



Commission for
Communications Regulation

The evolution of geographic numbering in Ireland

Consultants' report

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An Coimisiún um Rialáil Cumarsáide
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Report for ComReg

The evolution of geographic numbering in Ireland

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1 Executive summary

The Commission for Communications Regulation ('ComReg'), with its Numbering Advisory Panel (NAP), has a well established Numbering Development Framework (ODTR 01/58R). ComReg commissioned Analysys Mason and Antelope Consulting to consider the availability of geographic and other numbers in the light of trends in communications services. In this report we present our findings after our discussions with stakeholders.

Users still value having geographic information in telephone numbers. However, the supply of geographic numbers is dwindling. The concern of ComReg is how to maintain an adequate supply, preferably without requiring costly number changes.

We recommend that number conservation techniques should be introduced in centres of population where projections demonstrate that shortages of geographic numbers are likely to occur in the near future in the absence of conservation. The possibility of shortages should be reviewed regularly, especially as new services emerge. If shortages are likely to occur even when number conservation techniques are applied, the supply of numbers will need to be expanded; this can, and should, be done without changing any existing numbers unless the shortages are severe.

In Section 3 we examine the effects of emerging communications services and trends on the demand for numbers, with a particular emphasis on geographic and mobile numbering

We consider that emerging communications services are likely to result in only a low to moderate increase in the demand for new numbers, principally for the reasons outlined below.

- Many popular over-the-top (OTT) voice-over-IP (VoIP) services, such as Skype-to-Skype, do not rely on the use of numbers.
- Where users opt to make use of telephone numbers the greatest demand is likely to emerge from mobile VoIP (mVoIP). However, though usage is significant, our research indicates that around 90% of smartphone owners are not yet active users of mVoIP. Moreover, existing mobile numbers are tending to be the default identifiers for mobile OTT apps. This tendency looks likely to continue, given that users are unlikely to switch entirely from conventional services to OTT services.
- Where OTT services increase demand for geographic numbers and pose a risk to supply, the risk could be mitigated by maintaining the link between a number and an address in the geographical numbering area.

In Section 4 we discuss pressures on geographic numbers for

In Ireland the number of traditional fixed telephony connections has been falling, and the number of voice fixed broadband connections, which provide managed VoIP, has been rising. The rise in voice fixed broadband connections appears to be due to growth in the bundling of cable television

***Ireland in general
and Dublin in
particular***

with broadband, rather than demand for new services. It has not offset completely the fall in traditional fixed telephony connections.

Number shortages could occur in Dublin and some other locations that are major centres of population (such as Galway and Limerick). The ways of alleviating number shortages discussed in this report apply to these locations. However, some of their details are specific to Dublin, where number changes would be most costly.

***In Section 5 we
assess the supply
of, and demand for,
geographic
numbers***

At the current rate of allocation of geographic numbers to communications service providers (CSPs), the supply in Dublin and some other locations will be exhausted after some years (perhaps by 2020), even though the quantities of numbers required by customers might still be quite low.

Future demand for geographic numbers from customers is uncertain, but currently there is no sign of a vast upsurge. Indeed, the existing Dublin number range could supply enough numbers to satisfy foreseeable demand if numbers were conserved and extraterritorial requirements (due to people and organisations abroad having numbers in Ireland) were limited. Averages of two geographic numbers per household and two geographic numbers per employee would probably satisfy customer requirements.

***In Section 6 we
describe and
evaluate options for
providing
geographic
numbers that can
cover various levels
of number shortage***

The quantity of geographic numbers allocated to CSPs is still rising. New, as yet unknown, services might require yet more numbers. Hence the options for providing numbers need to cover various levels of number shortage. The preferred situation is that there is no shortage (so the supply is never exhausted), but this calls for the successful application of number conservation techniques. Failing that, there will ultimately be at least modest number shortages, which can be alleviated by continuing number conservation and using options that have fairly low costs. Alleviating severe number shortages in Dublin will entail the use of options that have very much higher costs. The options for providing numbers discussed in this report are:

1. continuing mainly with current practice
2. providing new numbers beginning with 3
3. providing new numbers beginning with 0 or 1
4. prefixing existing numbers
5. having a new range with some existing numbers
6. having a new range with all new numbers
7. using existing numbers with at most national tariffs
8. using new numbers with local tariffs.

The strategy provides for scenarios of no shortage, modest shortages and

severe shortages of Dublin numbers. We assume that Option 1 is adopted initially. If modest number shortages become likely despite the actions arising from Option 1, then Options 2 and 3 can supply seven-digit subscriber numbers. If severe number shortages become likely before Options 2 and 3 have supplied seven-digit subscriber numbers, then Options 2 and 3 can, instead, supply eight-digit subscriber numbers. If severe number shortages become likely in other circumstances, then Option 4 can be adopted. Options 5, 6, 7 and 8 seem unlikely to be very effective in alleviating number shortages, so they are absent from the strategy.

In Section 7 we describe and evaluate techniques for conserving geographic numbers that can avoid the expansion of number ranges

The costs and complications of introducing extra geographic numbers could be avoided by conserving the existing numbers. The techniques for conserving numbers discussed in this report are:

1. setting effective utilisation targets
2. reducing the sizes of blocks in allocations
3. charging for numbers
4. shortening the interval between assignments
5. retrieving unused numbers
6. pooling numbers
7. maintaining the linkage of numbers to locations
8. removing the distortions in demand due to tariffs.

Techniques 1, 5 and 6 are perhaps most likely to be effective, though Techniques 2 and 4 could supplement them usefully. Technique 3 could become important if other techniques prove ineffective; Techniques 7 and 8 could become important if new services are shown to boost demand greatly. Though the quantities of numbers made available by these techniques are modest, when accompanied by attitudes that favour conservation they could be enough to ensure that no extra geographic numbers would be needed for the foreseeable future.

2 Introduction

The Commission for Communications Regulation ('ComReg'), with its Numbering Advisory Panel (NAP), has a well-established Numbering Development Framework (ODTR 01/58R). ComReg commissioned Analysys Mason Ltd ('Analysys Mason') and Antelope Consulting International LLP ('Antelope Consulting') to consider the availability of geographic and other numbers in the light of trends in communications services. In this report we present our findings after our discussions with stakeholders.

Specifically, ComReg requested that we:

- evaluate the potential impact of emerging communications technologies and services on numbering, naming and addressing policy, with a particular emphasis on geographic numbering
- analyse the impact of trends in over-the-top (OTT) communications on the future growth or decline in the usage of geographic, mobile and non-geographic numbers
- draw conclusions on whether these and other trends (such as those towards fixed-mobile substitution and convergence) are here to stay
- develop a first-cut estimate of the economic impact of any key findings, particularly where they suggest that impending developments could lead to expensive number changes
- provide opinions on the alternative strategies for avoiding number changes (if appropriate) without stifling innovation
- draw attention to any other regulatory matters tangential to numbering that appear important and that should be addressed at some future point
- provide opinions on the appropriateness of restrictions on geographic number allocations to a particular quantity per line or channel and to specific minimum numbering areas (MNAs)
- provide opinions on the suitability of 'national' geographic numbers (available anywhere and tariffed as local numbers) for avoiding any future shortage of geographic numbers
- develop recommendations, including ones on possible policy developments.

In this report we therefore:

- examine the effects of emerging communications services and trends on the demand for numbers, with a particular emphasis on geographic and mobile numbering (in Section 3)
- discuss pressures on geographic numbers for Ireland in general and Dublin in particular (in Section 4)
- assess the supply of, and demand for, geographic numbers (in Section 5)
- describe and evaluate options for providing geographic numbers that can cover various levels of number shortage (in Section 6)
- describe and evaluate techniques for conserving geographic numbers that can avoid the expansion of number ranges (in Section 7)
- summarise our conclusions and recommendations (in Section 8).

3 Global trends

In this section we examine the effects of emerging communications services and trends on the demand for numbers, with a particular emphasis on geographic and mobile numbering.

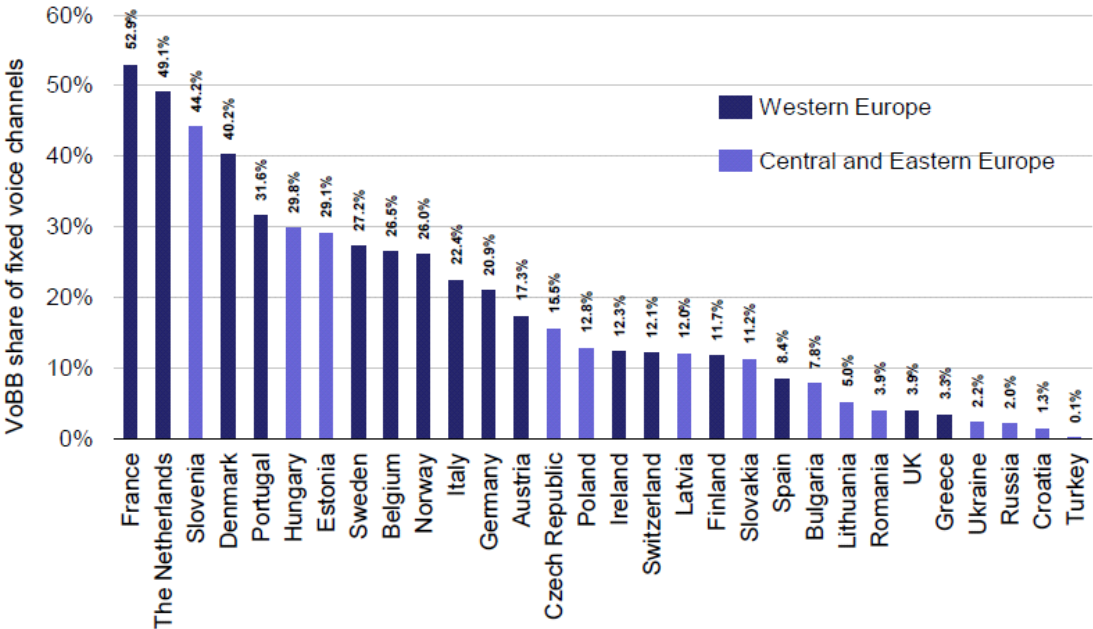
3.1 Introduction

Customers are increasingly moving from traditional fixed telephony to alternatives, including mobile telephony and services based on the Internet Protocol (IP).

IP technology is coming to all levels of telecoms networks. Circuit switched technology, used in fixed networks for a long time, is coming to the end of its life cycle and is being replaced in most networks.

VoIP¹ services can take many forms. There is an important distinction between OTT services offered via the Internet by the likes of Skype and Viber, and managed VoIP services provided over broadband networks operated by telephony providers and cable companies. This second category (often referred to as ‘voice over broadband’ or ‘VoBB’) is accounting for an increasing proportion of fixed voice channels across the whole of Europe (see Figure 3.1). Fixed voice is increasingly viewed as an adjunct to fixed broadband.

Figure 3.1: VoBB share of fixed voice channels, Europe, 1Q2012 [Source: Analysys Mason, 2012]



¹ Voice over Internet Protocol (VoIP) is a group of technologies for the delivery of voice communications over Internet Protocol (IP) networks.

Nevertheless, this rise does not necessarily introduce a demand for new geographic numbers, as the widespread introduction of number portability, by which a consumer can keep existing telephone numbers when moving to another service provider, ensures that those choosing to move between service providers can do without incurring the additional cost and inconvenience of number changes.

With respect to mobile telephony, increasingly users only have mobile telephones and more often than not these devices are smartphones. The effect of this is that some users are now tending to give up their traditional fixed telephone subscriptions; others keep the fixed line for broadband services only.

The popularity of social media is expected to continue to grow, with much of the electronic communications between users being via social media applications. It may actually reduce the use of telephone numbers in the very long term. On the other hand, it will need other types of addressing, e.g. IP addresses and SIP² addresses, in order to ensure smooth communications between different network technologies.

3.2 Over-the-top voice and message applications

OTT services can take many forms, but in telecoms, as opposed to broadcasting, voice and message applications are the most abundant.

Put simply, OTT VoIP refers to a voice service used over the IP network of a service provider that does not manage the voice service. To understand the concept better, consider the example of a user having a 3G data plan with a mobile service provider. This same user can use Skype, or any other OTT VoIP service, using the 3G network, provided that the data plan permits it. Skype here is the OTT service.

The use of OTT VoIP in a fixed telephony setting has been around for some time now. However, in an emerging second phase of VoIP innovation, accentuated through mobile apps on smartphones, many providers are now focusing largely or exclusively on mobile VoIP (mVoIP). This is illustrated in Figure 3.2.

² Session Initiation Protocol (SIP) is a signalling protocol, widely used for controlling multimedia communications sessions such as voice and video calls over IP networks

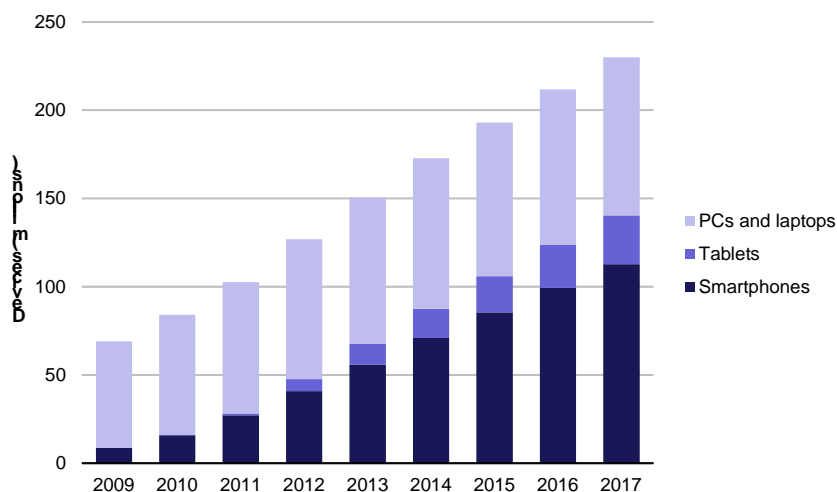


Figure 3.2: Usage of OTT VoIP applications by device in Western Europe, 2009–2017 [Source: Analysys Mason, 2013]

Skype has successfully built a user community in the personal computer environment and is extending its reach into smartphone platforms. Windows Messenger is the second-most popular platform. In November 2012, Microsoft announced that it would be merging this service with Skype, cementing its leading position in this market. Viber and Google Talk are the major alternatives, with Gadu-Gadu, a Polish instant messaging service, also prominent in our recent survey (albeit mostly in Poland), as shown in Figure 3.3.

VoIP service provider	Share
Skype	57%
Windows Messenger	13%
Google Talk	8%
Gadu-Gadu	8%
Viber	4%
iChat	2%
Other	8%

Figure 3.3: Share of installed base of VoIP services [Source: Analysys Mason Connected Consumer Survey³, 2013]

3.3 Mobile VoIP and other emerging mobile applications

Widespread adoption of smartphones is making a range of alternative communications services readily available to users. However, results from Analysys Mason’s *Connected Consumer Survey 2013*², which quantify usage of, and attitudes towards, VoIP services, suggest that the threat of substitution to alternative VoIP services, while important to monitor, is less of an immediate concern for mobile service providers than the threat of substitution to IP-based messaging services. According to its results, IP-based messaging services are already used by around 40% of smartphone users.

³ Analysys Mason’s *Connected Consumer Survey 2013* is a survey of more than 6000 consumers in five European markets (France, Germany, Poland Spain and the UK) and the USA. The survey was conducted in October and November 2012. The results from the survey do not necessarily represent worldwide experience: in 2010 Skype had 663 million registered users and Gadu-Gadu had between 10 million and 15 million.

Microsoft/Skype leads in the IP messaging market but its position is less dominant than in the VoIP market, particularly on the newer generation of devices. WhatsApp Messenger is the market leader among smartphone users and Facebook Messenger has a strong position across devices. Platform-specific services such as Apple’s iMessage and BlackBerry’s Messenger currently have low reported market shares.

Figure 3.4 shows that while mobile VoIP usage is significant, it has not yet been adopted by the mass market. In the *Connected Consumer Survey 2013*, service penetration was highest in Spain, with over 14% of smartphone users, and lowest in France, with less than 6%.

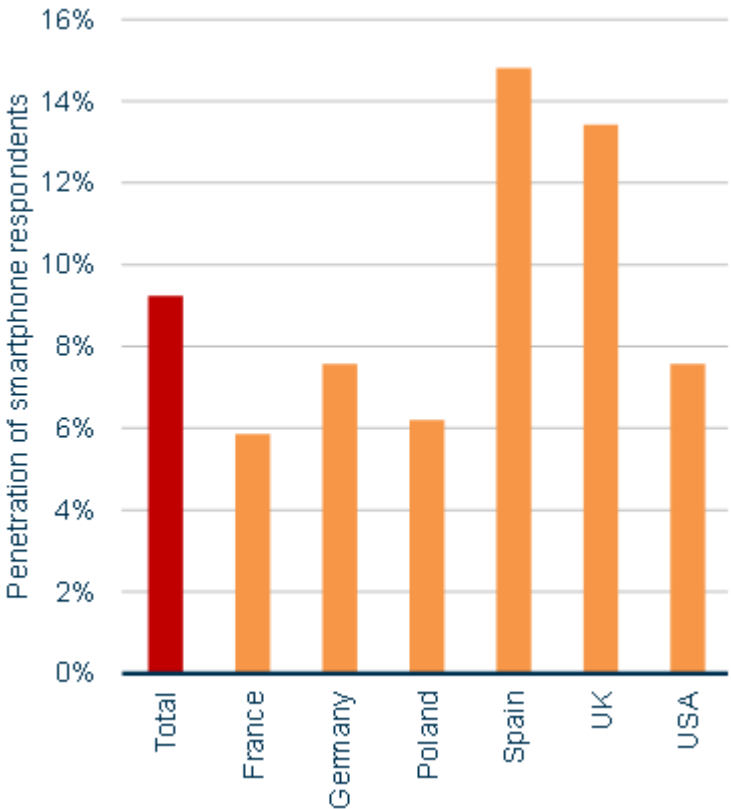


Figure 3.4: Penetration of VoIP applications on smartphones, by country [Source: Analysys Mason, 2013]

3.4 Numbers provided by OTT service providers

Before considering the demand for new numbers from OTT service providers, it is important to note that the vast majority of users of these services use ‘freemium’⁴ products for communications which do not rely on the use of telephone numbers, e.g. Skype to Skype.

⁴ Freemium is a business model by which a proprietary product or service (typically a digital offering such as software, media, or Web services) is provided free of charge, but money (premium) is charged for advanced features, functionality, or virtual goods.

Where OTT VoIP users opt to make use of phone numbers, the numbers provided by OTT service providers can be categorised as outlined below.

