Chapter 12

The Design and Management of Numbering Systems

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1.0 Why is Numbering Suddenly So Interesting?

Whereas the radio spectrum has long been recognised as an important function for central management, numbering has only recently come to the fore as a scarce resource meriting public attention. Why is this? Two main sets of reasons can be distinguished: those associated with industry growth, and those associated with the rights of people in and around the industry.

Most countries' numbering schemes were designed decades ago, when the growth in basic services and proliferation of new services that we are now experiencing could not have been foreseen. It is not surprising that many countries are now simply running out of numbers. This tends to happen at two levels: local and national. At the local level, particular areas may not have enough numbers to cater for basic telephony demand. And at the national level, new services such as mobile, and freephone need distinctive codes which may not be available. An inadequate numbering plan can hamper service growth and stifle innovation. At the same time, new network operators are arriving on the scene and demanding equal treatment with the incumbent in numbering as in other matters. And newly aware groups of customers and service providers are pressing for rights. The old style of numbering scheme design never envisaged such demands.

Coincident with these new demands on numbering schemes, we now have new freedom in their design. The design of "old" numbering schemes was largely dictated by the step-by-step switching systems that numbers had to operate. These are now obsolete. "New" numbering schemes can take advantage of a new level of technological flexibility, and be designed to meet other criteria. This generally means satisfying users. User-friendly numbering plans can foster use and thereby industry revenues.

2.0 Basic Concepts and Terminology

2.1 Country Codes

No discussion of numbering can last long without mentioning the ITU and its series of relevant standards. The most crucial is E.164, which sets out the framework for much of this chapter. International direct dialling relies on each country having a unique *country code* which identifies it from everywhere in the world. Country codes have one, two or

three digits. Only two one-digit country codes have ever been issued – one for the North American Numbering Plan (NANP) and seven for the former Soviet Union. There are under 50 two-digit country codes, belonging in general to the more industrialised or more populous countries, including 18 in Europe. The remaining 130-plus allocated country codes all have three digits. There are only about 70 spare three-digit codes. Understandably, given recent growth in new sovereign states and also in international services looking for codes, this limited supply is making ITU's Study Group II concerned about the ability to meet future needs. They are reviewing the existing and future use of country code space.

Originally the first digit of a country code indicated what part of the world the country was in – 2 for Africa, 3 for Europe and so on. This increased the difficulty of finding new codes and regional significance has already been dropped – as is evident for example by the code 299 for Greenland. As an organisation of sovereign states, the ITU is bound to give precedence to countries (or geographic groupings like the NANP) when allocating codes. However, we are beginning to see some non-country uses of country code space. The 87 series is in use for Global Mobile Satellite Services and 800 is reserved for Global Freephone. It is currently unclear whether Europe's application for the code 388 for Pan-European services will succeed.

2.2 National Numbering

When dialling an international number, the caller begins with the *international prefix* (usually, but not always, 00) followed by the country code. The rest of the digits constitute what is known as the *National Significant Number* (NSN). This is the same as the full number that one would dial to reach the same person from within their home country, but without the *trunk prefix* (usually 0, where there is one). The NSN in turn may be split into two parts: first the *National Destination Code* (NDC), often called the *trunk code* or *area code*, and lastly the *Subscriber Number* (SN). So for example to call England from Copenhagen one would dial the full international number, 00 44 181 505 XXXX, where:

- 00 is the international dialling prefix (the recommended standard)
- 44 is the country code for the United Kingdom
- 181 is the area code for outer London
- 505 98XX is the subscriber number.

NDCs may have either *geographic* or *non-geographic* significance. For example, 181 is geographic, while 800, also an NDC, is non-geographic – the code tells you that the call is free, but nothing about where you are calling.

A key variable in national numbering scheme design is *maximum NSN length.* Since the National Code Change in April 1995, this is now ten for the UK and a few other countries. The maximum NSN length has to be set within the *maximum ISN (international significant number) length* allowed by international standards. For many years this has been 12 digits (so the UK, with a two-digit country code and ten-digit NSN length, had reached its maximum) but on January 1 1997, the limit went up to 15 digits maximum.

2.3 Numbering Planning

The terms *(national) numbering scheme* and *(national) numbering plan* are used more or less interchangeably to mean the uses assigned to NDCs and the rules for SNs within NDCs. Sometimes the term *scheme* may mean the larger national design while *plan* denotes a particular operator's part within that scheme.

