitor and report the level of numbers in quarantine.

ComReg should require industry parties to ensure that ex-quarantine numbers are returned to "free for assignment". A target for the maximum level of numbers held in quarantine should be 16/12 of the annual churn rate × the current number of active subscribers.

5.3.3 Repatriation of numbers to original block holder

Recommendation(s):

In the interests of efficient number management, the number repatriation process described in the Mobile Number Portability Process Manual should be put into action.

We further recommend that MNPC members agree whether the process is implemented on a periodic as-needed basis, or is fully automated as part of the existing MNP process arrangements.

5.3.4 Introduction of improved inventory/distribution management processes and systems

Recommendation(s):

ComReg should encourage all CSPs to optimise their inventory management systems and processes and effectively manage the quantities of mobile numbers held within the distribution chain ('in channel') at an efficient level at any given time. One possible means to achieve this would be a 'use by' date on SIM packaging; another mechanism would be to recover numbers assigned to SIMs that had not been activated after a certain time period from manufacture (e.g. four years).

ComReg should also encourage all CSPs to undertake a one-off search/reconciliation process to recover and recycle MSISDNs which have in the past been allocated to SIM cards, but which have never been and will not be activated.

5.3.5 Introduction of mandatory mobile number utilisation target

Recommendation(s):

ComReg should only make available additional numbers through administrative allocation when the CSP's utilisation measure 2 is 45% or more.

Note: for the avoidance of doubt, the provision of initial allocations will not be affected by this recommendation.

5.3.6 Ending de-facto mapping of O8X network access code to CSP

Recommendation(s):

ComReg should make it clear to all CSPs that it is already the case that all mobile blocks can be allocated to any mobile CSP and that as a result CSPs' systems should not assume that the existing de-facto mapping of CSPs to network access codes will continue.

5.3.7 Monitoring, audit 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
- 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):

ComReg should undertake annual monitoring of mobile numbers.

We suggest the required data to be gathered includes for each CSP: numbers allocated to CSP by ComReg; number of empty blocks; numbers assigned to subscribers; numbers in-channel; numbers ported out; numbers ported in; numbers reserved for test purposes; numbers in quarantine; numbers free for assignment; utilisation and numbers ported in awaiting repatriation.

Annex A Confidential information

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

Annex B Discussion of possible approach to charging for mobile numbers

B.1 General

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

B.1.1 Current practices

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

Figure B.1: Summary of information provided by the national regulatory authorities (NRAs) in CEPT countries on charging for mobile numbers [Source: Ofcom, 2011[39]]

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	2002	10K		20.8p
Estonia	2004	Any size, including single numbers		27.3p
Finland[40]	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	2003	1K		5.7p
Ireland	No charge	–	–	–

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

40 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
Italy	1998	10K		1.0p
Latvia	No charge	–	–	–
Lithuania	2003	Any size, including single numbers	per allocation (any size) £37	6.2p
Luxembourg	1999	1K, 10K	8.8p per number (7)(8)	8.8p
F.Y.R. of Macedonia	not provided	1K, 10K, 100K		9.2p
Malta	not provided	10K		2.2p
Netherlands	1997	1K	per block, £15.8, minimum £158	0.4p
Norway	introduced 1996-1998	1K		0.5p
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	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 2012[41] 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.

41 http://stakeholders.ofcom.org.uk/binaries/consultations/geo-numbers/statement/numbers-statement.pdf.

Ofcom[42] stated that:

> "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.[43] 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.[44] 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

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

43 http://www.ictregulationtoolkit.org/Documents/Document/Document/1570.

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

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.

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.[45]

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:

[45] 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.

- *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. 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 subscribers 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 List of abbreviations used in this report

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

Abbreviation	Full term
AAA	Authentication, authorisation, and accounting
ACMA	Australian Communications and Media Authority
ANC	Annual Number Charge (Australia)
AuC	Authentication Centre
AUD	Australian Dollar
BSS	Business Support System
CEPT	European Conference of Postal and Telecommunications Administrations
COTS	Commercial off-the-shelf
CP	Communication provider
CSP	Communication service provider
DKK	Danish Krone
EIR	Equipment Identity Register
EUR	Euro
FMNP	Full Mobile Number Portability
GBP	British Pound
GSM	Global System for Mobile Communications
HLR	Home Location Register
HSS	Home Subscriber Server
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ITU	International Telecommunication Union
MBB	Mobile broadband
MNO	Mobile Network Operator
MNP	Mobile Number Portability
MNPC	Mobile Number Portability Committee
MSISDN	Mobile Station International Subscriber Directory Number
M2M	Machine to machine
MVNO	Mobile Virtual Network Operator
NPD	National Porting Database
NAP	Numbering Advisory Panel
NMS	Number management system
NRA	National Regulatory Authority
OSS	Operational Support Systems
POS	Point-of-sale
RO	Recipient Operator
SDM	Subscriber data management

Abbreviation	Full term
SIM	Subscriber Identity Module
TCO	Total cost of ownership
USO	Universal Service Obligation
UMTS	Universal Mobile Telecommunications System