- A **virtual number** is a telephone number without a directly associated telephone line. Usually these numbers are programmed to forward incoming calls to a destination chosen by the client; whether fixed, mobile or VoIP. A virtual number can work like a gateway between traditional calls (PSTN) and VoIP.

Examples of virtual number services include *Skype Number*, *Norango Freedom* and *Goldfish*.

Virtual numbers perhaps represent the most traditional and best known way in which VoIP creates demand for geographic numbers. Individuals or organisations obtain virtual numbers in locations where they want callers to initiate calls; local callers to the numbers are then charged local rates. Such services are attractive because the virtual number includes geographic information in the form of a country and area code allowing businesses, for example, to appear to be based locally.

- A **customised access number** is a number that callers dial instead of dialling the long distance or international number which they wish to contact; it lets them make low cost international calls at calling rates determined by the company providing the customised access number. Thus calls to customised access numbers are made by the people to whom the numbers have been assigned, while calls to virtual numbers are received by the people to whom the numbers have been assigned.

Examples of customised access number services include *Skype To Go*, *JAJAH.Direct* and *Rebtel*.

Users could have different customised access numbers for all of their long distance or international contacts, so potentially could have customised access numbers for multiple entries in their address books, and this would create a large demand for numbers. However, callers in countries with liberalised telecoms environments can usually also make cheap calls in other ways, such as carrier selection, that do not cause any incremental demand for numbers.

- A **universal contact number** is a number allowing incoming calls to the number to ring simultaneously or sequentially any of the user's configured devices.

Examples of services in this category include Telefónica O2's *TuGo* and *Google Voice*.

Services offering universal contact numbers essentially provide redirection. For example, the TuGo service allows Telefónica O2 mobile users to make and receive calls on any Wi-Fi connected device using their mobile number, in effect turning any connected device into a voice client. It can also be used to redirect messages.

3.5 Number demand

There are several observations that we can draw from the preceding sections.

- The vast majority of users of OTT VoIP services use free or ‘freemium’ products which do not rely on the use of numbers.
- Where OTT VoIP users opt to make use of phone numbers the greatest demand is likely to emerge from mVoIP. However, various factors are important when contemplating the likely demand for numbers from these services:
 - Though mVoIP usage is significant, our research indicates that around 90% of smartphone owners are not yet active users of mVoIP.
 - The margins on data plans used for making voice calls tend to be lower than the margins on ‘voice and SMS only’ plans. Consequently mobile service providers try to discourage this use of data plans by bundling voice minutes (for conventional mobile voice calls) with data plans, increasing the prices of data plans, charging extra for the right to use mVoIP, or seeking to block mVoIP.
 - Feature innovation is not a major driver in the voice market and customers are reasonably content with the user experience of existing operator-provided voice services. Differentiation on features has been easier to achieve in the messaging market, where SMS is starting to look out of date.
 - VoIP user experience may also be important. A sizeable proportion of respondents in our *Connected Consumer* survey think that VoIP services are too difficult to set up. Others believe that the service is not reliable – common quality issues include high drop-out rates in a cellular environment and calls marred by poor noise cancellation.
 - Existing mobile numbers are tending to be the default identifiers for mobile OTT apps. This tendency looks likely to continue, given that users are unlikely to switch entirely from conventional services to OTT services. Telefónica O2’s TuGo relies on users’ existing numbers, as does the popular WhatsApp Messenger, the cross-platform mobile messaging app, which creates user accounts based on users’ existing numbers. The mobile number is also used as a communications service identifier in other services, such as Viber.
 - Some emerging services will need new numbers, but there are competing services with equivalent functionality that do not. For instance, the cases for virtual numbers and customised access numbers are partly based on cost savings but are weakened in many markets by falling prices and alternatives such as carrier selection.

When considering emerging technologies and services, it is possibly the demand for virtual numbers which has the largest potential impact, particularly in major centres of population where number supply is nearing exhaustion. While the extent of demand for virtual numbers is presently unclear, it could be argued that even a modest increase could become an issue, and that the area with the greatest attractiveness for extraterritorial virtual numbers is Dublin, where there is also a potential shortage of numbers. In such circumstances it may be necessary to compare the potential cost of number changes with the economic benefits arising from a more widespread adoption of virtual numbers. The risk of exhaustion due to virtual numbers can be mitigated by maintaining the link between a number and an address in the geographical numbering area.

In conclusion, we therefore consider that emerging communications services are likely to result in a low to moderate increase in the demand for new numbers as long as current numbering conventions continue to be applied, in effect preventing the extraterritorial assignment of virtual numbers.

The demand for numbers to support OTT services is discussed in further detail in Section 5.2 with reference to data specific to Ireland.

4 National considerations

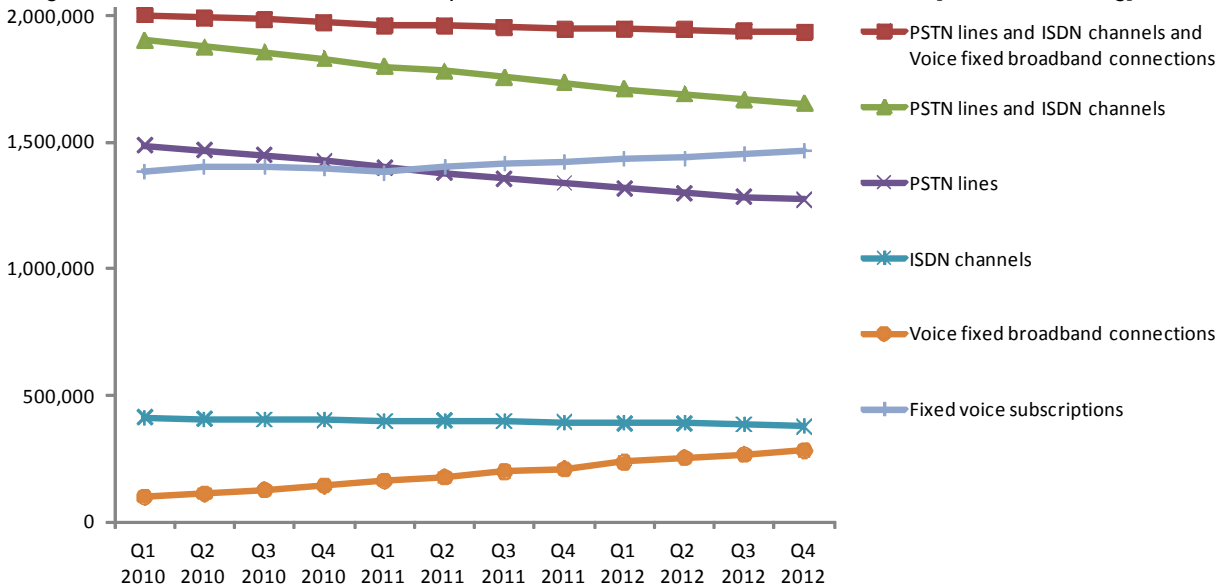
In this section we discuss pressures on geographic numbers for Ireland in general and Dublin in particular.

4.1 Recent developments

The figures collected for the Quarterly Key Data Report (ComReg 13/25) show that developments in Ireland are following consistent trends, as outlined below.

- Fixed voice subscriptions have been rising by 2.1% annually, with residential subscriptions rising by 0.9% annually and business subscriptions rising by 6.8% annually. The figures cover subscriptions that might (or might not) be in bundles and that might (or might not) provide VoIP. Bundles formed from some subset of fixed voice, fixed broadband, fixed television and mobile voice are becoming more popular.
- Fixed access links have been falling by 1.0% annually. The figures cover public switched telephone network (PSTN) lines, integrated services digital network (ISDN) channels and voice fixed broadband connections (which provide managed VoIP). The rise in voice fixed broadband connections is steep, but has not offset completely the falls in PSTN lines (4.7% annually) and ISDN channels (2.7% annually). The developments are illustrated in Figure 4.1.

Figure 4.1: Trends in fixed voice subscriptions and access links in Ireland, 2010-2012 [Source: ComReg]



The rise in voice fixed broadband connections is noteworthy. However, CSPs do not attribute it to demand for the services outlined in Section 3.4 (though they could be mistaken, as the services could be provided using OTT techniques, independently of the broadband providers); instead they attribute it to growth in the bundling of cable television with broadband. The effect of this bundling is especially marked in Dublin, as confirmed by the Consumer ICT Survey (ComReg 13/46) results about the main landline providers in Figure 4.2.

Figure 4.2: Proportions of main residential fixed access links supplied by CSPs in Dublin and Ireland, 2013
[Source: ComReg]

Location	Eircom	UPC	Vodafone	Others
Dublin	44%	42%	6%	8%
Ireland	56%	18%	16%	10%

4.2 The significance of Dublin for numbering purposes

Several factors influence demand for numbers. Among them are:

- international trends in communications services
- the intensity of competition among service providers
- the wish by business customers to establish their geographic presence.

These influences are likely to be felt most severely and rapidly in Dublin, as it is the capital.

When demand for numbers nearly exhausts supply, number ranges must be expanded and number changes might be needed. The costs of number changes fall heavily on the population of the location affected. The locations in Ireland that would be affected worst if their geographic numbers were changed are shown in Figure 4.3. Dublin outstrips the others, in terms of the numbers of households, inhabitants, enterprises and employees, so number changes in Dublin would be likely to be much more costly than number changes in the others.

Figure 4.3: Households, inhabitants, enterprises and employees in major centres of population, by city and county, 2011 [Source: Central Statistics Office]

City and county	Households	Inhabitants	Enterprises	Employees
Dublin	466 461	1 273 069	57 312	572 441
Cork	187 555	519 032	21 895	122 054
Galway	88 341	250 653	9 824	52 145
Limerick	69 421	191 809	7 156	39 152
Waterford	42 239	113 795	4 123	25 854

For these locations the cities and counties do not coincide with the areas covered by the corresponding geographic number ranges, so the figures are merely indicative of scale. A comparison more immediately relevant to numbering is in Section 5.1; it demonstrates that Dublin is one location where number changes could be needed, as well as where number changes would

be costly. Indeed ComReg has long been concerned about potential number shortages in Dublin, and has discussed it regularly with the NAP.

Accordingly detailed discussions of geographic numbers in this report focus on Dublin. However, much of the analysis and many of the conclusions apply throughout Ireland wherever there might be number shortages: the options for providing numbers (listed in Section 6.1) are tailored in their details to Dublin, but the principles underlying them, and the techniques for conserving numbers (listed in Section 7.1) are applicable widely.

4.3 The extent of Dublin for numbering purposes

Henceforth in this report ‘Dublin’ refers to the area covered by the 01 number range. It consists of:

- the whole of the county of Dublin, comprising Dublin City, Dún Laoghaire-Rathdown, South Dublin and Fingal
- some parts of the counties of Wicklow, Kildare and Meath, including Bray (in Wicklow), Greystones (in Wicklow) and Leixlip (in Kildare).

The numbers of households, inhabitants, enterprises and employees in these entities are displayed in Figure 4.4.

Figure 4.4: Households, inhabitants, enterprises and employees in counties wholly or partly included in Dublin, by entity, 2011 [Source: Central Statistics Office]

County	Entity	Households	Inhabitants	Enterprises	Employees
Dublin		466 461	1 273 069	57 312	572 441
	Dublin City	207 847	527 612		
	Dún Laoghaire-Rathdown	75 786	206 261		
	Fingal	92 951	273 991		
	South Dublin	89 877	265 205		
Wicklow		47 579	136 640	5 976	23 996
	Bray	9 687	26 326		
	Greystones	3 518	10 065		
Kildare		70 504	210 312	7 912	41 906
	Leixlip	5 103	15 458		
Meath		61 922	184 135	7 007	29 242

Overall in this report Dublin is regarded as consisting of 100% of the county of Dublin, 30% of the county of Wicklow, 20% of the county of Kildare and 10% of the county of Meath, in that these proportions are adopted to calculate the numbers of households, inhabitants, enterprises and employees. On that basis the statistics in Figure 4.5 show that the households, inhabitants, and enterprises in Dublin constitute about 30% of those in Ireland, while employees in Dublin constitute about 50% of those in Ireland. However, the statistics for numbers of employees need to be treated with caution, for the following reasons.

- In the business demography data of the Central Statistics Office, the location of an enterprise is taken to be the address where the enterprise is registered for tax purposes. If an enterprise has units in several locations, but all employees are registered for tax purposes through the headquarters, its employees are counted as being in the headquarters.⁵ Doing this overstates the number of employees in Dublin. In fact if in 2011 the number of employees in Dublin was the same proportion of the number of employees in Ireland as the number of enterprises in Dublin was of the number of employees in Ireland there would have been only 0.4 million such employees, not 0.6 million.
- Enterprises are organisations in the business economy as defined by the Central Statistics Office; thus they exclude organisations mainly concerned with public administration, education or health, for example. The quarterly national household survey of the Central Statistics Office provides statistics for all sectors but they relate to different geographic areas and notions of employment⁶. When adjusted for these differences, these statistics indicate that in 2011 there were about 0.6 million employees in Dublin (with about 0.4 million in the business economy) and about 1.9 million employees in Ireland (with about 1.3 million in the business economy).

Nonetheless, for the purpose of this report, the number of employees in Dublin can be taken to be about 0.6 million, and the business demography data and the quarterly national household survey can be used to refine estimates of the demand for numbers according to enterprise size, economic sector and occupational group.⁷

Figure 4.5: Households, inhabitants, enterprises and employees in Dublin and Ireland, 2011 [Source: Central Statistics Office]

Location	Households	Inhabitants	Enterprises	Employees
Dublin	501 028	1 374 537	65 057	602 860
Ireland	1 649 408	4 588 252	189 055	1 223 047

⁵ Also, in this report the 11 915 employees of the 3 669 enterprises with addresses outside Ireland are taken to be in Dublin.

⁶ They group together the counties of Kildare, Meath and Wicklow, and, though they provide numbers of employees, in this report employees are what the Central Statistics Office refers to as 'engaged persons', not 'employees'.

⁷ Only the business demography data can discriminate between enterprises according to size. Both the business demography data and the quarterly national household survey can discriminate between enterprises according to sector, but the business demography data can provide only a sector per enterprise, not a sector per employee.

5 Number supply and demand

In this section we assess the supply of, and demand for, geographic numbers.

5.1 Supply

In Figure 5.1 there is a comparison between major locations in Ireland according to the quantities of geographic numbers available and allocated.⁸ These all have subscriber numbers having six or seven digits.⁹

Figure 5.1: Quantities of geographic numbers available and allocated in major centres of population, by number range, 2012 [Source: ComReg]

Number range	Quantity of geographic numbers available	Quantity of geographic numbers allocated	Proportion of available geographic numbers allocated	Average [and maximum] annual rates of allocation since 2008	Years until exhaustion extrapolated from average [and maximum] annual rates of allocation since 2008
Dublin	6 811 000	5 600 000	82%	1.4% [2.3%]	12 years [7 years]
Cork	6 900 000	830 000	12%	0.3% [0.4%]	319 years [232 years]
Galway	690 000	460 000	67%	2.2% [3.3%]	15 years [9 years]
Limerick	690 000	583 000	84%	1.8% [2.0%]	8 years [7 years]
Waterford	690 000	362 000	52%	1.9% [3.2%]	25 years [14 years]

According to the numbering database, at the end of 2012, in the Dublin number range (01) 5.6 million numbers (82% of those available) had been allocated.¹⁰ Extrapolating linearly from the average (alternatively, maximum) annual demand since 2008 suggests that the range would be exhausted after 12 (alternatively, 7) years.¹¹ The Galway and Limerick number ranges (091 and 061) are also likely to be exhausted after some years. The options for providing numbers (listed in

⁸ In this report the 'numbers available for allocation' in a range are all the numbers in the range (including those that have been allocated to CSPs already) except those that are reserved by ComReg. In general numbers are reserved (and therefore not available for allocation) at least to prevent conflict with national numbers (thereby ruling out subscriber numbers beginning with 0), to prevent conflict with freephone, shared cost, premium rate, Internet dial and other codes (thereby ruling out subscriber numbers beginning with 1), to allow for expansion (thereby ruling out subscriber numbers beginning with another initial digit when subscriber numbers have six or seven digits), and to prevent accidental dialling of 999 (thereby ruling out subscriber numbers beginning with 99). In Dublin further numbers are reserved because of possible confusion about using 0 with short access codes. In Galway further numbers are reserved for unclear reasons; they are treated here as being available for allocation.

⁹ The subscriber number is the part of a telephone number after the country code (which is 353 for Ireland) and national destination code (which is 21 for the 021 number range, for example).

¹⁰ In Dublin 79 000 numbers in the 01520-01590 subranges are reserved to prevent confusion with premium rate numbers, and 10 000 numbers in the 01800 subrange are reserved to prevent confusion with freephone numbers. Consequently 6 811 000 numbers have been, or could be, allocated. Not all the desirable reservations are feasible; for instance, numbers in subranges that might be confused with shared cost numbers have already been allocated.

¹¹ Extrapolating by compound interest would shorten the projected time until exhaustion. The periods are rounded down to integral numbers of years. Extrapolating linearly from the average (alternatively, maximum) annual demand since 2002 suggests that the range would be exhausted after 14 (alternatively, 6) years

Section 6.1) and the techniques for conserving numbers (listed in Section 7.1) are likely to be relevant in these locations, too. By contrast, the Cork number range underwent a two stage expansion between 1998 and 2000 and is unlikely to need a further expansion.

In Figure 5.2 the quantities show that there is also pressure on number ranges for locations near Dublin that can house commuters and have five-digit subscriber numbers (0404 and 0402).¹² The options for providing numbers discussed in this report are perhaps less relevant to these than to the major centres of population, as lengthening these numbers would cause no problems for support systems and would enhance the uniformity of dialling patterns.

Figure 5.2: Quantities of geographic numbers available and allocated in locations near Dublin, by number range, 2012 [Source: ComReg]

Number range	Quantity of geographic numbers available	Quantity of geographic numbers allocated	Proportion of available geographic numbers allocated	Average [and maximum] annual rates of allocation since 2008	Years until exhaustion extrapolated from average [and maximum] annual rates of allocation since 2008
Drogheda	6 900 000	231 000	3%	0.1% [0.1%]	1333 years [831 years]
Enfield	6 900 000	234 000	3%	0.2% [0.3%]	397 years [276 years]
Kildare	690 000	460 000	56%	1.4% [2.0%]	32 years [21 years]
Wicklow	77 000	52 000	68%	2.5% [4.0%]	12 years [8 years]
Arklow	77 000	47 700	62%	2.4% [5.3%]	15 years [7 years]

The IP-based number range (076) could be seen as an alternative to geographic number ranges. Also, other number ranges, such as 031, could be pressed into service. Such possibilities are among the options for providing numbers listed in Section 6.1.