The *numbering plan* refers to NSNs, while the *dialling plan* refers to the digits dialled by a caller. Numbering and dialling plans are different where *local dialling* is permitted – this means that just the SN is dialled for connection to another user in the same NDC area. A single SN, say 234567, may be assigned to a different customer in each different NDC area. This kind of plan is known as an *open numbering plan.* The alternative, a *closed numbering plan*, exists where there is only a single dialling procedure for all national calls, as for example in Denmark and Norway, where all 8 digits are dialled for all calls and no trunk prefix is needed.

3.0 The Regulator and Numbering

Why does the regulator need to get involved? There is now widespread agreement that:

- the national numbering plan is a national resource;
- it should be managed in the overall national interest;
- in a competitive environment, the regulator needs to make sure that this happens.

Thus in most countries the responsibility for numbering is being transferred from the incumbent PTO to the regulator. A prime regulatory role is that of resolving conflicts of interest. There are plenty of these in numbering, for example:

- the incumbent operator is unlikely to be eager to share numbering resources fairly with new competitors;
- network operators may want to use numbers for "branding" their services, while users want a simple, uniform scheme where the identity of the operator is subordinate to the geographic or other significance of the NDC;
- business users may prefer a closed scheme while residential users want to retain local dialling.

3.1 Duties of the Regulator

Luckily (given common resource problems), the regulator does not need to take on all the day-to-day chores of running a numbering scheme. But there are certain tasks that cannot be avoided. These include:

- maintaining a long-term vision for the numbering scheme and resisting short-term pressures which may lead to dead ends. This means forecasting potential capacity shortages, instigating a review when necessary, and taking overall responsibility for the choice of scheme architecture;
- regularly consulting all interested parties, and acting as guardian of the user interest. This means ensuring that user views are solicited and taken into account;

especially at review time; and ensuring the right notice periods and publicity for any changes.

- deciding on and making public the basic rules governing the use of the numbering scheme, including number structures and lengths; number ranges to be used for particular purposes or reserved, (taking account of movements towards international harmonisation); and how numbers will be allocated to telecom operators – especially new competitors.

- administering the scheme at the top level. This means allocating number blocks to network operators while observing the principles of good management. Generally this boils down to granting capacity to meet bona fide demand (allocating modest size blocks while reserving others nearby for expansion), while retaining the ability to withdraw unused or badly used number blocks.

- setting the rules governing other competitive issues with numbering implications, in particular equal access and operator portability; and resolve any disputes.

3.2 Some Legal Aspects of Numbering

Generally the legal status of numbers and their "ownership" is unclear. It is very helpful for new telecom legislation or regulations to establish a system of rights and obligations which achieve something along the following lines:

- overall national "ownership" of numbers, enabling the regulator to control use of the numbering plan in the national interest, while delegating day-to-day administration to network operators. It is also wise to enable the regulator to "hive off" aspects of numbering scheme management as they become routine, perhaps to an industry body under the regulator's ultimate supervision;

- "rental" (allocation) to network operators and maybe service providers, possibly under the aegis of a licence condition. Allocation should be subject to reasonable conditions on the correctness and intensity of use of the allocated blocks, and should include the regulator's power to reclaim the space if necessary;

- "rights of use" by service providers and end customers, subject to the regulator and/or network operator retaining any desired control of golden numbers and number trading, and the ultimate right to change individual numbers or make general changes in the scheme if the national interest requires this;

- a clear understanding of "intellectual property" in particular numbers or number ranges, and in the numbering scheme as a whole, in order to prevent the misappropriation of some aspects of the scheme by some operators or powerful corporations;

3.3 Customer Requirements of Numbering Plans

Traditionally numbering plans have been the province of the industry. Because of the engineering significance of numbers, there was little room for users to represent their preferences. The subject developed a mystique which is only now being dispelled. But

contrary to old assumptions, qualitative cost-benefit analysis of numbering scheme options shows that user interests usually dominate a "national interest" equation. The incumbent's costs in any numbering change will be larger than any one other party's. But because users are many, even if individual costs are small they will probably outweigh the industry's aggregate cost. A similar analysis holds good for benefits (though these are even harder to pin down accurately).