5.2 Future demand

The Central Statistics Office forecasted that by 2026 Dublin would have between 0.6 million and 0.9 million households and between 1.2 million and 1.8 million inhabitants.¹³ Since 2002 in Dublin the number of households has grown at an average annual rate of 2.7%, while the number of inhabitants has grown at an average annual rate of 1.7%. If Dublin numbers are allocated and assigned without constraint, then scaling the quantity already allocated by the maximum projected growth in the number of households suggests that by 2026 10 million Dublin numbers could be needed, while scaling it by the maximum projected growth in the number of inhabitants suggests that 7.6 million Dublin numbers could be needed.

¹² When subscriber numbers have only five digits no initial digit is reserved for expansion; instead pairs of initial and second digits are reserved.

¹³ The projections date from 2008 and produce ranges resulting from different assumptions about fertility and migration.

The quantity of Dublin numbers allocated has grown more slowly than the numbers of households and inhabitants. Even so, using the recent annual rates of allocation of Dublin numbers used in Section 5.1 gives similar results: extrapolating linearly from the average (alternatively, maximum) annual demand since 2008 suggests that 6.4 million (alternatively, 6.8 million) Dublin numbers would be allocated by 2020, and 7.0 million (alternatively, 7.7 million) Dublin numbers would be allocated by 2026.

The preceding estimates of demand start with the quantity of Dublin numbers allocated. An estimate that starts with the numbers of households and employees has very different implications: if there were two geographic numbers for every household and for every employee, 2.2 million Dublin numbers would be needed now and 4.0 million could be needed in 2026.¹⁴

This estimate, based on the numbers of households and employees, can be questioned in various ways. For residential customers, there is no evidence that it underestimates demand at the moment; indeed the number of residential fixed voice subscriptions in Ireland is only 69% of the number of households, and CSPs say that typically residential customers are assigned one geographic number per household. Demand for numbers for the OTT services highlighted in Section 3.4 is considered below.

- **Virtual numbers.** Geographic numbers are sometimes assigned as virtual numbers. The demand for virtual numbers is unclear, especially as secondary allocations are not currently analysed. In this report the demand is assumed to not to go beyond that of the assumption that there are at most two numbers per household. However, the demand could become much greater than this if, for example, many members of the diaspora started to want numbers in Ireland.¹⁵ On the other hand, in some respects the demand might fall: foreign businesses that hitherto would have wanted virtual numbers might now expect to make most sales online and might therefore prefer online interfaces (without telephone numbers) for customer enquiry calls. The social and economic motives for wanting virtual numbers, and the resulting demand, need to be monitored.
- **Customised access numbers.** Geographic numbers are sometimes assigned as customised access numbers. The identity of the caller to a customised access number is determined from the calling line identity (CLI) if the caller is using a registered telephone or confirmed by the use of a personal identification number (PIN) otherwise; consequently different customers might be able to make calls to the same customised access number and with different intended recipients. Also, there are sometimes limits on how many customised access numbers customers may have; for instance, Skype To Go lets customers have at most 30 customised

¹⁴ The number of employees is related to the numbers of households and inhabitants. In this report it is scaled for 2026 by the greater of the growth in the number of households and the growth in the number of inhabitants, so it rises from 0.6 million to somewhere between 0.7 million and 1.1 million.

¹⁵ On some unofficial estimates in 2000 there were 3.1 million citizens of Ireland living abroad, of whom 0.8 million (including 0.5 million in the UK) were born in Ireland. If new Dublin numbers were assigned as virtual numbers to all those citizens, 3.1 million more Dublin numbers (and an expansion of the Dublin number range) would be needed, but if the numbers were assigned to only those citizens born in Ireland and living in the UK, the demand would amount to no more than one number per household.

access numbers (and 20 registered telephones). Currently, therefore, the demand for customised access numbers is limited. If different customers were not able to make calls to the same customised access number then in principle vast quantities of customised access numbers (amounting to one number for every friend, relative or business contact of every customer) would be required.¹⁶ Though such quantities are not required now, usage needs to be watched; for instance, there might be a vogue for making gifts of them to favoured friends, relatives and business contacts.

- **Universal contact numbers.** Geographic numbers are not currently assigned as universal contact numbers. Calls and messages are sent to universal contact numbers in parallel with, in series with, or instead of, the numbers dialled. Universal contact numbers are used for reasons of convenience, so they are often existing numbers that customers would use for other purposes. They are helpful only to customers that change their locations from time to time; such customers are perhaps unlikely to want new geographic numbers as universal contact numbers, but they might want new nomadic numbers (in the IP-based range) if those offered financial advantages over mobile numbers.¹⁷

Two further possible sources of demand are as follows.

- **Second-line numbers.** Geographic numbers might sometimes be assigned as second-line numbers.¹⁸ CSPs do not believe that this is common, especially when current bundles encourage people to use mobile telephones if they want second lines. Usually the provision of second lines is not the main selling point of services or bundles. Such demand as there is for second-line numbers in their own right could fall, as household sizes are falling.
- **Single-user numbers.** Geographic numbers are not currently assigned as single-user numbers.¹⁹ CSPs have seen no demand for such geographic numbers and have suggested that one number per household, with interactive voice response (IVR), would be preferable. In any case, mobile numbers are already assigned as single-user numbers and, perhaps partly because of this, personal non-geographic numbers in the 0700 subrange have fallen out of favour.

¹⁶ Providing the same customised access numbers to different customers is the current practice. It precludes porting the numbers, but it does not raise a serious barrier to customers switching between providers of customised access numbers, as the numbers do not identify the customers and are not publicly known. The numbers identify the end points that the customers call in order to speak to their contacts, who might have no business relationships with the providers of the numbers and are certainly not the holders of the numbers. Arguably the customers, too, are not the holders of the numbers; instead, customised access numbers resemble carrier selection codes in that they are not assigned to the callers using them.

¹⁷ There could be customers who do not port their existing geographic numbers (or who do not have such numbers) and who are attracted to a service because it provides universal contact numbers. In this respect such a service can contribute to demand for new numbers (or to leakage of existing numbers), just as other services with attractive features can; however, the contribution is not an intrinsic characteristic of the service.

¹⁸ These let several people at the same address make calls at the same time.

¹⁹ These let several people at the same address have their own, individually differentiated, services. In various countries there have been arrangements that offered different users of one PSTN line distinctive ringing cadences and sometimes different numbers. They do not appear to have been popular. With voice fixed broadband connections they could be enhanced in some ways; for instance, they could provide PINs to protect the use of particular numbers for outgoing calls.

As an extreme case of demand from residential customers, in the future there might be a service offering geographic numbers as single-user numbers for all the members of a household. If such a service became popular, demand for it could be assessed by scaling according to the number of inhabitants plus the number of households (to provide one shared number per household), instead of twice the number of households; in total 3.1 million Dublin numbers would be needed now and 4.9 million might be needed in 2026 (covering both residential and business customers).²⁰ These estimates assume that customers would not change geographic numbers as frequently as they change prepaid mobile numbers (in which case there could be many numbers in quarantine); currently this assumption is plausible, as customers prefer to keep geographic numbers until they stop taking service, and to use only mobile telephones (and mobile numbers) for personal purposes.

Turning to business customers, the following are among the reasons for potentially high demand:

- a business with direct dialling in (DDI) might have more than twice as many employees (and potentially more than twice as many numbers) as ISDN channels
- a business might provide home numbers as well as office numbers for employees that work at home sometimes
- a call centre might have many numbers (though only one number per hunt group would be published or need to be treated as the destination for calls to a non-geographic number)
- a ticket booth or newspaper might give a different number to each classified advertisement, to identify which advertisement interested callers
- a business might put a different number in each business directory, to track which directory callers used
- a business might want contiguous blocks of numbers to accommodate potential growth
- a business might want numbers in particular ranges, to appear to have local presences or let its callers be charged local geographic tariffs.

This demand can be limited broadly. In particular, call centres, ticket booths, and newspapers form small proportions of businesses, businesses having 2 000 employees rarely grow to having 10 000 without changing their locations, and businesses in Dublin need only three sets of numbers each to appear in all the MNAs. Moreover, though some employees might need more than two geographic numbers each, those who are not office workers need fewer. The consequences of varying the quantity of geographic numbers per employee in different enterprises are discussed in Section 5.3.

Overall, as estimated above, the numbering plan should allow for the possibility that 4.9 million Dublin numbers could be in use for residential and business customers in 2026, before taking into account extraterritorial requirements (due to people and organisations abroad having numbers in Ireland).

²⁰ With the fall in household sizes there could be little difference between “two numbers per household” and “one number per inhabitant” by 2026.

5.3 Current utilisation

At the end of 2012, according to the Quarterly Key Data Report (ComReg 13/25), in Ireland there were less than 1.5 million fixed voice subscriptions (with less than 1.2 million residential customers and less than 0.3 million business customers).²¹ These required less than 2.0 million fixed access links, as indicated in Section 4.1. If recent provisions in the National Numbering Conventions (ComReg 11/17) had always been in force, there should have been no more than 4.0 million geographic numbers assigned in Ireland.²² There should then have been no more than 2.0 million geographic numbers assigned in Dublin.²³ With 5.6 million Dublin numbers allocated, the proportion of allocated numbers assigned would be 28%, though the Numbering Development Framework envisaged that it would be 70%.²⁴ In this section reasons for this disparity are explored, by refining separately the estimates for residential customers and for business customers.

In Ireland overall the number of residential fixed voice subscriptions is 69% of the number of households. The quantity of geographic numbers that could be in use by residential customers in Dublin is therefore unlikely to exceed the number of households and can be estimated to be at most 0.5 million.²⁵ Unused fixed access links can be ignored for the current purpose (though they are discussed in Section 7.6).²⁶

In Ireland overall the number of business fixed voice subscriptions is 128% of the number of enterprises. Enterprises requiring subscriptions for multiple purposes or at multiple sites have more than one subscription. The distribution of their sizes is not clear: some might be small enterprises (other than sole traders) that have not consolidated their accounts while others might be large enterprises that serve different parts of the country. The quantity of geographic numbers that could be in use by business customers in Dublin can nonetheless be obtained by considering how many enterprises there are of given sizes in Dublin, which is shown in Figure 5.3.²⁷

²¹ Though counterparts to these 2012 figures are available for the first quarter of 2013, the 2012 figures are used in this report to make base lines consistent.

²² According to the National Numbering Conventions "Geographic number allocations shall not exceed a maximum of two numbers per registered user (in the case of consumers) or per business line". In this context a registered user is the holder of an active voice subscription.

²³ About 30% of the households, inhabitants and enterprises are in Dublin, but they might have, say, 50% of the fixed access links in Ireland, because large businesses are concentrated in Dublin.

²⁴ In this report an 'allocation' is a primary allocation unless otherwise stated, and an 'assignment' is an allocation to a user (in the sense of the National Numbering Conventions) that is not for this use a CSP.

²⁵ This assumes that the households in Dublin might have 43% of the residential fixed voice subscriptions in Ireland.

²⁶ In the cabling practice of some countries, each house would have both a used PSTN line and an unused PSTN line laid to it from its exchange, and the unused line would have a number; this practice has not been followed in Dublin, but if it had been there could be as many as 1 million Dublin numbers associated with residential customers, though only half of them would be in use.

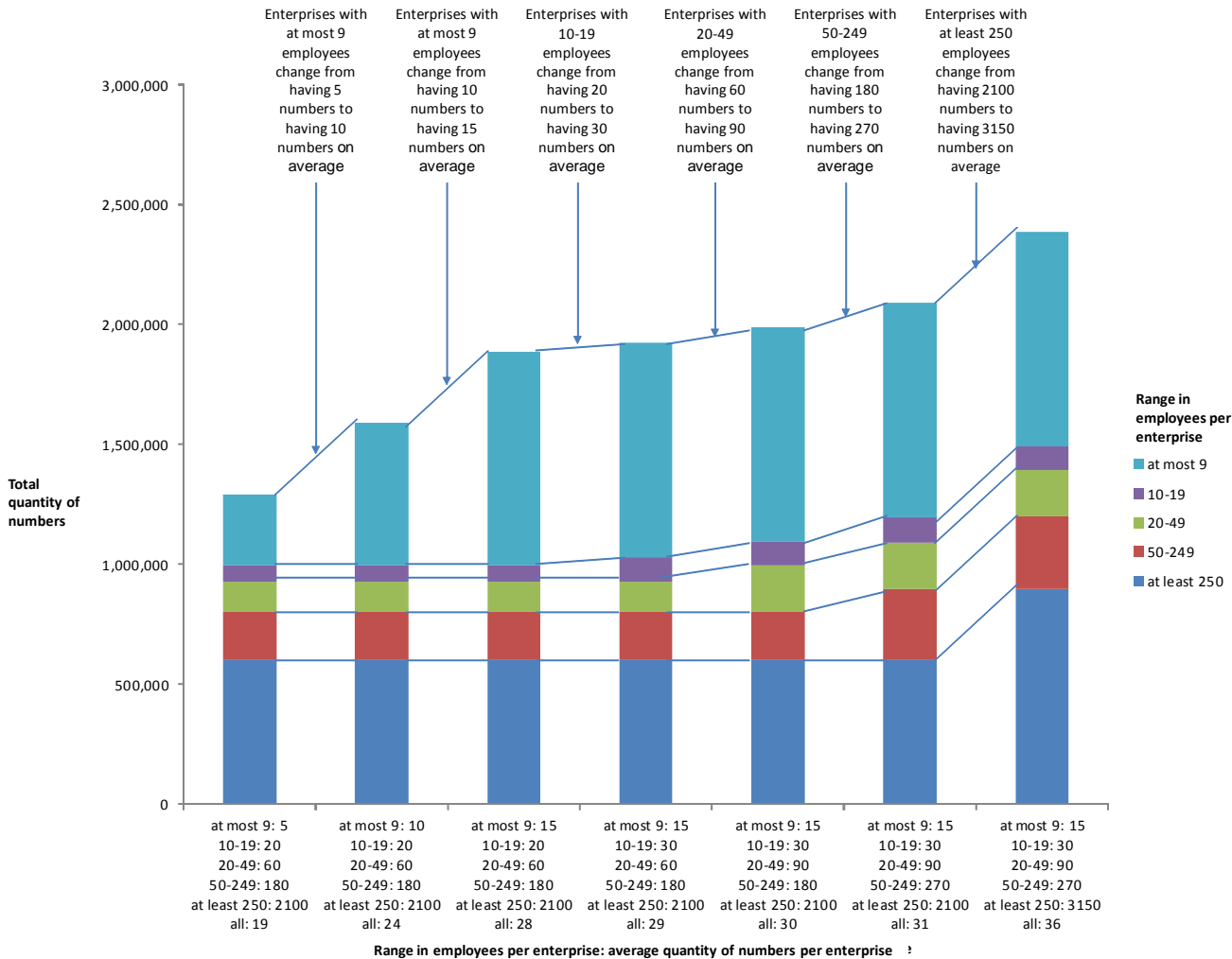
²⁷ A more detailed breakdown is possible for Ireland as a whole: in 2011, among the enterprises with at most 9 employees in Ireland, 52% were sole traders, 38% had 1-4 employees and 10% had 5-9 employees.

Figure 5.3: Enterprises and employees in Dublin, by enterprise size, 2011 [Source: Central Statistics Office]

Range in employees per enterprise	Enterprises	Employees	Average employees per enterprise
At most 9	58 320	101 450	1.7
10-19	3 360	45 393	13.5
20-49	2 061	62 014	30.1
50-249	1 135	114 598	101.0
At least 250	284	279 930	986.4
All	65 160	603 385	9.3

The effect of assigning different quantities of geographic numbers per enterprise in the given range is illustrated in Figure 5.4. This uses actual data for the numbers of enterprises of given sizes but hypothetical data for the average quantities of geographic numbers per enterprise: it shows the quantities of geographic numbers that would be assigned to enterprises in each range of enterprise size, if particular average quantities of geographic numbers were assigned to each enterprise.

Figure 5.4: Total quantities of geographic numbers in Dublin for different enterprise sizes and different hypothetical average quantities of geographic numbers per enterprise, 2011 [Source: Antelope Consulting]



The main implications of the illustration above are as follows.

- The major contributions to the total quantity of geographic numbers come from the very small enterprises, with at most 9 employees, and the very large enterprises, with at least 250 employees. The proportions of geographic numbers taken by the very small enterprises and the very large enterprises together lies between 69% and 79% for all the quantities shown.
- The maximum quantity of geographic numbers per enterprise has about 2.4 million geographic numbers assigned to business customers. This would still require only 43% of the allocated geographic numbers.
- The minimum quantity of geographic numbers per enterprise provides two geographic numbers per employee on average. This should satisfy many enterprises.²⁸

In brief, assigning 10 or 15 numbers to each very small enterprise, or assigning several thousand numbers to each very large enterprise, creates number shortages rapidly. Assigning two geographic numbers per employee should satisfy many enterprises and would not jeopardise the supply of numbers so much. Moreover, the further analyses below confirm that the figure of two geographic numbers per employee is likely to be much higher than is warranted in practical situations.

The business demography data used above counts employees of enterprises on the basis of enterprise size.²⁹ The quarterly national household survey counts employees of organisations (not just enterprises) on the basis of economic sector and occupational group.³⁰ The economic sectors and occupational groups can be arranged following several levels of hierarchy (coded using letters or digits). The resulting distinctions between employees can allow for the determination of average quantities of numbers per employee that are specialised for particular employees.

To determine the total quantities of geographic numbers appropriate to organisations, the distinctions between employees might be made most clearly by economic sectors (such as “construction” and “information and communication”) for small organisations and by occupational groups (such as “professional and administrative” and “elementary”) for large organisations. The total quantities of geographic numbers might then be the entries in two matrices: one would relate the quantities to organisation sizes and economic sectors and the other would relate them to organisation sizes and occupational groups. Without going this far, the analyses below illustrate how the quantities might relate to economic sectors and occupational groups in Dublin (which is taken to be the area covered by the 01 number range, as defined in Section 4.3).

²⁸ The minimum quantity of numbers for each range in the number of employees allows for some thick tail effects in the distribution: it is obtained by rounding up to a sensible level (usually an ISDN level) the sum of the lower bound on the range and two-and-a-half times the difference between the average number of employees for the range and the lower bound on the range.

²⁹ See [http://www.cso.ie/px/pxeirestat/database/eirestat/Business Demography/Business Demography_statbank.asp?sp=Business Demography](http://www.cso.ie/px/pxeirestat/database/eirestat/Business%20Demography/Business%20Demography_statbank.asp?sp=Business%20Demography).

³⁰ See [http://www.cso.ie/px/pxeirestat/database/eirestat/Quarterly National Household Survey Main Results/Quarterly National Household Survey Main Results_statbank.asp?sp=Quarterly National Household Survey Main Results](http://www.cso.ie/px/pxeirestat/database/eirestat/Quarterly%20National%20Household%20Survey%20Main%20Results/Quarterly%20National%20Household%20Survey%20Main%20Results_statbank.asp?sp=Quarterly%20National%20Household%20Survey%20Main%20Results).

In Figure 5.5 employees are placed in economic sectors defined according to the statistical nomenclature of economic activities in the European Community (NACE); descriptions of the economic sectors are accompanied by the corresponding NACE codes in brackets. With each employee is associated a hypothetical average quantity of geographic numbers that depends on the economic sector of the employee, so that the total quantity of geographic numbers can reflect differences between economic sectors.

Figure 5.5: Employees and hypothetical average quantities of geographic numbers per employee in Dublin, by economic sector, 2013 [Source: Central Statistics Office and Antelope Consulting]

Economic sector [with NACE code for corresponding top level of hierarchy]	Employees	Hypothetical average quantity of geographic numbers per employee	Total quantity of geographic numbers
Agriculture, forestry and fishing [code: A]	2 081	0.75	1 561
Industry [codes: B, C, D, E]	46 124	0.75	34 593
Construction [code: F]	23 923	0.75	17 942
Wholesale and retail trade, motor vehicle and motor cycle repair [code: G]	83 552	0.75	62 664
Transportation and storage [code: H]	35 059	0.75	26 294
Accommodation and food service [code: I]	39 923	1.50	59 885
Information and communication [code: J]	40 942	2.25	92 120
Financial, insurance and real estate [codes: K, L]	52 851	2.25	118 914
Professional, scientific and technical [code: M]	51 456	2.25	115 776
Administrative and support service [code: N]	21 228	1.50	31 842
Public administration and defence, compulsory social security [code: O]	32 770	1.50	49 155
Education [code: P]	45 026	0.75	33 769
Human health and social work [code: Q]	82 487	1.50	123 731
Other [codes: R, S, T, U]	37 634	1.50	56 451
Not stated	2 639	1.50	3 958
All	597 696	1.39	828 657

In Figure 5.6 employees are placed into occupational groups defined according to the UK standard occupational classification (SOC); descriptions of the occupational groups are accompanied by the corresponding SOC codes in brackets. With each employee is associated a hypothetical average quantity of geographic numbers that depends on the occupational group of the employee, so that the total quantity of geographic numbers can reflect differences between occupational groups.

Figure 5.6: Employees and hypothetical average quantities of geographic numbers per employee in Dublin, by occupational group, 2013 [Source: Central Statistics Office and Antelope Consulting]

Occupational group [with SOC code for corresponding top level of hierarchy]	Employees	Hypothetical average quantity of geographic numbers per employee	Total quantity of geographic numbers
Managers, directors and senior officials [code: 1]	55 651	1.75	97 389
Professional [code: 2]	139 819	1.75	244 683
Associate professional and technical [code: 3]	86 093	1.75	150 663
Administrative and secretarial [code: 4]	78 765	1.00	78 765
Skilled trade [code: 5]	50 505	1.00	50 505
Caring, leisure and other service [code: 6]	40 554	1.00	40 554
Sales and customer service [code: 7]	49 420	1.75	86 486
Process, plant and machine operatives [code: 8]	29 895	0.25	7 474
Elementary [code: 9]	64 757	0.25	16 189
Not stated	2 236	1.00	2 236
All	597 696	1.30	774 944

For the economic sectors and occupational groups alike, the hypothetical average quantities of geographic numbers per employee were invented for this report, as no available systematic survey could provide the actual average quantities. They were chosen to be higher than might generally be expected on intuitive grounds. Nonetheless, they result in overall averages (across all employees) that are well below two geographic numbers per employee.

Even with hypothetical average quantities, analyses like those above could help to determine the quantities of geographic numbers that should be assigned to organisations having particular sizes and mixes of employees.

6 Options for providing numbers

In this section we describe and evaluate options for providing geographic numbers that can cover various levels of number shortage.

6.1 Summary

The quantity of geographic numbers allocated to CSPs is still rising, though it already exceeds the number of subscribers greatly. Also, new, as yet unknown, services might require yet more numbers. The effects of these would be particularly pronounced in Dublin, for reasons outlined in Section 4.2. Indeed, the strategy in this report refers explicitly to Dublin, though it applies to all number ranges having similar subranges reserved for range expansion.

Hence the options for providing numbers need to cover various levels of number shortage. The preferred situation is that there is no shortage (so the supply is never exhausted), but this calls for the successful application of number conservation techniques such as those listed in Section 7.1. Failing that, there will ultimately be at least modest number shortages (requiring 2.6 million extra numbers, for example), which can be alleviated by continuing number conservation and using options that have fairly low costs. Alleviating severe number shortages (requiring 26 million extra numbers, for example) will entail the use of options that have very much higher costs.

In Sections 6.2-6.9 we draw conclusions and make recommendations about various options for providing numbers, as summarised below.

- **Option 1: using the existing Dublin number range with existing subscriber numbers.** This can supply enough Dublin numbers if the demand for them from CSPs does not continue to expand when customers need relatively few. It has the lowest cost among the options. However, unless numbers are conserved, the existing supply will ultimately be inadequate.
- **Option 2: using the existing Dublin number range with new subscriber numbers beginning with 3.** This uses the initial digit 3 of Dublin subscriber numbers, which is currently kept spare to allow for expansion of the number range. It does not require number changes: it simply makes most subscriber numbers beginning with 3 available for allocation, while keeping some spare to allow for future expansion (at least if the subscriber numbers that it supplies have seven digits). Its costs would be very low. It could be the first step in providing extra numbers if that became necessary. Alternatively, it could be the second step (after closing the numbering plan for Dublin) if it would make unnecessary any further expansion and the support systems could accommodate eight-digit subscriber numbers.
- **Option 3: using the existing Dublin number range with new subscriber numbers beginning with 0 or 1.** This entails closing the numbering plan for Dublin (so 01 is dialled at the start of Dublin numbers, even in Dublin). It requires no other changes, so it affects users

only if they make calls from fixed telephones in Dublin or publicise their Dublin contact details without including 01. The resulting costs should be quite low. Closing the numbering plan for Dublin is desirable, though not essential, for various other options; if this option were adopted before them it would alleviate some number shortages and might therefore make them superfluous. It would be particularly likely to ensure that more expensive, complicated and unpopular options were not needed if its adoption could be delayed until the support systems could accommodate eight-digit subscriber numbers.

- **Option 4: using the existing Dublin number range after prefixing existing subscriber numbers.** This expands the number range to offer many more numbers. It requires a change to some or all Dublin numbers, which, though systematic, would have very high costs for CSPs and customers. It would be appropriate only if projections showed that large extra quantities of numbers (20 per household and 20 per enterprise, for example) were needed.
- **Option 5: using a new Dublin number range with existing subscriber numbers.** This entails splitting the existing number range by placing roughly half the existing subscriber numbers in a new number range, probably according to their locations. It requires a change to the nationally dialled forms, but not the locally dialled forms, of numbers placed in the new range, and it would probably provoke objections from the people to whom those numbers were assigned. It might be accompanied by closing the numbering plan for Dublin, to avoid mistaken local dialling to numbers in the other range.
- **Option 6: using a new Dublin number range with new subscriber numbers.** This entails overlaying the existing number range with a new one containing new subscriber numbers. It does not require number changes, but it would provoke objections from the people to whom Dublin numbers were assigned thereafter, as those numbers would be drawn from the new range even if numbers for neighbours were not. It might be accompanied by closing the numbering plan for Dublin, to avoid mistaken local dialling to numbers in the other range.
- **Option 7: using an existing national number range with at most national geographic tariffs.** Promoting vigorously the use of the IP-based number range (076) might encourage some customers to take numbers in that range instead of the Dublin range. However, the evidence from use of the range so far does not inspire confidence. Given that the range exists already, the relief that it offers to number shortages is welcome but is likely to be fairly small.
- **Option 8: using a new national number range with local geographic tariffs.** Introducing a new number range (031 or 077) having local geographic tariffs might encourage some customers to take numbers in that range instead of the Dublin range. However, the new range would face many of the problems faced by the existing IP-based range and would not evidently be more successful. The effect on number shortages seems likely to be too small to provide much justification for introducing the new range.

The options are tabulated in Figure 6.1 (in which the lengths of new subscriber numbers appear in brackets alongside the options), with indicative costs to society as a whole.³¹ If customers need to change their contact details the costs can be very large; otherwise they can be moderate (and even small or very small provided that the CSPs do not need to make various system upgrades). The estimates suggest that the cost per number made available might be more than EUR 3, but some options are very much cheaper than others. The implications of the options (in brackets after the summaries of the options), together with the costs, determine the options chosen for the strategy.

³¹

The costs are categorised as: at most EUR 1 million ('very small'); between EUR 1 million and EUR 5 million ('small'); between EUR 5 million and EUR 25 million ('moderate'); between EUR 25 million and EUR 125 million ('large'); and at least EUR 125 million ('very large').

Figure 6.1: Options relevant to different number requirements [Source: Antelope Consulting]

Option [with subscriber number length]	Quantity of extra numbers made available	Cost	Summary [with implications]
1 [7 digits]	0	Very small	Continuing mainly with current practice [need for geographic number conservation]
1 [8 digits]	3.6 million	Moderate	Continuing mainly with current practice [mixture of number lengths, need for geographic number conservation]
2 [7 digits]	0.9 million	Very small	Providing new numbers beginning with 3 [need for geographic number conservation]
2 [8 digits]	9.0 million	Moderate	Providing new numbers beginning with 3 [mixture of number lengths, barrier to range expansion]
3 [7 digits]	1.7 million	Moderate	Providing new numbers beginning with 0 or 1 [need for geographic number conservation, loss of local dialling, possible misdialling of numbers and codes]
3 [8 digits]	17.0 million	Moderate	Providing new numbers beginning with 0 or 1 [loss of local dialling, possible misdialling of numbers and codes, mixture of number lengths]
4 [8 digits]	58.1 million	Very large	Prefixing existing numbers [apparent unfairness to new customers, changes to existing numbers]
5 [7 digits]	6.9 million	Very large	Having a new range with some existing numbers [need for geographic number conservation, apparent unfairness to some locations, puzzlement about the use of local dialling, changes to existing numbers, unbalanced distribution of allocated numbers]
6 [7 digits]	6.9 million	Moderate	Having a new range with all new numbers [need for geographic number conservation, apparent unfairness to new customers, puzzlement about the use of local dialling, number hoarding]
7 [7 digits]	0	Small	Using existing numbers with at most national tariffs [need for geographic number conservation, insufficient take-up to relieve number shortages, number hoarding]
8 [7 digits]	6.9 million	Moderate	Using new numbers with local geographic tariffs [need for geographic number conservation, puzzlement about the nature of regional dialling, insufficient take-up to relieve number shortages, number hoarding]

We assume that Option 1 with seven-digit subscriber numbers is adopted initially, but we make recommendations about actions related to Options 1, 2, 3 and 4 that should be taken alongside Option 1; these actions prepare for, and in some cases reduce the likelihood of, number shortages.

If modest number shortages become likely despite the actions arising from Option 1, then Options 2 and 3 can instead supply seven-digit subscriber numbers. If severe number shortages become likely before Options 2 and 3 have supplied seven-digit subscriber numbers, then Options 2 and 3 can supply eight-digit subscriber numbers. If severe number shortages become likely in other circumstances, then Option 4 can be adopted. These possibilities are subject to the following constraints:

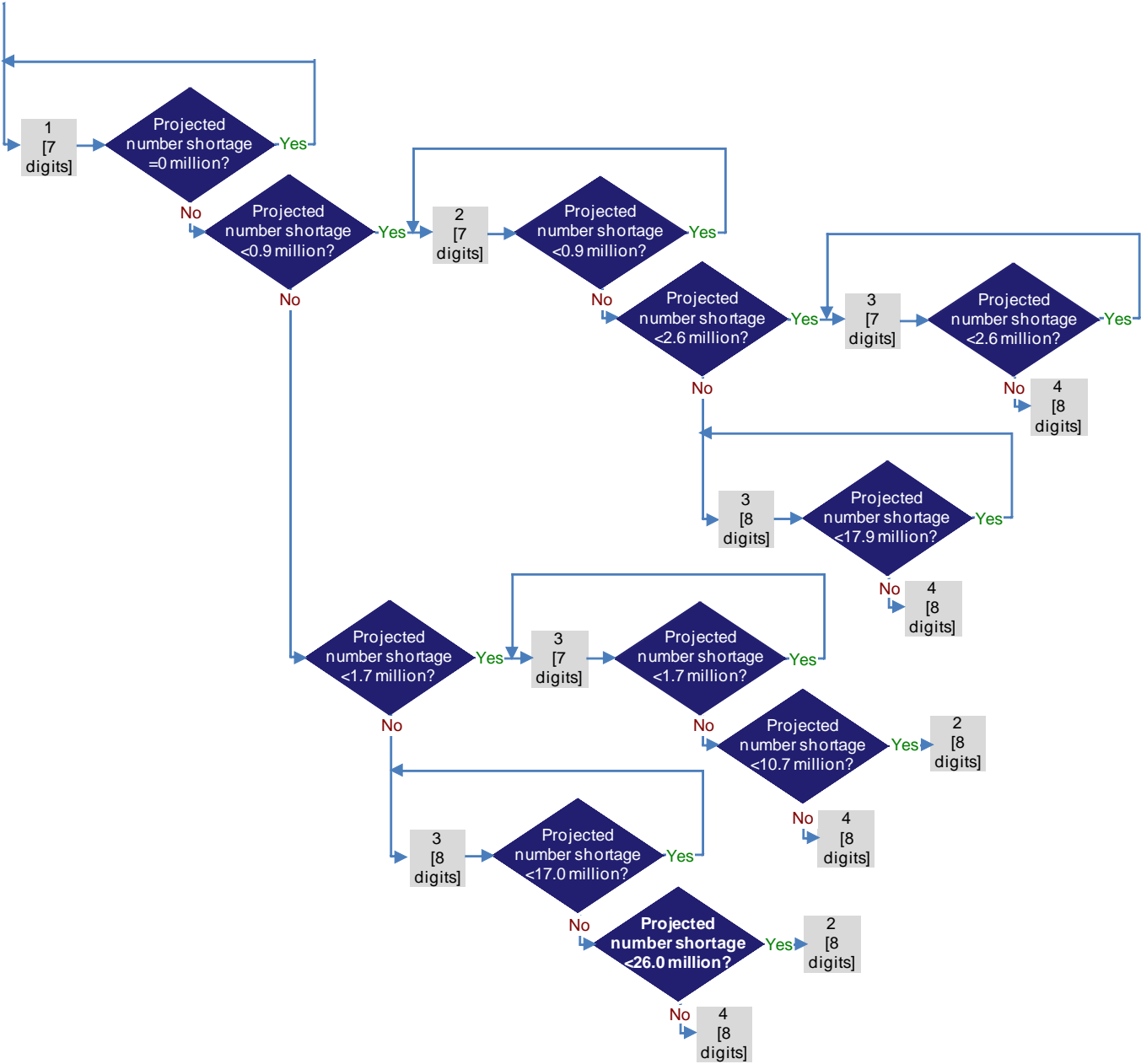
- an option with new seven-digit subscriber numbers would be less expensive, complicated and unpopular than the same option with new eight-digit subscriber numbers
- Option 2 with new seven-digit subscriber numbers would be less expensive, complicated and unpopular than Option 3 with new seven-digit subscriber numbers
- Option 3 with new eight-digit subscriber numbers would be less expensive, complicated and unpopular than Option 4 with new eight-digit subscriber numbers
- Option 2 with new eight-digit subscriber numbers is not followed by any other option (though in fact it could be followed by Option 3, to obtain some extra numbers, in some circumstances)
- Option 4 with new eight-digit subscriber numbers is not followed by any other option (though in fact it could be followed by Options 2 and 3, to obtain some extra numbers, in some circumstances).

There are various other possibilities that, on balance, seem less appealing than those here. Two are discussed briefly in Section 6.5.

Options 5, 6, 7 and 8 seem unlikely to be very effective in alleviating number shortages, so they are absent from the strategy.

The choice of options is made according to projections about number shortages that become firmer as the monitoring of allocations and trends proceeds in the way illustrated in Figure 6.2. In this, the ‘best’ option is chosen that will fit the projected demand, but, in the course of allocating the numbers made available by that option, the demand is monitored so that a further option can be chosen if the demand becomes likely to exceed the supply from the ‘best’ option.

Figure 6.2: Options chosen in the light of projected number shortages [Source: Antelope Consulting]



6.2 Option 1: using the existing Dublin number range with existing subscriber numbers

According to the figures given in Section 5.2, with care in the assignment of numbers for the reasons noted in Section 5.3, 4.9 million numbers would be enough for Dublin. The existing Dublin number range (01), with the current reservations and seven-digit subscriber numbers, can make 6.811 million numbers available. It could therefore supply enough numbers to satisfy foreseeable demand, provided that the numbers are used efficiently and extraterritorial requirements are limited.

Continuing to allocate numbers from the existing number range with seven-digit subscriber numbers has very low costs in the short term but not necessarily in the long term if shortages occur. Number conservation techniques such as those listed in Section 7.1 can reduce the risk of shortages, without themselves having high costs. However, they need to be applied rigorously if they are not to fail. In the short term, the option of allocating numbers from the existing number range, while implementing number conservation techniques rigorously, seems satisfactory.

Making new subscriber numbers have seven digits is preferable to making them have eight digits, but making them have eight digits is preferable to changing existing subscriber numbers. In particular, subscriber numbers beginning with 56, 57, 58 and 59 have not yet been allocated, so they might be kept back until the support systems could accommodate eight-digit subscriber numbers and they could be allocated with eight digits (when they would provide 4.0 million numbers instead of 0.4 million numbers, thereby making 3.6 million numbers available above the baseline of continuing entirely with current practice). This possibility can usefully be kept open until there is evidence that it would not provide large enough quantities of extra numbers.

There are variants of other options, too, that provide eight-digit subscriber numbers. They all might face problems because they mix subscriber numbers having different lengths in one range.³² For instance, they could result in misdialling or misconfiguration (in national or international networks) and unnecessary lengthening of the post-dialling delay. In the past developments involving differing geographic number lengths in Ireland have also encountered problems with billing, stop digit recognition and steering digit selection. However, making new subscriber numbers have eight digits (without changing existing subscriber numbers) would be less expensive, complicated and unpopular than changing all subscriber numbers to have eight digits, and should be preferred to doing that if it offers large enough quantities of extra numbers.