Perhaps surprisingly, given the great economic importance of user factors in the design of numbering schemes, few systematic research results on the subject are available. However, those that exist are generally consistent. The comments below are based on fieldwork in the UK by Ovum Ltd (a consultancy specialising in numbering studies), the regulator OFTEL, and the TUA and TMA user organisations; by the regulator Austel and the PTO Telstra in Australia; and by Ovum in Hong Kong and the European Union.

Users consistently value numbers:

- *For making calls correctly* – This means that numbers should be easy to remember or find, and reproduce accurately, pointing to infrequent changes. There is also a widespread preference for a single NSN length and for uniform number patterns and formats (such as the NANP 3-3-4 pattern), even at the cost of dialling extra digits – these increase user confidence and reduce dialling errors

- *For receiving calls correctly* – This means that numbers should not be readily misdialled from other much-called numbers, and should change infrequently. Users would prefer to keep their own number when moving locally or when changing local operator without moving premises.

- *For deciding whether to make a call* – This means that codes should give easily recognisable wanted information (e.g., on likely call cost, or on location of the called party). Users are rarely interested in the identity of the network operator, and do not want this information in the number.

Users also have some differences of opinion among themselves, for example:

- keeping local dialling matters more to residential users and in countries where there are long trunk codes. Business users may favour a single dialling scheme for all calls;

- the significance of special numbers varies depending on cultural factors. The obvious example of this is Hong Kong where certain combinations of digits are thought lucky or unlucky;

- users' views on the desirability of international harmonisation (e.g. of short codes) varies depending on how much the people questioned themselves travel or have personal international networks.

Users' preferences in relation to number portability are also far from clear, and change quickly. A balance must be struck between portability and meaning in numbers – in the extreme, complete number portability comes at the cost of a complete loss of

meaning. Although most people would opt for local portability if it came free, if it is realistically charged then some might well prefer an alternative such as a changed number announcement, especially one with an automatic call connection facility. And there are complications yet to be sorted out in how portable numbers will relate to call line identification (CLI) and to personal numbering (see below).

3.4 Industry Requirements of Numbering Plans

Of course, the industry also has a vital interest in numbering plans. Network operators want the plan to promote:

- economical network operation, which means that it should conform with network constraints, and should change infrequently;
- traffic stimulation, which means it should be customer-friendly, and number supply must be plentiful; "attractive" numbers should be available to service providers and end-users on a fair basis;
- fair competition: the scheme should be managed fairly by the regulator.

The second category, user factors, have been discussed above.

3.5 Network Requirements of Numbering Schemes

For step-by-step exchanges, each digit corresponds to a switching stage. There is therefore a strong cost incentive to keep numbers as short as possible. With common control exchanges, there is still a cost link although a much less significant one – number length determines the required register capacity. In intelligent networks, the proportion of dialled numbers requiring full translation affects the total processing capacity required and hence the cost. Not least, for all exchange types, misdialled traffic ties up valuable equipment unproductively. Thus there is good reason to design numbers so as to minimise misdialling.

When a major numbering change is in prospect, attention focuses on the network costs of change, and these can be large. However, they occur only once. It is important to keep them in perspective, both with the user costs of change, and with continuing network operational costs and benefits. Even a tiny percentage traffic stimulation effect brought about by an improved numbering scheme can rapidly pay for the costs of a numbering change.

3.6 Competitive Requirements of Numbering Schemes

When faced with the prospect of managing a numbering scheme previously run by a monopoly in a way that several new competitors will accept as fair, a new regulator must proceed carefully. Fortunately, the requirements of new competitors can be identified, and in most countries can be fulfilled with little change to the numbering scheme.

New local loop competitors require adequate **local number capacity** in each area where they plan to operate. Although alternatives have been considered and evaluated, it has become normal in countries which have introduced local loop competition for all competitors to share any geographic significance of numbers, in accordance with user preferences. (The only current important exception seems to be Japan). This only causes problems if all number ranges in an area are already in use, or if many competitors want

new ranges in an area. In either case, more local capacity would probably soon be needed even without competition, so a capacity review should be brought forward.

Long-distance competitors require **carrier selection codes** to enable their services to be accessed call-by-call. This is much less important if equal access preselection is introduced for long-distance carriers, as selecting them takes place less often and longer codes are acceptable. Any free numbering range can be used for carrier selection, but it is increasingly common to use a range which is already familiar for short codes – for example the 10XXX range, or other 1YXX short codes. The European Telecommunications Office (ETO) is studying possible European harmonisation in this area.

New network operators and service providers require numbering **capacity for new services.** Again, it has become usual, in accordance with user preferences, for all competitors to share nationally recognised codes for services such as freephone, or premium rate. Again, any capacity problem that this requirement seems to create would probably have happened soon anyway. Some competitors may want "special" service space for proprietary services that do not yet have a widely recognised service description. The regulator may, as is planned in Germany, set aside a limited amount of numbering space for "branding"; or may, as in the UK, say that operators receiving any such allocations must be prepared for operator portability to be required at some future time.

New local loop competitors will want similar access to **short codes** as is enjoyed by the incumbent. Since these codes are re-used by each access network, this is a relatively easy problem to solve in capacity terms. However, it may be worth rethinking how these codes are used. International harmonisation may be appropriate for a few codes e.g. the emergency code 112 in Europe. National harmonisation (across competing operators) may be desirable for several more commonly used codes for services such as Directory Enquiries, fault reports, and Calling Line Identification suppression. But this need not preclude leaving a range of short codes for individual operators to use as they want – in the interests of innovation and competition.

Last but possibly most problematic is **operator number portability**. Portable numbering is most important for new competitors who are targeting small business customers: large businesses can keep separate lines for incoming traffic, and residential customers may have only a few correspondents to inform. In the early days of local competition, number portability may appear to new competitors to be crucial to their success and to the incumbent to be technically a very tall order. The size of this problem also can be over-rated. After the recent landmark Monopolies and Mergers Commission case in the UK, regulators are likely to see local number portability as at least a serious option wherever there is competition and modern exchanges. They will also be considering freephone and mobile number portability, where substantial benefits seem to be available at relatively low cost.

Personal numbers (otherwise known as Universal Personal Telecommunications or UPT numbers) can route calls to any terminal (e.g. home, office, mobile). The routing may change several times a day (on user demand or pre-programmed). This is an intelligent network (IN) function, and is likely to be combined with enhanced services (e.g. messaging). The service provides much of the functionality already provided by mobile terminals, and indeed may be perceived by users as equivalent to mobility. It

seems intuitively clear that such numbers, being “numbers for life”, should be portable between operators; however this will not occur automatically. Personal numbering services could create a massive new demand for numbers. Many numbering solutions are likely for UPT, some at each of local, national and international levels. The code 878 (equivalent to UPT on an alphanumeric key pad) has been suggested for this use, and 700 is gaining popularity.

Portable numbers may be portable by location (geographic portability); by operator at a single address (operator portability); by service (service portability); or some combination of these. Routing change is expected only from time to time, with reasonable notice, and is an administrative function. Portable numbering may be implemented through various evolving network technologies – full IN is not needed at the outset. Whether requiring portability is justified depends on the state of the network, and on the perceived desirability of local competition. Geographic portability may be seen as a market issue while operator portability is a competitive issue – but because similar techniques provide both facilities, the two are linked.

It is normally existing numbers that are ported, thus number portability should not greatly affect demand for numbers, (although it does have some indirect effects). One low-cost approach to meeting demand for portable numbers however is to designate some new numbering ranges as portable from the start similar to some existing non-geographic services.

4.0 Elements of Numbering Planning

4.1 Prudence and Good Husbandry

Some basic principles of numbering planning are straightforward but worth restating:

- Change is expensive: plan long-term so as to minimise changes.
- Keep the options open as long as possible, until one course of action is clearly right.
- The customer’s interest is the national interest (there is no serious conflict with the industry interest).

Simple mathematics shows that in theory, a NSN length of n digits yields 10^n numbers. For example:

A small rural exchange: n=2, 100 numbers may be plenty for ever;
Sri Lanka: n=7, 10m numbers for approximately ~20m people, will run out;
United Kingdom: n=10, 10,000m numbers for ~60m people, should last!

But not all of these numbers can be used, because:

- information in the number restricts the usable numbers e.g., the use of geographic area codes reduce number utilisation significantly.
- some numbers have less than the full NSN, e.g., in Germany NSN lengths vary between eight and eleven digits;

- administrative units for number allocation have a similar effect e.g. cellular service providers reduce maximum cellular number utilisation to around 60 percent;
- some ranges are set aside for dialling prefixes and short codes (e.g. 0, 1);
- some numbers are in post-use sterilisation (much-used numbers typically would be left a year before reallocation); and
- some frequently misdialled numbers are in permanent sterilisation.