Options that provide eight-digit subscriber numbers might also require costly modifications to support systems. Possible ways of avoiding these modifications are outlined in Section 6.5. They suggest that there could be an advantage in not introducing eight-digit subscriber numbers before closing the numbering plan for Dublin.

³²

These problems might not be significant now. In the UK about fifty (out of about six hundred) geographic number ranges have mixtures of six digit and five digit subscriber numbers, and one even has a mixture of five digit and four digit subscriber numbers; these relate to towns having between 6 000 inhabitants (Selkirk) and 194 000 inhabitants (Dudley) but typically having between 30 000 inhabitants and 130 000 inhabitants. There are also in effect some mixed length national destination codes: some four digit national destination codes (with five digit subscriber numbers) are formed by attaching postfixes to three digit national destination codes (with six digit subscriber numbers). Moreover, freephone numbers in the UK follow 080 with either seven digits or eight digits.

Figure 6.3: Option 1: using the existing Dublin number range with existing subscriber numbers [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	0. 3.6 million	-. (01) 56xx xxxx, (01) 57xx xxxx, (01) 58xx xxxx, (01) 59xx xxxx, except reservations
Costs to service providers	Very small. Moderate	-. For the variant with eight-digit subscriber numbers: system upgrades
Costs to residential customers	Very small	
Costs to business customers	Very small	
Other objections by the public	Very small; Small	-. For the variant with eight-digit subscriber numbers: mixture of number lengths
Risks	Moderate	Need for geographic number conservation

We recommend that:

- ComReg should allocate numbers from existing geographic number ranges without expansion until projections demonstrate that shortages will occur
- ComReg should, at intervals of two years, review whether such shortages might occur within the following four years
- ComReg and the CSPs should introduce number conservation techniques, with the objective of ensuring that such shortages do not occur
- ComReg should allocate seven-digit Dublin subscriber numbers beginning with any of 56, 57, 58 and 59 only if projections demonstrate that otherwise the numbering plan for Dublin will need to be closed.

6.3 Option 2: using the existing Dublin number range with new subscriber numbers beginning with 3

Using the existing Dublin number range with new seven-digit subscriber numbers beginning with 3 would make 0.9 million extra numbers available.³³

CSPs might need to provide publicity to make users aware that subscriber numbers beginning with 3 could exist. There would be no other cost if no subscriber numbers were lengthened.

Making available all seven-digit subscriber numbers beginning with 3 would prevent the expansion of the number range that was originally envisaged and that is outlined in Section 6.5.³⁴ However, reserving those beginning with 33 should not do so: if, subsequently, all existing

³³ This assumes that the second digit 3 of subscriber numbers beginning with 3 is reserved to allow for expansion.

³⁴ The expansion would attach 3 as a prefix to all existing subscriber numbers, thereby making them into eight-digit subscriber numbers. During the changeover, to distinguish between seven-digit subscriber numbers and eight-digit subscriber numbers networks would need to route on entire numbers (not on initial digit sequences) and have long post-dialling delays. Also, there would be frequent misdialling and misconfiguration.

subscriber numbers were prefixed with 3 as outlined in Section 6.5, the network and support systems would analyse subscriber numbers to at least the second digit, and customers would notice merely that some subscriber numbers began with 33 (but not with 333).

A variant of this option with eight-digit subscriber numbers beginning with 3 would make 9 million extra numbers available. However, this would entail having different lengths of subscriber number in the same number range, which could have the problems mentioned in Section 6.2; in this respect it might be less problematic if it were adopted after closing the numbering plan for Dublin (when, also, it might incur no cost for making support systems accommodate eight-digit subscriber numbers, as outlined in Section 6.5). It would prevent the expansion of the number range discussed in Section 6.5 if subscriber numbers were not to have nine digits. Consequently, it should be adopted only if it offered large enough quantities of extra numbers.

Figure 6.4: Option 2: using the existing Dublin number range with new subscriber numbers beginning with 3 [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	0.9 million. 9 million	(01) 3xx xxxx, except reservations. (01) 3xxx xxxx, except reservations
Costs to service providers	Very small. Moderate	Publicity. For the variant with eight-digit subscriber numbers: system upgrades
Costs to residential customers	Very small	
Costs to business customers	Very small	
Other objections by the public	Very small. Small	-. For the variant with eight-digit subscriber numbers: mixture of number lengths
Risks	Moderate. Large	Need for geographic number conservation. For the variant with eight-digit subscriber numbers: barrier to range expansion

We recommend that:

- ComReg should allocate seven-digit subscriber numbers beginning with 3 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at most 0.9 million numbers will occur
- ComReg should allocate eight-digit subscriber numbers beginning with 3 from the existing Dublin number range only if the numbering plan for Dublin has been closed and projections demonstrate that otherwise shortages amounting to at most 9.0 million numbers will occur.

6.4 Option 3: using the existing Dublin number range with new subscriber numbers beginning with 0 or 1

Using the existing Dublin number range with new seven-digit subscriber numbers beginning with 0 or 1 would make 1.7 million extra numbers available.³⁵ It necessitates closing the numbering plan for Dublin (so 01 must always be dialled at the start of Dublin numbers), as otherwise there would be scope for conflict with national numbers in the case of 0 and with short access codes (which are freephone, shared cost, premium rate, Internet dial, operator service and other codes) in the case of 1.³⁶

After closing the numbering plan there would remain some possibility of misdialling, with 01 inserted or omitted wrongly. This possibility could be reduced by delaying for some years the allocation of those subscriber numbers that begin in the same ways as short access codes, which begin with 11, 13, 14, 15, 17, 18 or 19. If subscriber numbers beginning in these ways were allocated the order of allocation would be opposite to the frequency with which the short access codes were dialled.

Besides the short access codes there are geographic number portability and local unbundled metallic path (GLUMP) identifiers that look like subscriber numbers beginning with 12 or 16. Though there could be subscriber numbers that looked the same and that could be dialled, introducing them would be bad practice. Currently there are 97 000 such GLUMP identifiers, but this quantity exceeds the demand, many could be released for re-allocation as subscriber numbers. Nonetheless here the assumption is that subscriber numbers beginning with 11, 12 or 16 would be reserved indefinitely, just as subscriber numbers beginning with 99 are reserved currently.

Though in principle 01 would be required only before Dublin subscriber numbers beginning with 0 or 1, in practice it would be required before all Dublin subscriber numbers; then customers would not be confused and would not feel discriminated against if they were obliged to take subscriber numbers beginning with 0 or 1.

There would be uniformity in closing the numbering plan for the rest of Ireland at the same time as closing that for Dublin. All areas could be treated in the same way as Dublin, so local dialling would be eliminated everywhere. Eliminating local dialling everywhere would reduce occasional confusion among visitors to Dublin that habitually use fixed telephones with local dialling (instead of mobile telephones or fixed telephones with national dialling). However, it would also deprive people everywhere of a convenient and valued facility.³⁷ The numbering plan needs to be closed

³⁵ This assumes that 100 000 numbers in each of the 0111, 0112 and 0116 subranges are reserved to prevent confusion with important short access codes. It also assumes that numbers currently reserved do not become available for allocation, though the case for reserving the 0199 subrange is fairly weak when the dialling plan is closed. Overall, the choice of numbers to reserve is rather cautious. To a degree, the figure of 1.7 million (rather than 2.0 million, for example) is used in this report just to help with tracing the connections between the recommendations for this and other options.

³⁶ The national prefix, 0, would continue to be omitted when dialling from abroad, so closing the numbering plan would not make freephone, shared cost, premium rate, Internet dial and other codes accessible from abroad.

³⁷ Though the importance of local dialling is diminishing, it remains considerable in some locations. For instance, in the UK the majority of respondents to surveys (57% in 2010 and 76% in 2005) used local dialling. The surveys covered both rural and urban areas.

only for areas where there could otherwise be number shortages. Nonetheless, if there were many such areas, then closing the numbering plan for the whole of Ireland might on balance be helpful to users.

CSPs would need to provide publicity and announcements in Dublin about the need to use national dialling. Residential customers in Dublin might need to change the address books in fixed telephones; the address books in mobile telephones and many private branch exchanges (PBXs) would already contain full national numbers. Small business customers in Dublin would change their contact details unless they relied on public information and general knowledge of national dialling; other business customers would be very likely to include 01 in their contact details already. The costs seem moderate, but, on the basis of the figures cited in Section 6.5, they could rise by more than EUR 60 million if, say, all business customers in Dublin with at most 9 employees (other than sole traders) changed their contact details when they would not normally be replacing their stationery, signage and marketing materials. Suitable warning well before the numbering plan was closed, and continual reminders that full national numbers were needed by mobile callers, could avoid these costs almost entirely. As 1.7 million new numbers could be made available for allocation with this option, if the total cost were EUR 5.1 million, for example, the cost per number made available would be EUR 3.0.

A variant of this option with eight-digit subscriber numbers beginning with 0 or 1 would make 17 million extra numbers available. It could have the problems mentioned in Section 6.2 but might incur no cost for making support systems accommodate eight-digit subscriber numbers, if it let one digit of the subscriber number be regarded as part of the national destination code in the way outlined in Section 6.5.

Figure 6.5: Option 3: using the existing Dublin number range with new subscriber numbers beginning with 0 or 1 [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	1.7 million. 17 million	(01) 0xx xxxx, (01) 1xx xxxx, except reservations. (01) 0xxx xxxx, (01) 1xxx xxxx, except reservations
Costs to service providers	Moderate. Moderate	Publicity, announcements. For the variant with eight-digit subscriber numbers: system upgrades
Costs to residential customers	Small	Systematic and simple address book changes
Costs to business customers	Small	Systematic and simple contact details changes
Other objections by the public	Moderate. Moderate	Loss of local dialling. For the variant with eight-digit subscriber numbers: mixture of number lengths
Risks	Moderate. Moderate	Need for geographic number conservation; For the variant with eight-digit subscriber numbers: possible misdialling of numbers and codes

We recommend that:

- ComReg should allocate seven-digit subscriber numbers beginning with 0 or 1 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at most 1.7 million numbers will occur
- ComReg should allocate eight-digit subscriber numbers beginning with 0 or 1 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at least 1.7 million numbers will occur
- ComReg should seek to ensure that if locations face number shortages that could be alleviated by closing the numbering plans then the numbering plans for all such locations are closed at the same time
- the CSPs should point out regularly to their fixed service customers that national dialling is no more expensive than local dialling (to the same destination) and that including national numbers in contact details helps callers from mobile telephones or in other locations
- ComReg should ensure that blocks of GLUMP identifiers in geographic number ranges are de-allocated, and are not re-allocated, when they become unused.

6.5 Option 4: using the existing Dublin number range after prefixing existing subscriber numbers

Using the existing Dublin number range after attaching a prefix (3) to all existing seven-digit subscriber numbers would make 58.1 million extra numbers available.³⁸ Thereafter new subscriber numbers could begin with digits other than 0, 1, 3 and the initial digit reserved for expansion.

To reduce the inherent bias in favour of existing service providers, all new customers would be obliged to receive subscriber numbers beginning with digits other than 3. They could feel that they were discriminated against by not receiving numbers beginning with 3; the somewhat analogous scheme in the UK, using new London subscriber numbers beginning with 3 (alongside those beginning with 7 or 8), seems to be shunned by residential and business customers even now, eight years after its introduction.

CSPs would need to provide publicity and announcements throughout Ireland about the systematic but unfamiliar number change. More significantly, some of them might need to make system modifications to accommodate subscriber numbers having eight digits, and all of them would need to change the entries in their provisioning systems. Customers throughout Ireland and abroad would need to change their address books in PBXs and telephones. All business customers in Dublin would need to change their contact details.

³⁸ This assumes that the initial digits 0 and 1 of subscriber numbers are reserved to prevent conflict with national numbers and short access codes, that another initial digit of subscriber numbers is reserved to allow for expansion, that 1 million numbers in the 0199 subrange are reserved to prevent accidental dialling of 999, that 800 000 numbers in the 01520-01590 subranges are reserved to prevent confusion with premium rate numbers, and that 100 000 numbers in the 01800 subrange are reserved to prevent confusion with freephone numbers. It also assumes that numbers currently reserved do not become available for allocation when prefixed with 3, though there is longer the difficulty that reservation was designed to prevent; for instance, subscriber numbers beginning with 399 are unlikely to be accidentally dialled as 999.

A Europe Economics report on International Access to Irish Non-Geographic Numbers (ComReg 11/68a) suggested without detailed justification that the cost “to standard operators” of making system modifications to accommodate subscriber numbers having eight digits outside existing upgrade programmes was more than EUR 50 million; on the basis of this suggestion, even if only one CSP needed to make the modifications, the cost would not be trivial. One CSP reckons it to be EUR 10 million.³⁹ It could of course be avoided by making the modifications inside existing upgrade programmes. For Dublin numbers it might also be avoided if the eight-digit subscriber numbers were used only in conjunction with the national destination code: in effect the initial digit of a subscriber number would be regarded as part of the national destination code.⁴⁰ Whether existing support systems can accommodate eight-digit subscriber numbers used only in this way is uncertain; here the cost estimates do not assume that they can do so.

Though the options in this report are largely different from those in the Europe Economics report, some figures in that report are relevant and have evidential bases in earlier number changes in Ireland and the United Kingdom (UK). In particular, the cost to CSPs of a change to Dublin subscriber numbers is taken in that report to be more than EUR 50 million without adding the cost of accommodating longer numbers before a scheduled upgrade. This might be a high estimate, but, according to two CSPs, the minimum cost of even a small geographic number change is EUR 1 million to each of them. A change to all Dublin numbers is not small, and some portion of the cost would be proportional to the number of customers affected.

The cost to business customers of changing contact details (on stationery, signage and marketing materials) and address books is said in that report to be EUR 2 293 for a business with at most 9 employees, EUR 31 482 for a business with at least 250 employees, and EUR 7 699 otherwise (though these figures seem too high for sole traders, who constitute 46% of the enterprises); consequently if all business customers in Dublin changed their contact details without waiting until they would anyway be replacing their stationery, signage and marketing materials, the cost to them would be more than EUR 190 million. Other figures, for the cost to business customers of losing business and the cost to residential customers of changing address books, are necessarily even more speculative.

Overall, then, the cost of this option could be more than EUR 210 million, leading to a cost per number made available of EUR 3.6. The relevant consultation, development and testing might take three years, so projection of demand would need to look ahead for at least that length of time (or, more cautiously, four years).

The prefix might not be attached to all subscriber numbers. For instance, eight-digit subscriber numbers beginning with 36 might be allocated before 3 was attached to seven-digit subscriber numbers, with the effect that 0.9 million extra eight-digit subscribers numbers would be allocated

³⁹ There would also be risks, as with any system modifications, but the cost should cover enough testing to make the risks small.

⁴⁰ For instance, if Dublin subscriber numbers beginning with 3 had eight digits and there was no local dialling the number 3xxx xxxx would arise only in conjunction with 01, in which case it might be encoded in network and support systems as 013 xxx xxxx. Limitations in existing systems prevent the application of analogous stratagems to national destination codes longer than that for Dublin.

early instead of 9 million subsequently.⁴¹ Attaching the prefix to some, but not all subscriber numbers, would reduce the quantity of subscriber numbers affected, so it would reduce proportionately the cost to CSPs of changing the entries in provisioning systems and the cost to business customers of changing their contact details. However, some numbers would not be affected by the change, but others would be lengthened, so there would be two different lengths of subscriber number, with the potential problems mentioned in Section 6.2.

A different possibility exploits the fact that subscriber numbers do not currently begin with 0 or 1, so existing subscriber numbers could be lengthened by attaching the prefix 0 or 1 to them at the same time as closing the numbering plan for Dublin. However, doing this might confuse customers and would be unnecessarily expensive if the new subscriber numbers beginning with digits other than 0 and 1 were never needed.

Figure 6.6: Option 4: using the existing Dublin number range after prefixing existing subscriber numbers
[Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	58.1 million	(01) 4xxx xxxx, (01) 5xxx xxxx, (01) 6xxx xxxx, (01) 7xxx xxxx, (01) 8xxx xxxx, (01) 9xxx xxxx, for example, except reservations
Costs to service providers	Large	Provisioning, publicity, announcements, system upgrades
Costs to residential customers	Large	Systematic but unfamiliar address book changes
Costs to business customers	Very large	Systematic but unfamiliar address book changes, systematic but unfamiliar contact details changes
Other objections by the public	Large	Apparent unfairness to new customers, changes to existing numbers
Risks	Small	

We recommend that:

- ComReg should prefix subscriber numbers (and subsequently allocate new subscriber numbers not beginning with the prefix) only if the numbering plan for Dublin has been closed and projections demonstrate that otherwise shortages amounting to at least 9.0 million numbers will occur
- the CSPs should include in their upgrade programmes for network and support systems the removal of limitations on the lengths of subscriber numbers, in case geographic or other subscriber numbers are ultimately required to have more than seven digits
- ComReg should, at intervals of two years, review progress towards removing such limitations.

⁴¹ After eight digit subscriber numbers beginning with 36 are allocated, seven digit subscriber numbers beginning with 6 must not be lengthened with the prefix 3 and eight digit subscriber numbers beginning with 6 must not be allocated.

6.6 Option 5: using a new Dublin number range with existing subscriber numbers

Using a new Dublin number range (03) with existing seven-digit subscriber numbers would make 6.9 million extra numbers available.⁴² About half the existing subscriber numbers already allocated would be placed in the new range. This option might be understood more readily if the numbering plan for Dublin were closed already (as otherwise the simplest dialling sequence would depend on whether the caller had a number in the existing range or in the new range); in that case it would make 8.9 million extra numbers available (if the subscriber numbers beginning with 0 or 1 had seven digits).

As far as possible the placement of the existing numbers would follow the principles that locations in Dublin City would remain in the current range, that geographically contiguous locations would be in the same range, and that subscriber numbers with the same initial digit would be in the same range. The starting point, but probably not the ending point, for the split might be the assumption that subscriber numbers beginning with 4, 6, 7 and 8 would be in the 01 range (because of their high proportions of numbers in the Dublin Central MNA).

Much as discussed in Section 6.5, customers having subscriber numbers in the new range might feel that there was discrimination against them. Callers would be puzzled by needing sometimes to dial 03 instead of 01 to reach other Dublin numbers. Different locations in the 03 range would be in different MNAs, though some would be in the same MNA as locations in the 01 range. There could be considerable pressure to keep particular locations in the 01 range (just as there was in the UK, when London numbers were split between the 0171 and 0181 ranges), so balancing the allocated numbers between the two ranges could be difficult.