Combining all these factors, it is probably unrealistic to aim for overall number utilisation above 20 percent, although a higher figure may be possible in a closed scheme.

Some 'good husbandry' guidelines for numbering are to:

- Allow for growth in adjacent numbering space, and plan smooth migration paths, including introducing longer numbers where needed;
- Keep the addition of special meaning in numbers to the necessary minimum;
- Leave some spare numbering space for the unforeseen;
- Allocate numbers in blocks of modest size (e.g. 10,000 numbers); and
- Retain the ability to reclaim under-used numbering space.

4.2 Open and Closed Numbering Schemes

The terms "open" and "closed" do not seem to be "officially" defined in ITU Recommendations, but are normally used as follows. A **closed** scheme has a single dialling procedure for an entire country, and no trunk dialling prefix; it usually though not necessarily has a single uniform number length. An **open** scheme has separate local and trunk dialling procedures; the lengths of codes and subscriber numbers may vary (though they do not always do so). Currently, closed schemes prevail in countries with:

- a relatively small geographic area (e.g. Hong Kong);
- a relatively small population/number of lines (e.g. Norway, Denmark);
- a NSN length of eight or less.

Schemes can change from open to closed or from closed to open, but the former is easier and more likely unless previously separate schemes are amalgamating. The main advantages of an open scheme are that customers can dial shorter numbers for local calls, and that geographic area identities are maintained. The main advantages of a closed scheme, on the other hand, are a uniform dialling procedure for all calls, and that a higher capacity utilisation is possible. (Also, as there is no need for a trunk prefix, one dialled digit can be saved on national calls).

In today's larger countries with longer numbers, open schemes are the norm. This may well remain so indefinitely. But gradually, as time passes, the balance of advantage moves towards closure: more people have modern phones (so the number of digits dialled

matters less); geographic structures get simpler, area codes shorter, non-geographic services are called more and international traffic grows. Some large countries are already looking seriously at closure as an option, and it is one that most countries should keep open for the long-term in case it looks desirable at some future time.

4.3 Geographic and Non-geographic Numbering

Traditionally, a high proportion of NDC space has been dedicated to geographic numbering (also referred to as PSTN, POTS, or STD codes). But now:

- switching/transmission economics favour fewer trunk exchanges, simpler network structures and fewer numbering areas;
- these factors are also leading to less distant-dependent tariffs, which in turn may mean larger and fewer local call areas;
- management efficiencies are leading to fewer administrative units. Historically these have often matched numbering areas.
- revenues from new non-geographic services (PANS, for example) are growing fast, and may overtake PSTN revenues.

In consequence, many countries are simplifying their geographic numbering structures and reducing the proportion of NDC space devoted to the PSTN. This has two incidental benefits: it improves the efficiency of use of numbering space; and users may be reconciled to the necessity of longer local numbers by the larger local dialling areas that accompany them.

The major benefit, however, is the freeing of space in the numbering plan for new services. These need distinctive numbers and may eventually need more capacity than geographic services. Typically, where the scheme allows, one or more initial digit (e.g. 8, 9) is allocated for new services, or otherwise a distinctive set of codes e.g. 900, 800, 700... (This particular series tends to be available even where the codes 90, 80, 70 or 9, 8, 7 are in geographic use, because local numbers rarely start with 0). The freephone code 800 has become one of the best examples of a de facto international standard; 900 for premium rate services is gaining ground but cannot yet claim such a status.

4.4 International Harmonisation

International numbering harmonisation is a subject of which we hear a great deal but to date have seen very little. It is one of those improvements which “sound nice”, but upon examination turns out to cost a surprising amount, and may be difficult to justify. It is notable that policymakers are among that minority of the public who travel a lot and make many international phone calls. Since they personally would benefit, they are at risk of overestimating the total benefit from harmonisation.

These remarks, however, apply to what may be termed “retrospective harmonisation” – or changing existing numbers of existing services. “Prospective harmonisation”, that is introducing the same new numbers for the same new services, is cheaper, though still not easy. Either kind of harmonisation costs less if done when other changes are made, and the opportunity should not be missed to consider harmonisation when a numbering plan is being changed for other reasons.

Particular candidates for harmonisation include:

- trunk and/or international dialling codes and procedures (to 0, 00)
- short codes, especially for emergencies and commonly used services
- new services – e.g. freephone (800), premium rate services (900?), personal numbering (700??).

Alternatives to harmonisation include:

- the use of international numbering space for service numbers e.g. +800
- shared use of national numbering space, e.g. the UK might make available for shared use some of the empty numbering ranges which its national code change has created behind the country code 44

A logical question for any regulator considering harmonisation must be: harmonise with whom? Some countries are part of a natural community of interest such as the European Union or the NANP. But for others the answer is much less obvious, and it can have wide political repercussions.

4.5 Planning a Major Numbering Change

The regulator who has decided to embark on a numbering review or is already committed to major change must consider the following,

4.5.1 Numbering Options

A systematic approach to a numbering review will entail:

- defining the options to be considered – a range should cover all sensible possibilities;
- listing the criteria to be used for evaluating the options. These will be heavily based on the customer and industry requirements mentioned above, and will also include the regulator's own requirements such as ease of management. The criteria should be weighted according to their overall importance;
- evaluating the options against the criteria. This should lead to an apparent "winner" and probably one or two plausible "runners-up";
- subjecting this result to common-sense criticism. In many countries this will be achieved by wide circulation of the material in an industry and public consultation.

Absolute requirements of all numbering options include:

- providing adequate numbering capacity (in both quantity and quality) for all foreseeable needs for the chosen planning period;
- being evolutionary, not revolutionary – i.e. being realisable through a step-by-step migration path from the status quo;

- the capability to trap misdialled calls during any transition period;
- long-term flexibility.

4.5.2 Implementing a Major Numbering Change

A big numbering change is itself a major management challenge. Assuming the decision on the chosen option has been made, decisions may yet remain on practical details such as whether the change should be all at once ("big bang") or in stages. A "big bang" may be simpler to publicise and more straightforward for the public; on the other hand, a staged change has a flatter resource profile and implies less commitment to precise dates. Also, with complex changes, staged changes may be easier for the public to assimilate.
A regulator's checklist of implementation requirements would include considerations such as the following.

Network operators must be sure to:

- implement the right changes to exchanges of different types. This sort of program cannot be implemented overnight. It must be gradual to avoid unacceptable risk of network failure;
- implement recorded announcements for misdialled calls;
- make changes to operational support systems (e.g. directories, any computer system holding telephone numbers); and
- ensure matching changes at international exchanges by overseas correspondent administrations.

For the general public, it is necessary to:

- obtain political assent to the change;
- provide advance publicity – far enough but not too far ahead (diary publishers usually need information two years ahead);
- plan a period of parallel running, to enable large business systems to be reprogrammed gradually; and
- provide support for changes to customer premises equipment, especially payphones and automatic alarms.

5.0 International Experience

5.1 Some Developed Country Examples

United Kingdom

After many years of study and consultation on options, in April 1995 a simple move to ten digits was implemented by putting '1' in front of all geographic numbers. Geographic numbers were thereby condensed from nearly 100 percent of the numbering space to only

ten percent. At the same time five cities with capacity problems were given new codes and longer local numbers. Further study is now in progress on how to relieve capacity problems in other cities and how to make best use of the large amount of new numbering capacity created by the change.

North American Numbering Plan

The NANP is still at an NSN length of ten digits, though the need to move to eleven is foreseen. Recently the number of area codes has been increased by allowing the middle digit to take any value (formerly it was restricted to the values 0 and 1). The freephone code 800 is near exhaustion and has been supplemented by the new code 888. Meanwhile a number of large urban areas have needed fresh code capacity. This has been provided in some cases by code splits and in some through overlay (i.e. use of two codes in the same area), although expansion through overlay has recently been found anti-competitive.

France

France moved in 1996 to a closed scheme with nine significant digits but ten dialled digits for all calls, i.e. retaining a "trunk prefix" (to become 0 instead of the current non-standard 16). The country is now divided into five big regions coded 1 to 5, with the first digits 6 to 9 being reserved for new services. Non-zero first digits may be used for carrier selection. The change is particularly simple because it follows an earlier change in 1985 when all numbers became a uniform 8 digits in two large areas (Greater Paris and the rest of France).