CSPs would need to provide publicity and announcements and ensure compatibility of billing between the 01 and 03 ranges. Customers throughout Ireland and abroad would need to change their address books in telephones and PBXs and might find the range difficult to grasp. Some business customers in Dublin would need to change their contact details and might lose business through using the unfamiliar numbers.⁴³ Overall this option seems unlikely to contribute much to a strategy for meeting the demand for geographic numbers.⁴⁴

An alternative to this option would move all the subscriber numbers to the new number range, which could be 012, so that other number ranges (013-019) could be created for Dublin, much as described in Section 6.7. It would make 47.4 million extra seven-digit subscriber numbers available. It would still require customers to change their contact details and their address books, but it could let them keep their habitual local dialling; in effect it would increase the cost and

⁴² This assumes that the initial digits 0 and 1 of subscriber numbers are reserved to prevent conflict with national numbers and short access codes, that an initial digit of subscriber numbers is reserved to allow for expansion, and that 100 000 numbers in the 0399 subrange are reserved to prevent accidental dialling of 999.

⁴³ Though losing business could be costly for an individual business customer, another business customer might gain the business. In that case the cost to society as a whole would be unaffected, unless it was weighted to take account of cognitive biases against loss.

⁴⁴ To make the option applicable in other locations, the new Dublin number range would be 031, not 03, and the new Limerick number range, for example, would be 0361. This would probably strengthen the feelings of discrimination.

inconvenience to customers other than those who made calls mainly to Dublin numbers from fixed telephones. Again it might be less problematic if the numbering plan for Dublin were closed already; in that case it would make 61.4 million extra numbers available (if the subscriber numbers beginning with 0 or 1 had seven digits).⁴⁵ Proportionately larger quantities of extra numbers would be made available if subscriber numbers had eight digits.

Figure 6.7: Option 5: using a new Dublin number range with existing subscriber numbers [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	6.9 million	(01) 2xx xxxx, (01) 5xx xxxx, (01) 9xx xxxx, (03) 4xx xxxx, (03) 6xx xxxx, (03) 7xx xxxx, (03) 8xx xxxx, for example, except reservations
Costs to service providers	Moderate	Provisioning, billing, publicity, announcements
Costs to residential customers	Large	Systematic but unfamiliar address book changes, learning the significance of the number range
Costs to business customers	Very large	Systematic but unfamiliar address book changes, systematic but unfamiliar contact details changes, loss of business on using the number range
Other objections by the public	Large	Apparent unfairness to some locations, puzzlement about the use of local dialling, changes to existing numbers
Risks	Moderate	Need for geographic number conservation, unbalanced distribution of allocated numbers

6.7 Option 6: using a new Dublin number range with new subscriber numbers

Using a new Dublin number range (03) with new seven-digit subscriber numbers would make 6.9 million extra numbers available.⁴⁶ New subscriber numbers would be allocated from the new range. This option might be understood more readily if the numbering plan for Dublin were closed already (as otherwise the simplest dialling sequence would depend on whether the caller had a number in the existing range or in the new range); in that case it would make 8.9 million extra numbers available (if the subscriber numbers beginning with 0 or 1 had seven digits).

Much as discussed in Section 6.5, customers having subscriber numbers in the new range might feel that there was discrimination against them. Callers would be puzzled by needing sometimes to dial 03 instead of 01 to reach other Dublin numbers. There would be an incentive to number hoarding that could accelerate the onset of number shortages, as business customers would want to ensure that they never needed to have unfamiliar new numbers.

⁴⁵ Quantities of numbers like these ignore the fact that if the national destination code becomes 012 and the numbering plan for Dublin is closed then various numbers can be allocated instead of being reserved to avoid difficulties.

⁴⁶ This assumes that the initial digits 0 and 1 of subscriber numbers are reserved to prevent conflict with national numbers and short access codes, an initial digit of subscriber numbers is reserved to allow for expansion, and 100 000 numbers in the 0399 subrange are reserved to prevent accidental dialling of 999.

CSPs would need to provide publicity and ensure compatibility of billing between the 01 and 03 ranges. Customers might find the range difficult to grasp. Some business customers in Dublin might lose business through using the unfamiliar numbers. Overall this option seems unlikely to contribute much to a strategy for meeting the demand for geographic numbers.⁴⁷

Figure 6.8: Option 6: using a new Dublin number range with new subscriber numbers [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	6.9 million	(03) xxx xxxx, except reservations
Costs to service providers	Small	Billing, publicity
Costs to residential customers	Small	Learning the significance of the number range
Costs to business customers	Moderate	Loss of business on using the number range
Other objections by the public	Large	Apparent unfairness to new customers, puzzlement about the use of local dialling
Risks	Moderate	Need for geographic number conservation, number hoarding

6.8 Option 7: using an existing national number range with at most national geographic tariffs

Using an existing national number range (076) with at most national geographic tariffs would make no extra numbers available. It would rely for its success in relieving number shortages partly on the appeal of nomadic use going beyond the “short term nomadic operation” permitted for geographic numbers by the National Numbering Conventions.

At the end of 2012, in the IP-based number range less than 0.7 million numbers (8% of those available) had been allocated.⁴⁸ Extrapolating linearly from the average (alternatively, maximum) annual demand since 2008 suggests that the range would be exhausted after 189 (alternatively, 73) years. Average annual allocations of Dublin numbers exceed those of IP-based numbers by 50%. Thus if many customers could be assigned IP-based numbers instead of Dublin numbers the supply of numbers would be ample.

This remedy has been tried before: voice over IP customers were originally offered IP-based numbers, but preferred to switch to Dublin numbers when those could be provided to them. CSPs suggest, as reasons for this preference, that IP-based numbers do not resemble familiar numbers, do not provide geographic information, are not necessarily in tariff bundles (though national calls to them have at most national geographic tariffs) and are not always accessible from abroad.

⁴⁷ To make the option applicable in other locations, the new Dublin number range would be 031, not 03, and the new Limerick number range, for example, would be 0361. This would probably strengthen the feelings of discrimination.

⁴⁸ This assumes that an initial digit of subscriber numbers is reserved to allow for expansion.

The position has changed slightly over the past two years, in that some government telephone numbers are now IP-based numbers (in the 0761 subrange); this could make IP-based numbers better known, create pressure from customers to include IP-based numbers in tariff bundles, and free some geographic numbers currently used by public servants.⁴⁹ However, until these benefits start to emerge, using IP-based numbers is unlikely to relieve geographic number shortages greatly.

The position might also change if the supply of geographic numbers (in some location) were exhausted, so that customers would have no choice but to use non-geographic numbers. Then the numbers would at least need to be included in tariff bundles (with local geographic tariffs for at least that location) and made accessible from abroad. As mentioned in Section 6.7, customers might feel that there was discrimination against them if they were obliged to have these numbers and might hoard geographic numbers to avoid this.

There are services for which non-geographic numbers would be adequate if customers were confident that the numbers were included in tariff bundles with local geographic tariffs; for instance, customised access numbers (and perhaps some virtual numbers) could reasonably be non-geographic numbers. Creating the necessary customer confidence would take time and effort which might not be justified unless it saved many geographic numbers. ComReg might itself be inhibited from promoting the use of IP-based numbers instead of geographic numbers, as it could appear to be favouring nomadic services over fixed ones.⁵⁰

CSPs would need to provide publicity. Customers might find the range difficult to grasp. Some business customers would fear losing business through using the unfamiliar numbers. Overall this option seems unlikely to contribute much to a strategy for meeting the demand for geographic numbers.

Figure 6.9: Option 7: using an existing national number range with at most national geographic tariffs [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	0	
Costs to service providers	Small	Publicity
Costs to residential customers	Small	Learning the significance of the number range
Costs to business customers	Small	Loss of business on using the number range
Other objections by the public	Small	
Risks	Large	Need for geographic number conservation, insufficient take-up to relieve number shortages, number hoarding

⁴⁹ Web sites giving 0761 numbers do not always provide full, or even any, explanations of the numbers and tariffs. An example, from http://www.citizensinformation.ie/en/contact_us.html, is "The new 0761 prefix for Citizens Information and MABS telephone numbers is part of a Government initiative to reduce call costs for both public bodies and customers. Call costs to 0761 numbers vary – your telephone service provider should be able to give you further details on the costs that apply for your telephone package."

⁵⁰ It could even appear to be favouring national geographic tariffs over local geographic tariffs, if there were still some IP-based numbers without local geographic tariffs.

6.9 Option 8: using a new national number range with local geographic tariffs

Using a new national number range (031 or 077) with local geographic tariffs would make 6.9 million extra numbers available.⁵¹ The new subscriber numbers would have seven digits; giving them eight digits might make them less popular, as other numbers would still have seven digits.

If the new national number range was 031, other new national ranges (032, 034, 035, 036, 037 and 039) could be provided for the areas of the country corresponding with the national destination codes beginning with 2, 4, 5, 6, 7 and 9. Thus the numbers would have regional associations. This would offer more comfort than practical assistance in finding a truly local tradesman, for example; however, telephone numbers will become less valuable for this purpose, with the growing use of online searches (especially if post codes are introduced). It could even be seen as confusing (in that it relates to another layer in the obsolescent switching hierarchy, which does not even correspond with the historic provinces). Customers would not understand whether, if they lived in Cork, say, they could have 031 numbers instead of 032 numbers.

If the new national range was 077, some (but, by now, probably rather few) customers might associate it with Donegal, just as for 076. Yet in other respects 031 would not necessarily be better than 077, for the reasons noted above. In any event, customers who would have disliked being assigned numbers from the 03 range of Section 6.6 might also spurn 031 or 077, even if all national calls to them now had local geographic tariffs. There could be number hoarding, as customers might suspect that soon they would be forced to take any new numbers from the new range.

The experience in Ireland and elsewhere in introducing national number ranges has not been a happy one. Even if they have been designed and publicised well, such ranges remain stubbornly underused unless they are for mobile services or for consumer-to-business services with distinctive charging arrangements. In addition, the somewhat analogous scheme in the UK, using 03 for new national number ranges with national tariffs, seems to be little known even now, six years after its introduction.⁵² In Ireland most calls now have national dialling, and geographic information in numbers is falling in importance; even so, introducing a new national range would run a high risk of not relieving geographic number shortages.

As discussed in Section 6.8, if the supply of geographic numbers (in some location) was exhausted, customers would have no choice but to use non-geographic numbers but they might feel that there was discrimination against them and might hoard geographic numbers to avoid this. Again, though there are services for which non-geographic numbers would be adequate, creating

⁵¹ This assumes that the initial digits 0 and 1 of subscriber numbers are reserved to prevent conflict with national numbers and short access codes, that an initial digit of subscriber numbers is reserved to allow for expansion, and that 100 000 numbers in the 03199 or 07799 subrange are reserved to prevent accidental dialling of 999.

⁵² The introduction of an earlier scheme in the UK, using both 02 and 03 for ranges with regional associations (such as 020 and 028), stopped before any 03 ranges had been created.

the necessary customer confidence might not be justified by the resulting saving in geographic numbers.

CSPs would need to provide publicity, introduce different provisioning schemes and ensure consistency of billing inside and outside the new range. Customers might find the range difficult to grasp. Some business customers would fear losing business through using the unfamiliar numbers. Overall this option seems unlikely to contribute much to a strategy for meeting the demand for geographic numbers.

Figure 6.10: Option 8: using a new national number range with local geographic tariffs [Source: Antelope Consulting]

Attribute	Assessment	Explanation
Extra numbers provided	6.9 million	(031) xxx xxxx, for example, except reservations
Costs to service providers	Moderate	Provisioning, billing, publicity
Costs to residential customers	Small	Learning the significance of the number range
Costs to business customers	Small	Loss of business on using the number range
Other objections by the public	Moderate	Puzzlement about the nature of regional dialling
Risks	Large	Need for geographic number conservation, insufficient take-up to relieve number shortages, number hoarding

7 Techniques for conserving numbers

In this section we describe and evaluate techniques for conserving geographic numbers that can avoid the expansion of number ranges.

7.1 Summary

As indicated in Section 5.2, if the allocation of geographic numbers continued at its present rate, by 2020 between 6.4 million and 6.8 million Dublin numbers would be allocated. The existing Dublin number range (01) can provide 6.811 million numbers, including the numbers already allocated. Thus even by 2020 the introduction of extra Dublin numbers, with the attendant costs and complications, might be needed if the existing ones are not conserved.

In Sections 7.2-7.9 we draw conclusions and make recommendations about various techniques for conserving numbers, as summarised below.

- **Technique 1: setting effective utilisation targets.** This is the starting point in avoiding number shortages: ComReg would agree a target to improve efficiency in the use of numbers with the CSPs, each of which would devise its own ways of reaching the target. Modest process changes (if necessary) could over time make available many numbers that have been allocated already but that are not being used effectively.
- **Technique 2: reducing the sizes of blocks in allocations.** This could encourage consideration of whether extra numbers were really needed and cater efficiently for small and experimental providers needing geographic numbers. By allocating numbers in small blocks ComReg could reduce the need for secondary allocations to CSPs and thereby increase transparency in the use of numbers.
- **Technique 3: charging for numbers.** Numbers will be conserved only if the long-term benefits of doing so can be recognised. To offset short-term pressures on the CSPs and achieve an equitable distribution of any costs, charging for numbers might ultimately be appropriate. It would be introduced only after discussions to ensure that as far as possible CSPs had equivalent incentives.
- **Technique 4: shortening the interval between assignments.** Inevitably there will be many geographic numbers in quarantine between assignments to different customers. However, efficiency in the use of numbers could be improved by ensuring expeditious entry into, and exit from, quarantine.
- **Technique 5: retrieving unused numbers.** Operating processes ought to pay heed to the circumstances in which assigned numbers are unused and could be retrieved. For instance, business customer numbers are not needed when the customers go out of business. Porting provides opportunities to retrieve unused numbers: there might be assigned numbers that are

ported despite being unused, and there might be numbers that stop being used after being ported.

- **Technique 6: pooling numbers.** There appear to be many numbers lying unassigned or unused in blocks that nonetheless are not entirely vacant. The blocks could be passed by primary or secondary allocation to other CSPs, provided that the original block holders kept control of the numbers assigned to customers. Pooling numbers would let this happen and could over time make the use of numbers much more efficient.
- **Technique 7: maintaining the linkage of numbers to locations.** The current rules about when customers may be assigned geographic numbers are not always followed. The resulting extra demand for geographic numbers is uncertain but could be stimulated greatly by new, as yet unknown, services. It needs to be monitored. Some rules might need to be applied more forcefully while others might need to be removed.
- **Technique 8: removing the distortions in demand due to tariffs.** Eliminating distinctions between national and local geographic tariffs might reduce demand from customers for geographic numbers. Similarly, merging the MNAs for a number range might reduce demand for numbers in particular locations. Also, promoting specialised inexpensive international tariffs might reduce demand for numbers from some OTT services, which currently flourish because of the big gap between local geographic tariffs and international tariffs.

The techniques are tabulated in Figure 7.1, with illustrative costs to society as a whole.⁵³ The estimates suggest that the cost per number made available might be less than EUR 1. The costs and the quantities of numbers over ten years are estimated from hypothetical data (and the quantities of numbers are not estimated for techniques that mainly encourage attitudes making other techniques more effective). Though the quantities of numbers made available by the techniques are smaller than those made available by options for providing extra numbers, when accompanied by attitudes that favour conservation they could be enough to ensure that no extra numbers were needed for the foreseeable future.

⁵³

The costs are categorised as: at most EUR 1 million ('very small'); between EUR 1 million and EUR 5 million ('small'); between EUR 5 million and EUR 25 million ('moderate'); between EUR 25 million and EUR 125 million ('large'); and at least EUR 125 million ('very large').

Figure 7.1: Techniques relevant to different number requirements [Source: Antelope Consulting]

Technique	Quantity of extra numbers made available	Cost	Summary
1		Very small	Setting effective utilisation targets
2	0.05 million	Very small	Reducing the sizes of blocks in allocations
3		Small	Charging for numbers
4	0.01 million	Very small	Shortening the interval between assignments
5	0.5 million	Very small	Retrieving unused numbers
6	0.4 million	Very small	Pooling numbers
7		Very small	Maintaining the linkage of numbers to locations
8	0.01 million	Small	Removing the distortions in demand due to tariffs

The techniques discussed in this report refine those already adopted by ComReg, with the intention of delaying, and if possible avoiding, number changes. In this regard Techniques 1, 5 and 6 are perhaps most likely to be effective, though Techniques 2 and 4 could supplement them usefully. Technique 3 could become important if other techniques prove ineffective; Techniques 7 and 8 could become important if new services are shown to boost demand greatly.

7.2 Technique 1: setting effective utilisation targets

As implied in Section 5.3, in the past CSPs have not been bound by the limits on the quantity of numbers per line in recent versions of the National Numbering Conventions.⁵⁴ The demand for numbers to be allocated has run well ahead of the demand for numbers to be used. However, the demand for numbers to be used can be limited broadly.

As noted in Section 5.2, with the fall in household sizes, an average of two geographic numbers per household could eventually provide a geographic number per inhabitant, if a service required it. Three numbers per household would be needed if, in addition, there were a shared number for each household. However, until there is evident demand for geographic numbers as single-user numbers an average of two geographic numbers per household is likely to be more than enough, as only 69% of households have fixed voice subscriptions. Also, an average of two geographic numbers per household would still let a customer have, say, 30 customised access numbers, on the assumption that one customised access number could be provided to multiple customers, in accordance with the current practice.

For business customers, having two geographic numbers per employee on average should be sufficient (where, as with residential customers, the average is calculated across the customer category, not per customer). CSPs need to know roughly how many business customers they have

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According to the National Numbering Conventions “Geographic number allocations shall not exceed a maximum of two numbers per registered user (in the case of consumers) or per business line”. In this context a registered user is the holder of an active voice subscription.

of each size (or even in each sector), for marketing purposes; they can use this information, with their assignment and billing records, to determine historic average quantities of numbers per employee. They can project these average quantities into the future by requesting suitable information in applications for new assignments. Of course, either the applicant or the sales staff of the CSP might exaggerate, but this risk could be countered by relating tariffs to quantities of numbers.

Targets such as two geographic numbers per household and two geographic numbers per employee should take account of the possibility that customers have more than one CSP.⁵⁵ The targets for individual CSPs should be set lower than the targets for the industry as a whole; in particular, if projections suggested that 25% of residential customers had two CSPs then a target of two geographic numbers per household for the industry as a whole should be lowered to 1.6 for individual CSPs. In the case of business customers, the targets for individual CSPs (and the projected number of CSPs per customer) could vary according to enterprise size, economic sector and occupational group. The targets must therefore reflect the experience and expectations of the CSPs as well as social and economic statistics and might be arranged as matrices in the manner mentioned in Section 5.3.