Germany

After a recent Expert Commission review, it has been decided that no immediate change is needed to permit competition to start in 1998. A full review is however planned medium-term. Carrier preselection will be required from the start of competition, and local number portability where possible. Special codes in the X00 series are reserved for new services.

The Netherlands

In 1995 the Netherlands moved from a non-uniform to a uniform open nine-digit scheme, with two- and three-digit area codes. Many former areas with four-digit codes were combined (in a logical way permitted by the earlier arrangements) into fewer, larger three-digit code areas. At the same time the many subscriber numbers starting with 1 were all changed so as to allow a new range of short codes in the 1XX range. Policy for use of this range is now under consideration.

Hong Kong

In early 1995 Hong Kong moved from seven digits to a closed uniform eight-digit scheme without geographic significance, by putting the free digit 2 in front of all geographic numbers. Competitors all share the same number ranges, and local number portability is required.

5.2 Case Study of a Developing Country: Sri Lanka

Typically, in a developed country, if a numbering change can be postponed then there is advantage in doing so. Costs are thereby not only postponed but also reduced, because the later network will be more modern and flexible. New options may also become technically possible, and the design of the new scheme may be improved by a better understanding of forthcoming developments.

In a developing country a different set of factors enters. The network may already be quite modern, though small, with the emphasis strongly on expansion. New exchanges are to be opened and many new customers connected. If there is to be a numbering change, then the sooner it happens, the fewer exchanges and people will be affected. A later change will cost more. The new services for which numbering capacity will be needed are already fairly clear from experience in the developed world. Not least, large populations who have never used the phone may soon do so for the first time – they stand to benefit from a new scheme designed for ease of use with them in mind. However, poor number information services mean changes should be systematic and easily described.

Arguments such as these convinced the Sri Lanka Telecom Authority (SLTA) in 1994 that the time was right for a review of the Sri Lanka numbering scheme. In parallel with the numbering review, there was much activity relating to the appointment of new wireless local loop (WLL) operators to compete with Sri Lanka Telecom. Indeed, a major objective for the numbering review was to ensure suitable numbering for these newcomers. Because of slippage in the licensing timetable, it has not yet been possible to finalise the new plan. The following changes are likely to happen, but details may still change.

The current plan in Sri Lanka is a conventional seven-digit open scheme. The island is split into 28 numbering areas, each with its own trunk code. Calls within each area are dialled by just the local number – which in Colombo has six digits, elsewhere usually four or five digits. Calls outside the local area are prefixed by the trunk prefix 0 plus the trunk code. Three cities – Colombo, Kandy and Galle – have single-digit trunk codes (respectively 01, 08 and 09); the other 25 areas have two-digit codes.

The proposed revised geographical structure represents a radical simplification into only five new numbering regions, which correspond to the areas covered by tertiary switching centres. Particular features worth note in the Sri Lankan proposals include:

- a long-term aim to achieve uniform eight-digit numbers everywhere and for all services. Such uniformity makes life easier for users (especially new users) and is also simpler for equipment to handle;

- the option of closing the scheme, i.e. of dialling the full eight digits for every call and dropping the trunk prefix. (The code for Colombo has been planned to change from 1 to avoid a clash with 1XX short codes if the scheme is closed);

- the availability of the initial digits 7, 8 and 9 for new services. Cellular is already in the 07 range so it seems a natural home for future mobile services. Freephone on 0800 is a clear possibility. Part of 9 is also reserved to allow for possible long-term expansion to longer numbers;

- the likelihood that the new WLL operators will find a single numbering range in each region adequate – while under the old scheme they might need many separate ranges;
- the possibility of smooth implementation of the changes. The proposals were devised with the ease of the transition very much in mind, and most changes can be achieved by inserting a new digit or digits into the early part of existing numbers; and
- the conformity of the new scheme with international recommendations and de facto standards. Because it will "feel familiar" to foreign visitors, the new scheme should give a small but useful boost to both trade and tourism. Sri Lankans abroad will benefit similarly.

6.0 Conclusion

It is apparent that numbers are an extremely valuable public resource for all industry players and users. If bought and sold in an open market, they could command common fees. They could also provide significant barriers to entry, limitations on service development and network inefficiency. However effective long term planning and close monitoring of industry developments by telecom regulators can ensure that efficiency and service benefits are maximized and numbers provide a foundation for a full range of competitive opportunities.