We recommend that:

- ComReg, after discussions with the CSPs, should set target upper bounds for the average quantities of geographic numbers assigned per household in Dublin and per employee in Dublin that are at most 2.0 and 2.0 respectively
- the CSPs should devise and implement plans for ensuring that these targets are reached
- ComReg should perform detailed regular audits of the quantities of numbers in use
- ComReg should check applications for allocations of Dublin numbers for evidence that the demand could not be met partly or wholly from prior allocations and that the plans for reaching these targets are being implemented effectively
- ComReg should elicit through its consumer surveys information from households about the quantities of numbers in use and known to be assigned
- ComReg should elicit through its business surveys information from enterprises of different sizes about the quantities of numbers in use and known to be assigned.

7.3 Technique 2: reducing the sizes of blocks in allocations

Currently the switches can handle sub-blocks containing 100 numbers, but for operational reasons some CSPs prefer to keep granularity to 1 000 numbers. Reducing the sizes of blocks in allocations from 1 000 numbers to 100 numbers would encourage applicants to consider carefully what they really needed. It would also allow more allocations to be treated as primary allocations instead of as secondary allocations, for which efficiency of use is difficult to monitor. However, it

⁵⁵ For instance, residential customers might have second-line numbers from their broadband providers and customised access numbers from their preferred OTT service providers, as well as the original numbers from their traditional telephony providers; though at the moment second-line numbers and customised access numbers do not seem to be in great demand, usage needs to be monitored.

would add a little administrative overhead, as extra applications would sometimes be necessary, and it might require modifications to network and support systems, as numbers would need deeper digit analysis.

Between 2002 and 2012, 1 038 000 Dublin numbers were allocated, in response to 660 successful applications. If decreasing the block size added EUR 50 to the cost of an application, the cost over ten years would be EUR 33 000. If, further, 5% of the allocated numbers (amounting to 52 000 numbers) could be saved over ten years by having smaller blocks the cost per number made available would be EUR 0.6.

We recommend that:

- ComReg should set a subrange holder block size for Dublin numbers that is at most 100 from a date defined after discussions with the CSPs
- the CSPs should include in their upgrade programmes for network and support systems the introduction of this subrange holder block size.

7.4 Technique 3: charging for numbers

In the past business customers have been assigned many more numbers than they could use. This practice has possibly been encouraged by competitive pressures on CSPs. Of course a customer might need to be assigned numbers that are not in use initially, to allow for growth; moreover, the customer might prefer the numbers to form a coherent collection, to make the customer dialling plan simple (though PBXs can usually handle sparsely populated dialling plans). However, as demonstrated in Section 5.3, assigning numbers in large quantities is wasteful and could result in an expensive number change.

In some cases the customer would be upset by the retrieval of superfluous numbers. In other cases the customer might have a dialling plan that fragmented the collection of assigned numbers in a way that would make the retrieved numbers difficult to manage coherently. Yet there are many cases where no problems would result from retrieving superfluous numbers; some are mentioned in Section 7.6.

To provide an incentive to retrieve numbers ComReg could make an annual charge for all allocated Dublin numbers, in line with widespread practice elsewhere.⁵⁶ Payment would confer rights of use, not ownership, just as at present. An upper bound on the charge can be obtained by discounting: if a number change such as that described in Section 6.5 cost EUR 210 million and the annual treasury discount rate (net of inflation) was 3%, delaying the change for one year would pay off provided that it cost less than EUR 6.3 million overall or about EUR 1.1 per allocated Dublin number per year. If all of that EUR 6.3 million were spent on improving processes so that numbers were conserved, the charge would be EUR 0.0 per allocated Dublin number per year. A

⁵⁶ There are charges for geographic numbers in at least twenty EU countries. In almost all of these countries, a main objective, or even the only objective, of charging is promoting efficiency in the use of numbers.

very modest charge, of EUR 0.1 per allocated Dublin number per year, would cost the industry as a whole about EUR 5.5 million over ten years.⁵⁷

Of course, CSPs might simply pass the charge through to their customers. However, those making more efficient use of numbers might not do so but instead might see the charge as a source of competitive advantage. Even passing the charge through to customers might have desirable effects; for instance, small business customers with 100 numbers each might relinquish numbers that they never used.

ComReg could be prepared to de-allocate blocks of 100 numbers, in accordance with Section 7.3. The “grounds for withdrawal of numbers” in the National Numbering Conventions would usually preclude attempts by CSPs to change numbers assigned to customers in order to empty blocks.⁵⁸

We recommend that:

- ComReg, after discussions with the CSPs, should determine an appropriate annual charge (which might be EUR 0.0) for each Dublin number allocated
- ComReg should clarify the National Numbering Conventions to ensure that CSPs do not withdraw or change the numbers of customers except at the request of ComReg or the customers.

7.5 Technique 4: shortening the interval between assignments

Numbers that are no longer in use are placed in quarantine for 13 months before being recycled. Fewer numbers would be needed overall if this period were shortened. However, the period is founded in the requirement that people do not receive unsolicited calls and messages about services when an ‘opt-out’ period of 12 months has passed since the previous uses of the services. It should not be reduced without a corresponding reduction in the opt-out period. Customised access numbers might seem to be sufficiently constrained that they need not be placed in quarantine, but even for them there are potential patterns of use that make quarantine desirable.

For postpaid accounts, numbers can pass directly from being in use to being in quarantine, if customers terminate the contracts. For prepaid accounts (and for postpaid accounts that CSPs close for non-payment), before entry into quarantine, numbers would need to be inactive for a period to confirm that closure was appropriate.⁵⁹ If the numbers do not pass automatically to being in quarantine, they are not recycled as rapidly as they could be. If the churn on accounts were 5%

⁵⁷ Arguably a charge per allocated but unused number would be more appropriate than a charge per allocated number, but it might require more intrusive monitoring of the CSPs to determine the quantities of unused numbers.

⁵⁸ According to the National Numbering Conventions “End-users shall be entitled to retain use of their allocated numbers in all normal circumstances. The recovery of numbers in exceptional cases shall be objectively justified by reference to these conventions”. This appears to relate to recovery by ComReg, not by CSPs, and does not require CSPs to request permission to withdraw numbers.

⁵⁹ Prepaid accounts for fixed services have been implemented in various countries, particularly to attract low-usage customers. They might possibly also be wanted if geographic numbers were assigned as single-user numbers..

annually and 1.3 numbers were assigned per account, process changes that let each number be recycled three months sooner than at present would be equivalent to making available in Dublin 7 000 numbers.⁶⁰

We recommend that:

- ComReg should take advantage of any reduction in the opt-out period to reduce the quarantine period for geographic numbers
- the CSPs should ensure that numbers pass rapidly to being in quarantine after cessation of service (for postpaid accounts) or at the end of the inactivity period (for prepaid accounts).

7.6 Technique 5: retrieving unused numbers

Assigned numbers can remain or become out of use, in which circumstance they could be recycled. Some instances are outlined below.

- Following the cessation of a service the associated numbers can be retrieved. This is particularly important when business customers might well have been assigned many more numbers than they needed.
- Following the cessation of a service a ‘soft dialtone number’ might be provided to permit outgoing emergency calls (though the need for it is diminished greatly by the prevalence of mobile telephones). If the cessation occurs because the customer has transferred to another CSP without porting the number, the soft dialtone number could be retrieved immediately. If the cessation occurs because the property is vacated, the soft dialtone number should be retrieved when the property is re-occupied. Retrieval would be unnecessary if soft dialtone numbers were drawn from a range dedicated to them and designed to avoid number shortages.
- When the numbers assigned to a customer in a single subscription are ported usually all of them are ported (at a cost), even though only some of them might be in use. The number portability process could arrange that the donor operator identified the unused numbers through billing records and the recipient gave the customer an opportunity to return them to the subrange holder without porting them.
- Some time after the numbers assigned to a customer have been ported, the customer might stop taking services. The number portability process could ensure that the numbers are returned to the subrange holder.

Illustrative costs and returns are as follows.

⁶⁰ The process changes save 3/12 of a ‘number year’ on each occasion that a number can be recycled after the termination of a fixed voice subscription, and, each year, 5% of the 1 464 000 fixed voice subscriptions are terminated, so the process changes save 24 000 number years per year (in other words, 24 000 numbers). These figures are for Ireland; those for Dublin are obtained by scaling according to the proportion of inhabitants.

- In 2011 there were 58 320 enterprises in Dublin having at most 9 employees (and on average 1.7 employees). About 10% of the enterprises in Ireland go out of business annually, so after ten years about 65% will have stopped taking a service (because the probability of survival from one year to the next is 90%).⁶¹ Hence among enterprises having at most 9 employees, in Dublin perhaps 20 000 will have stopped taking a service. If they were originally assigned on average 6.0 numbers and successor enterprises will be assigned on average 3.4 numbers, 52 000 numbers could be retrieved. The cost for this would be very small, as it would be subsumed in that of regular staff training.
- In 2011 there were 284 enterprises in Dublin having at least 250 employees (and on average 986.4 employees). As there are few of them, there could be a special process to retrieve unused numbers from them when or before their contracts are renewed. . If they were originally assigned on average 3 000 numbers and they need on average 2 000 numbers, 284 000 numbers could be retrieved. If the retrieval process cost EUR 500 per enterprise, the cost per number made available would be EUR 0.5.
- In 2011 there were 501 028 households in Dublin. At any time in Ireland about 8% of the houses and flats are unoccupied, and 69% of households have residential fixed voice subscriptions.⁶² Hence at any time in Dublin there might be 28 000 (in proportion to the number of households) unoccupied houses and flats having soft dialtone numbers. These numbers persist for some time after the houses and flats are re-occupied. Retrieving them on average three months earlier (say) than would otherwise happen would be equivalent to making available in Dublin 7 000 numbers. The potential for making numbers available by changing processes would be much greater than this if currently in some situations soft dialtone numbers are not retrieved. This could happen if new occupants take services from other CSPs without informing the original CSPs or porting the original numbers. For such situations there might need to be a process to notify the original CSPs that the soft dialtone numbers could be retrieved.⁶³
- Until 2009, when the figures stopped being published, in Ireland about 70 000 geographic numbers were ported annually, so in Dublin perhaps 20 000 (in proportion to the number of inhabitants) were ported annually. About 80% of fixed voice subscriptions (and perhaps 60% of fixed voice access paths) are held by residential customers. If, after porting their numbers, 25% of the residential customers and 65% of the business customers ultimately stop taking a service, over ten years 82 000 Dublin numbers could be returned to the original subrange holders under the number portability process. The cost for this would be very small, as it would be subsumed in that of regular staff training.

⁶¹ See [http://www.cso.ie/px/pxeirestat/database/eirestat/Business Demography/Business Demography_statbank.asp?sp=Business Demography](http://www.cso.ie/px/pxeirestat/database/eirestat/Business%20Demography/Business%20Demography_statbank.asp?sp=Business%20Demography).

⁶² See [http://www.cso.ie/px/pxeirestat/database/eirestat/Profile 4 The Roof Over Our Heads - Housing in Ireland/Profile 4 The Roof Over Our Heads - Housing in Ireland_statbank.asp?SP=Profile 4 The Roof Over Our Heads - Housing in Ireland](http://www.cso.ie/px/pxeirestat/database/eirestat/Profile%204%20The%20Roof%20Over%20Our%20Heads%20-%20Housing%20in%20Ireland/Profile%204%20The%20Roof%20Over%20Our%20Heads%20-%20Housing%20in%20Ireland_statbank.asp?SP=Profile%204%20The%20Roof%20Over%20Our%20Heads%20-%20Housing%20in%20Ireland).

⁶³ The annual number of geographic number ports is similar to the annual growth in voice fixed broadband connections, so such a process might not be needed. The CSPs ought to be able to investigate this further.

We recommend that:

- the CSPs should withdraw numbers that are assigned to customers but that are not in use and are not required by contractual commitments
- the CSPs should review their standard contract terms and their working practices to ensure that they do not make commitments to assign numbers in quantities larger than the customers will use
- the CSPs should make arrangements to ensure that if geographic numbers that are assigned but not in use are about to be ported they can instead stop being assigned and be made available after quarantine for re-assignment
- the CSPs should make arrangements to ensure that ported geographic numbers that subsequently stop being assigned to customers are returned after quarantine automatically and immediately to the subrange holders for re-assignment
- ComReg should consider the introduction of a number range that would replace geographic number ranges in providing numbers required only or mainly for internal network purposes, such as soft dial tone and GLUMP identifiers.

7.7 Technique 6: pooling numbers

An illustration of number pooling is as follows: if from a block of 1 000 numbers there had been, say, one assignment of 100 numbers alongside each other and 20 assignments, each of two numbers scattered elsewhere in the block, the 900 sparsely assigned numbers (of which 40 were in use) could be de-allocated and re-allocated to a CSP who would port the 40 scattered numbers to the original block holder.

In 2002 the NAP agreed that pooling geographic numbers should be considered before any decision was taken to increase the subscriber number length to eight digits. The main objections to pooling appeared to be that it introduced a new number pooling process (or, rather, a combination of the block de-allocation and re-allocation process and the number porting process) and that the geographic number portability implementation could not handle the extra load. The geographic number portability implementation is now under review.

The administrative load of number pooling is justified only if the numbers are sparsely assigned; for instance, it might be justified only if at most 25% of the numbers in a block of the minimum size are assigned.

The maximum charge for porting a number was specified in Setting a Maximum Fixed and Mobile Number Porting Charge (ComReg 09/04). There it was set to lie between EUR 2.50 and EUR 8.51 (depending on the quantity of numbers ported and the time of day) for the current geographic number portability implementation, and to be EUR 2.05 for the current mobile number portability implementation. If a new geographic number portability implementation were related closely to the current mobile number portability implementation, a charge of EUR 2.05 might be appropriate for geographic numbers as well as mobile numbers. If, in addition, 10%, say, of the allocated numbers were in blocks having at most 25% of the numbers assigned, and those blocks had on

average 15% of the numbers assigned, then the cost of porting numbers in the number pooling process would be about EUR 165 000. The cost of de-allocating and re-allocating blocks (with 100 numbers each) at EUR 20 per block would add EUR 110 000 to this, to give a total cost of EUR 275 000 for making 467 000 numbers available for assignment, so the cost per number made available would be EUR 0.6.⁶⁴

We recommend that:

- ComReg, after discussions with the CSPs, should determine what savings in numbers allocated might result over time from pooling numbers both with and without a new geographic number portability implementation
- ComReg should ensure that any new geographic number portability implementation takes into account the requirement for number pooling.

7.8 Technique 7: maintaining the linkage of numbers to locations

Offering geographic numbers in all areas of the country stimulates competition.⁶⁵ Many CSPs do this while complying with the rules in the National Numbering Conventions about the addresses of number holders.⁶⁶ These rules prohibit using geographic numbers as virtual numbers. They are intended to maintain the geographic information in numbers, which users value, and to conserve geographic numbers, which could otherwise require costly changes.

In 2010-2012 ComReg investigated and closed 17 cases of non-compliance where number holders did not have suitable addresses.⁶⁷ All except two of these cases involved two CSPs (one of which held only a secondary allocation) and all except two dealt with one number each.

Such investigations take time and effort, especially where the numbers are within secondary allocations (when ComReg does not know immediately to which CSP the numbers have been allocated). As a guide, in 2012 about 20 CSPs had primary allocations of Dublin numbers that might be intended for voice fixed broadband connections; perhaps ten others had secondary allocations. Inspection of the numbering database suggests that about 18 000 Dublin numbers might warrant checks that the holders had suitable addresses. Investigating 5% of the numbers, at perhaps EUR 100 for each number investigated, could cost EUR 90 000. It might retrieve some numbers, but it would also encourage compliance with the rules in the National Numbering Conventions and clarify whether the rules helped to maintain the geographic information in numbers and conserve geographic numbers.

⁶⁴ If 35%, not 15%, of the numbers were assigned, then 65%, not 85%, of the numbers would be gained and the cost per number made available would be EUR 1.4.

⁶⁵ In the words of one holder of secondary allocations "With the basic multi VoIP packages, we provide you with a block of telephone numbers in the area code of your choice".

⁶⁶ According to the National Numbering Conventions "A geographic number shall only be allocated to an entity whose address, as registered with ComReg or its network operator, is within the designated geographic numbering area for that number".

⁶⁷ See http://www.comreg.ie/telecoms/closed_cases.561.1042.html.

The extent and importance of non-compliance is not clear, partly because of the use of secondary allocations.⁶⁸ Large secondary allocations are also made to large businesses. In some cases, as noted in Section 5.3, these allocations are wasteful. ComReg should at least be notified when they occur. As there are only hundreds of CSPs and large businesses in Ireland the cost of giving ComReg the details of large secondary allocations are negligible.

We recommend that:

- ComReg should request CSPs to describe how they check that their customers for geographic numbers have addresses within the relevant areas
- the CSPs should provide to ComReg the details of secondary allocations that contain at least 1 000 geographic numbers
- ComReg should investigate the compliance of assignments of geographic numbers with the National Numbering Conventions, with a single investigation for all the assignments from allocations to one entity where that would reduce effort
- the CSPs should introduce practices to ensure that secondary allocations by them are used in accordance with the National Numbering Conventions
- ComReg should, at intervals of two years, review whether the rules in the National Numbering Conventions about the addresses of number holders could be relaxed without affecting greatly the value of the geographic information in numbers or the likelihood of costly number changes.

7.9 Technique 8: removing the distortions in demand due to tariffs

As noted in Section 7.2, one reason why customers want geographic numbers is to let their callers be charged local geographic tariffs. Eliminating the distinction between national and local geographic tariffs could therefore reduce the demand for geographic numbers: some customers would be content with numbers somewhere else or even with numbers in the IP-based number range. However, for current services eliminating the distinction seems unlikely on its own to have a major effect on demand, even in Dublin, where the area covered by the number range has the highest population. Indeed, only about 10 000 numbers would be needed to allocate one Dublin number to every enterprise in Ireland outside Dublin that has at least ten employees.

⁶⁸ Assignments to customers, as well as secondary allocations to CSPs, can obscure compliance. For instance, people wanting numbers but lacking suitable addresses might use the addresses of willing friends, relatives or business contacts; checks on this (such as examining the electoral register) would need excessive effort, given that the extent and importance of non-compliance is not clear.

The distinction between national and local geographic tariffs is also relevant to the OTT services highlighted in Section 3.4 that aim to use local geographic tariffs instead of specialised inexpensive international tariffs: if the distinction were eliminated, customers for these services would become more willing to have IP-based numbers instead of geographic numbers. In addition, if specialised inexpensive international tariffs were promoted using existing features of the numbering plan, there would be less pressure to assign numbers as virtual numbers or customised access numbers.⁶⁹

Merging MNAs in the same number range (while keeping the distinction between national and local geographic tariffs) might reduce the demand for numbers in particular locations, because small CSPs would then apply for only one allocation each in every number range. This reduction in demand is likely to be small; for instance, out of 30 CSPs in Dublin, seven have only 1 000 numbers each in at least two of the three MNAs, and only 12 000 numbers have been allocated to them unnecessarily if they applied for numbers in the MNAs simply to be represented there.

Merging MNAs in the same number range would not increase the supply of numbers, as free number blocks can already be transferred between them to keep the proportions of allocated numbers roughly the same; in particular, currently 84%, 78% and 60% of the available numbers are allocated in the three Dublin MNAs, though one of them has at least ten times as many numbers available as the others do. Transferring free number blocks between MNAs can only relieve for some time the pressure on one of the MNAs as it nears exhaustion.

Of course, having distinct MNAs in the same number range makes tariffs more obscure than they would otherwise be; transferring number blocks between MNAs exacerbates the obscurity, because the leading digits of subscriber numbers no longer provide easy identification of the MNAs. Tariff transparency would be improved by merging the MNAs, even if the distinction between national and local geographic tariffs was kept.

We recommend that:

- ComReg, after discussions with the CSPs, should consider whether eliminating tariff distinctions and promoting specialised inexpensive international tariffs would contribute significantly to conserving numbers.

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In some respects, freephone and shared cost codes are already alternatives to virtual numbers and call-by-call carrier selection codes are already alternatives to customised access numbers. With the automatic input of CLIs from registered telephones, or the manual input of PINs, calling cards and services using shared cost and premium rate codes can offer specialised inexpensive international tariffs as effectively as services using customised access numbers can.

8 Conclusions

In this section we summarise our conclusions and recommendations.

8.1 Global trends

Where OTT VoIP users opt to make use of telephone numbers the greatest demand is likely to emerge from mVoIP. However, though usage is significant, our research indicates that around 90% of smartphone owners are not yet active users of mVoIP.

Existing mobile numbers are tending to be the default identifiers for mobile OTT apps. This tendency looks likely to continue, given that users are unlikely to switch entirely from conventional services to OTT services. Telefónica O2's TuGo relies on users' existing numbers, as does the popular WhatsApp Messenger, the cross-platform mobile messaging app, which creates user accounts based on users' existing numbers. The mobile number is also used as a communications service identifier in other services, such as Viber.

When considering emerging technologies and services, it is possibly the demand for virtual numbers which has the largest potential impact, particularly in major centres of population where number supply is nearing exhaustion. While the extent of demand for virtual numbers is presently unclear, it could be argued that even a modest increase could become an issue, and that the area with the greatest attractiveness for extraterritorial virtual numbers is Dublin, where there is also a potential shortage of numbers. In such circumstances it may be necessary to compare the potential cost of number changes with the economic benefits arising from a more widespread adoption of virtual numbers. The risk of exhaustion due to virtual numbers can be mitigated by maintaining the link between a number and an address in the geographical numbering area.

In conclusion, we therefore consider that emerging communications services are likely to result in a low to moderate increase in the demand for new numbers as long as current numbering conventions continue to be applied, in effect preventing the extraterritorial assignment of virtual numbers.

8.2 National considerations

In Ireland the number of fixed access links has been falling, and the number of voice fixed broadband connections has been rising. The rise in voice fixed broadband connections appears to be due to growth in the bundling of cable television with broadband, rather than demand for new services.

Number shortages could occur in Dublin and some other locations that are major centres of population (such as Galway and Limerick). The ways of alleviating number shortages discussed in

this report apply to these locations. However, some of their details are specific to Dublin, where number changes would be most costly.

8.3 Number supply and demand

At the current rate of allocation of geographic numbers to CSPs, the supply in Dublin and some other locations will be exhausted after some years (perhaps by 2020), even though the quantities of numbers required by customers might still be quite low.

Future demand for geographic numbers is uncertain, but currently there is no sign of a vast upsurge. Indeed, the existing Dublin number range could supply enough numbers to satisfy foreseeable demand if numbers were conserved and extraterritorial requirements (due to people and organisations abroad having numbers in Ireland) were limited.

There would be a rise in demand if customers wanted their own individual geographic numbers. However, nationally the rise in the number of residential fixed voice subscriptions is accompanied by a fall in household size, so on average assigning two geographic numbers per household would probably be adequate.

There is currently a large disparity between the quantity of numbers that have been allocated by ComReg and the quantity of numbers that, according to recent versions of the National Numbering Conventions, should have been assigned to customers. A major cause of this disparity appears to be that very small enterprises, with at most 9 employees, and very large enterprises, with at least 250 employees, are assigned many more numbers than they use. Assigning 10 or 15 numbers to each very small enterprise, or assigning several thousand numbers to each very large enterprise, creates number shortages rapidly. As an average across enterprises, assigning two geographic numbers per employee would probably be adequate.

8.4 Options for providing numbers

The quantity of geographic numbers allocated to CSPs is still rising. New, as yet unknown, services might require yet more numbers. The effects of these would be particularly pronounced in Dublin. Indeed, the strategy in this report refers explicitly to Dublin, though it applies to all number ranges having similar subranges reserved for range expansion.

Hence the options for providing numbers need to cover various levels of number shortage. The preferred situation is that there is no shortage (so the supply is never exhausted), but this calls for the successful application of number conservation techniques. Failing that, there will ultimately be at least modest number shortages (requiring 2.6 million extra numbers, for example), which can be alleviated by continuing number conservation and using options that have fairly low costs. Alleviating severe number shortages (requiring 26 million extra numbers, for example) will entail the use of options that have very much higher costs.

We draw conclusions and make recommendations about possible options for providing numbers as follows.

- **Option 1: using the existing Dublin number range with existing subscriber numbers.** This can supply enough Dublin numbers if the demand for them from CSPs does not continue to expand when customers need relatively few. It has the lowest cost among the options. However, unless numbers are conserved, the existing supply will ultimately be inadequate. We recommend that:
 - ComReg should allocate numbers from existing geographic number ranges without expansion until projections demonstrate that shortages will occur
 - ComReg should, at intervals of two years, review whether such shortages might occur within the following four years
 - ComReg and the CSPs should introduce number conservation techniques, with the objective of ensuring that such shortages do not occur
 - ComReg should allocate seven-digit Dublin subscriber numbers beginning with any of 56, 57, 58 and 59 only if projections demonstrate that otherwise the numbering plan for Dublin will need to be closed.

- **Option 2: using the existing Dublin number range with new subscriber numbers beginning with 3.** This uses the initial digit 3 of Dublin subscriber numbers, which is currently kept spare to allow for expansion of the number range. It does not require number changes: it simply makes most subscriber numbers beginning with 3 available for allocation while keeping some spare to allow for future expansion (at least if the subscriber numbers that it supplies have seven digits). Its costs would be very low. It could be the first step in providing extra numbers if that became necessary. Alternatively, it could be the second step (after closing the numbering plan for Dublin) if it would make unnecessary any further expansion and the support systems could accommodate eight-digit subscriber numbers. We recommend that:
 - ComReg should allocate seven-digit subscriber numbers beginning with 3 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at most 0.9 million numbers will occur
 - ComReg should allocate eight-digit subscriber numbers beginning with 3 from the existing Dublin number range only if the numbering plan for Dublin has been closed and projections demonstrate that otherwise shortages amounting to at most 9.0 million numbers will occur.

- **Option 3: using the existing Dublin number range with new subscriber numbers beginning with 0 or 1.** This entails closing the numbering plan for Dublin (so 01 is dialled at the start of Dublin numbers, even in Dublin). It requires no other changes, so it affects users only if they make calls from fixed telephones in Dublin or publicise their contact details without including 01. The resulting costs should be quite low. Closing the numbering plan for Dublin is desirable, though not essential, for various other options; if this option were adopted

before them it would alleviate some number shortages and might therefore make them superfluous. It would be particularly likely to ensure that more expensive, complicated and unpopular options were not needed if its adoption could be delayed until the support systems could accommodate eight-digit subscriber numbers. We recommend that:

- ComReg should allocate seven-digit subscriber numbers beginning with 0 or 1 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at most 1.7 million numbers will occur
 - ComReg should allocate eight-digit subscriber numbers beginning with 0 or 1 from the existing Dublin number range only if projections demonstrate that otherwise shortages amounting to at least 1.7 million numbers will occur
 - ComReg should seek to ensure that if locations face number shortages that could be alleviated by closing the numbering plans then the numbering plans for all such locations are closed at the same time
 - the CSPs should point out regularly to their fixed service customers that national dialling is no more expensive than local dialling (to the same destination) and that including national numbers in contact details helps callers from mobile telephones or in other locations
 - ComReg should ensure that blocks of GLUMP identifiers in geographic number ranges are de-allocated, and are not re-allocated, when they become unused.
- **Option 4: using the existing Dublin number range after prefixing existing subscriber numbers.** This expands the number range to offer many more numbers. It requires a change to some or all Dublin numbers, which, though systematic, would have large costs for CSPs and customers. It would be appropriate only if projections showed that large extra quantities of numbers (20 per household and 20 per enterprise, for example) were needed. We recommend that:
 - ComReg should prefix subscriber numbers (and subsequently allocate new subscriber numbers not beginning with the prefix) only if the numbering plan for Dublin has been closed and projections demonstrate that otherwise shortages amounting to at least 9.0 million numbers will occur
 - the CSPs should include in their upgrade programmes for network and support systems the removal of limitations on the lengths of subscriber numbers, in case geographic or other subscriber numbers are ultimately required to have more than seven digits
 - ComReg should, at intervals of two years, review progress towards removing such limitations.
 - **Option 5: using a new Dublin number range with existing subscriber numbers.** This entails splitting the existing number range by placing roughly half the existing subscriber numbers in a new number range, probably according to their locations. It requires a change to the nationally dialled forms, but not the locally dialled forms, of numbers placed in the new range, and it would probably provoke objections from the people to whom those numbers were

assigned. It might be accompanied by closing the numbering plan for Dublin, to avoid mistaken local dialling to numbers in the other range.

- **Option 6: using a new Dublin number range with new subscriber numbers.** This entails overlaying the existing number range with a new one containing new subscriber numbers. It does not require number changes, but it would provoke objections from the people to whom Dublin numbers were assigned thereafter, as those numbers would be drawn from the new range even if numbers for neighbours were not. It might be accompanied by closing the numbering plan for Dublin, to avoid mistaken local dialling to numbers in the other range.
- **Option 7: using an existing national number range with at most national geographic tariffs.** Promoting vigorously the use of the IP-based number range (076) might encourage some customers to take numbers in that range instead of the Dublin range. However, the evidence from use of the range so far does not inspire confidence. Given that the range exists already, the relief that it offers to number shortages is welcome but is likely to be fairly small.
- **Option 8: using a new national number range with local geographic tariffs.** Introducing a new number range (031 or 077) with local geographic tariffs might encourage some customers to take numbers in that range instead of the Dublin range. However, the new range would face many of the problems faced by the existing IP-based range and would not evidently be more successful. The effect on number shortages seems likely to be too small to provide much justification for introducing the new range.

The strategy provides for scenarios of no shortage, modest shortages and severe shortages of Dublin numbers. We assume that Option 1 is adopted initially. If modest number shortages become likely despite the actions arising from Option 1, then Options 2 and 3 can supply seven-digit subscriber numbers. If severe number shortages become likely before Options 2 and 3 have supplied seven-digit subscriber numbers, then Options 2 and 3 can instead supply eight-digit subscriber numbers. If severe number shortages become likely in other circumstances, then Option 4 can be adopted. Options 5, 6, 7 and 8 seem unlikely to be very effective in alleviating number shortages, so they are absent from the strategy.

8.5 Techniques for conserving numbers

If the allocation of geographic numbers continued at its present rate, by 2020 extra numbers might be needed in Dublin and some other locations. The costs and complications of introducing these could be avoided by conserving the existing numbers.

We draw conclusions and make recommendations about possible techniques for conserving numbers as follows.

- **Technique 1: setting effective utilisation targets.** This is the starting point in avoiding number shortages: ComReg would agree a target to improve efficiency in the use of numbers with the CSPs, each of which would devise its own ways of reaching the target. Modest

process changes (if necessary) could over time make available many numbers that have been allocated already but that are not being used effectively. We recommend that:

- ComReg, after discussions with the CSPs, should set target upper bounds for the average quantities of geographic numbers assigned per household in Dublin and per employee in Dublin that are at most 2.0 and 2.0 respectively
 - the CSPs should devise and implement plans for ensuring that these targets are reached
 - ComReg should perform detailed regular audits of the quantities of numbers in use
 - ComReg should check applications for allocations of Dublin numbers for evidence that the demand could not be met partly or wholly from prior allocations and that the plans for reaching these targets are being implemented effectively
 - ComReg should elicit through its consumer surveys information from households about the quantities of numbers in use and known to be assigned
 - ComReg should elicit through its business surveys information from enterprises of different sizes about the quantities of numbers in use and known to be assigned.
- **Technique 2: reducing the sizes of blocks in allocations.** This could encourage consideration of whether extra numbers were really needed and cater efficiently for small and experimental providers needing geographic numbers. By allocating numbers in small blocks ComReg could reduce the need for secondary allocations to CSPs and thereby increase transparency in the use of numbers. We recommend that:
 - ComReg should set a subrange holder block size for Dublin numbers that is at most 100 from a date defined after discussions with the CSPs
 - the CSPs should include in their upgrade programmes for network and support systems the introduction of this subrange holder block size.
 - **Technique 3: charging for numbers.** Numbers will be conserved only if the long-term benefits of doing so can be recognised. To offset short-term pressures on the CSPs and achieve an equitable distribution of any costs, charging for numbers might ultimately be appropriate. It would be introduced only after discussions to ensure that as far as possible CSPs had equivalent incentives. We recommend that:
 - ComReg, after discussions with the CSPs, should determine an appropriate annual charge (which might be EUR 0.0) for each Dublin number allocated
 - ComReg should clarify the National Numbering Conventions to ensure that CSPs do not withdraw or change the numbers of customers except at the request of ComReg or the customers.
 - **Technique 4: shortening the interval between assignments.** Inevitably there will be many geographic numbers in quarantine between assignments to different customers. However, efficiency in the use of numbers could be improved by ensuring expeditious entry into, and exit from, quarantine. We recommend that:

- ComReg should take advantage of any reduction in the opt-out period to reduce the quarantine period for geographic numbers
 - the CSPs should ensure that numbers pass rapidly to being in quarantine after cessation of service (for postpaid accounts) or at the end of the inactivity period (for prepaid accounts).
- **Technique 5: retrieving unused numbers.** Operating processes ought to pay heed to the circumstances in which assigned numbers are unused and could be retrieved. For instance, business customer numbers are not needed when the customers go out of business. Porting provides opportunities to retrieve unused numbers: there might be assigned numbers that are ported despite being unused, and there might be numbers that stop being used after being ported. We recommend that:
 - the CSPs should withdraw numbers that are assigned to customers but that are not in use and are not required by contractual commitments
 - the CSPs should review their standard contract terms and their working practices to ensure that they do not make commitments to assign numbers in quantities larger than the customers will use
 - the CSPs should make arrangements to ensure that if geographic numbers that are assigned but not in use are about to be ported they can instead stop being assigned and be made available after quarantine for re-assignment
 - the CSPs should make arrangements to ensure that ported geographic numbers that subsequently stop being assigned to customers are returned after quarantine automatically and immediately to the subrange holders for re-assignment
 - ComReg should consider the introduction of a number range that would replace geographic number ranges in providing numbers required only or mainly for internal network purposes, such as soft dial tone and GLUMP identifiers.
 - **Technique 6: pooling numbers.** There appear to be many numbers lying unassigned or unused in blocks that nonetheless are not entirely vacant. The blocks could be passed by primary or secondary allocation to other CSPs, provided that the original block holders kept control of the numbers assigned to customers. Pooling numbers would let this happen and could over time make the use of numbers much more efficient. We recommend that:
 - ComReg, after discussions with the CSPs, should determine what savings in numbers allocated might result over time from pooling numbers both with and without a new geographic number portability implementation
 - ComReg should ensure that any new geographic number portability implementation takes into account the requirement for number pooling.
 - **Technique 7: maintaining the linkage of numbers to locations.** The current rules about when customers may be assigned geographic numbers are not always followed. The resulting extra demand for geographic numbers is uncertain but could be stimulated greatly by new, as yet unknown, services. It needs to be monitored. Some rules might need to be applied more forcefully while others might need to be removed. We recommend that:

- ComReg should request CSPs to describe how they check that their customers for geographic numbers have addresses within the relevant areas
 - the CSPs should provide to ComReg the details of secondary allocations that contain at least 1 000 geographic numbers
 - ComReg should investigate the compliance of assignments of geographic numbers with the National Numbering Conventions, with a single investigation for all the assignments from allocations to one entity where that would reduce effort
 - ComReg should, at intervals of two years, review whether the rules in the National Numbering Conventions about the addresses of number holders could be relaxed without affecting greatly the value of the geographic information in numbers or the likelihood of costly number changes.
- **Technique 8: removing the distortions in demand due to tariffs.** Eliminating distinctions between national and local geographic tariffs might reduce demand from customers for geographic numbers. Similarly, merging the MNAs for a number range might reduce demand for numbers in particular locations. Also, promoting specialised inexpensive international tariffs might reduce demand for numbers from some OTT services. We recommend that:
 - ComReg, after discussions with the CSPs, should consider whether eliminating tariff distinctions and promoting specialised inexpensive international tariffs would contribute significantly to conserving numbers.

The techniques discussed in this report refine those already adopted by ComReg, with the intention of delaying, and if possible avoiding, number changes. In this regard Techniques 1, 5 and 6 are perhaps most likely to be effective, though Techniques 2 and 4 could supplement them usefully. Technique 3 could become important if other techniques prove ineffective; Techniques 7 and 8 could become important if new services are shown to boost demand greatly. Though the quantities of numbers made available by these techniques are modest, when accompanied by attitudes that favour conservation they could be enough to ensure that no extra geographic numbers would be needed for the foreseeable future.

Annex A List of abbreviations used in this report

Abbreviation	Full term
3G	Third generation (mobile telephony)
CLI	Calling line identity
CSP	Communications service provider
DDI	Direct dialling in
EU	European Union
EUR	Euro
GLUMP	Geographic number portability and local unbundled metallic path
ICT	Information and communications technology
IP	Internet Protocol
ISDN	Integrated services digital network
IVR	Interactive voice response
MNA	Minimum numbering area
mVoIP	Mobile voice over IP
NACE	Statistical nomenclature of economic activities in the European Community
NAP	Numbering Advisory Panel
OTT	Over-the-top
PBX	Private branch exchange
PIN	Personal identification number
PSTN	Public switched telephone network
SIP	Session Initiation Protocol
SOC	Standard occupational classification
VoBB	Voice over broadband
UK	United Kingdom
VoIP	Voice over IP