A strategic numbering review

A report to the DGTP

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Summary of recommendations

Objectives of the study

This study has three main objectives:

- to identify major trends in the development and management of naming and addressing schemes
- to assess the impact which these trends will have on the development of the Dutch E.164 numbering plan and other important naming and addressing schemes used by Dutch citizens
- to evaluate and make recommendations on the role which the Dutch government should play in the future management of key naming and addressing schemes.

Focus of work

Based on our analysis of the current situation and likely market developments we recommend that the Dutch government should focus it research on developments in four key naming and addressing schemes:

- the naming scheme of the E.164 numbering plan
- the IMSIs of ITU Recommendation E.212
- domain naming
- IP addressing.

Developments in IP naming and addressing

We recommend that the Government should:

- support the position that names are principally allocated on a service and/or geographical basis and not on the basis of technology. This means that networks that provide telephony over IP will qualify for E.164 numbers according to the same criteria as circuit switched networks
- discourage the embedding of numbers into addresses or add a requirement to the numbering conventions that this practice should not be followed
- ensure that servers that do translations from E.164 to IP maintain adequate security and receive regular updates from the organisations responsible for allocating E.164 numbers.
- study further the development of reverse mapping, which allows IP addresses to be mapped onto domain names, to ensure that they meet the Government's requirements for lawful interception
- maintain awareness of the technical issues involved in IP naming and addressing by participating in at least some of the development work within ITU-T, ETSI, and IETF.

Public directory services

The development of comprehensive public directory services in the Netherlands is important to maximise effective use of telecommunications services. With this objective in mind we recommend that the Government should consider the following measures, if they have not already been implemented:

- assess the case for requiring all numbering and naming assignment authorities to provide information for inclusion in a reference directories database in return for a reasonable charge

- support the establishment of any national reference database for directories with appropriate regulatory controls and accountability
- if established, make this database accessible to organisations wishing to offer public directory services
- establish more sophisticated policies on privacy and the rights of users with respect to public directory services to encourage users to supply directory information.

The Government should review the actions it has taken to enable competition in mainstream voice directory services. In particular it should ensure that it has taken adequate measures to:

- require KPN, as the dominant operator in the Netherlands, to offer its listings database to others at a reasonable and non-discriminatory price ie a charge which is the same as the transfer price which it charges to its own voice directory services subsidiary
- require KPN to offer access to its online search engine at a reasonable and non-discriminatory charge
- structure access codes for competitive voice directory service providers so as to enable them compete on equitable terms with access network operators like KPN. This might involve customers accessing independent directory service providers using 1XX short codes or short numbers from the 800 and/or 900 ranges.

IMSIs

The Government has already developed a plan for IMSIs and taken the necessary steps to ensure that Mobile Network Code capacity is not wasted. We recommend that it should:

- discuss with the industry whether ways can be found to re-use IMSIs released by the termination of contracts, after a suitable sterilisation period
- take no further actions until the way in which the market is going to develop becomes clearer.

Shortages in the Dutch E.164 plan

To minimise the number of ***geographic*** NDCs requiring relief, and to provide relief if and when it is needed, we recommend that the Government should:

- continue its current good practice of careful management of number block allocation
- move as soon as possible to 1000-number block allocation (number pooling) in the areas where it is most needed, and possibly within the next 5 years to single number allocation if that seems desirable in particular areas
- prepare contingency plans to enable migration to 3-digit codes[1] which do not end in 0 or 1[2] in areas with potential capacity shortages. Then each group of 3-digit codes starting with the same 2-digit codes can readily be merged into a single new 2-digit code area with no change to procedures for dialling into the area
- prepare contingency plans for the relief of exhausted areas with 2-digit NDCs within the existing framework. In the short term the options are an overlay or a split. In the longer term options3 include:

  widespread implementation of contingency plans, so that all or nearly all NDCs have 2 rather than 3 digits

[1] The three digits excluding the leading digit 0

[2] Codes ending in 9 also need special consideration; see main text.

[3] Ordered from the least to the most radical.

an additional digit on local numbers, possibly applied only where needed to minimise disruption, or possibly across-the-board so as to retain uniformity

moving to a closed scheme, with first regional and later national geographic number portability.

To deal with possible shortages in the mobile range we recommend that the Government should hold two sub-ranges in reserve - one to permit easy expansion to an additional digit for mobile numbers, and another which could be used from the start with longer numbers

The Government should set aside parts of the unused 08 (or possibly 06 or 09) sub-ranges for new applications where ***numbers are dialled only or mainly by machines*** rather than human beings. Numbers for this purpose should be issued at the longest practicable digit length[4] . Differential charging may be needed to incentivise operators to use these longer numbers

As a matter of urgency, the Government should take action to deal with the impending shortage of ***1XX access codes***. This is already in hand.

The Government's role in managing naming and addressing schemes

The Government should not play any role in the administration of IP addresses.

The Government should continue to play a strong role in the administration of the E.164 plan – both to ensure the right balance between the interests of users and the industry and, to a lesser extent, to ensure equitable access to E.164 numbers for rival service providers.

The Government should leave the current procedures for domain name allocation unchanged and simply monitor the activities of the Dutch Foundation for Domain Name Registration and of ISPs which allocate domain names to see whether there is any development which significantly damages the interests of Dutch consumers or businesses.

The Government could consider giving OPTA a more important role in policy formulation on the E164 plan, while retaining overall authority over all policy decisions. The advantages and disadvantages of such a move are finely balanced. It would bring closer together those responsible for policy formulation and operational management functions and those responsible for competitive and numbering issues. But it would also weaken the checks and balances inherent in the current arrangements in the Netherlands. We make no recommendation here. This is a matter for the Government to decide. In doing so it will need to take account of the findings of an ongoing study on how to make the Dutch numbering plan more flexible.

The Government should consider outsourcing, to a private company chosen by competitive tender, E.164 operational management functions which are stable, which can be strictly codified and which are significant enough to justify the one off cost of the outsourcing process.

The Government should:

- review the rights of use to E164 numbers and number blocks by end users and service providers
- specify these rights of use explicitly.

The Government should consider introducing legislation to allow it to charge at higher rates for numbering resources. If it does so it is important to limit the extent of these charges, both to reassure the industry that they are not a tax on telecommunications service providers and to comply with EU requirements. The obvious constraint is that the Government should only have the power to set charges which can be justified on the grounds that they enable efficient allocation and use of numbers.

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[4] If possible, the full 13 significant digits permitted by the international 15-digit limit (with a 2-digit country code), or 12 digits if it is desired to allow for the risk of the current country code being extended to 3 digits.

1 Introduction

1.1 Background

In July 1999 the DGTP commissioned Ovum to carry out a review of major trends in numbering and addressing schemes[5]. This study has three main objectives:

- to identify major trends in the development and management of naming and addressing schemes
- to assess the impact which these trends will have on the development of the Dutch E.164 numbering plan and other important naming and addressing schemes used by Dutch citizens
- to evaluate and make recommendations on the role which the Dutch government should play in the future management of key naming and addressing schemes.

Ovum carried out an initial Phase 1 review which identified key issues. It then studied and analysed these issues in detail in Phase 2. This document present a report on the findings of both phases.

1.2 Key market developments

In Phase 1 of the study we identified the following market developments which will affect future demand for naming and addressing schemes in the Netherlands:

- growth in the use of telecommunication services shows no sign of slowing down. There is strong growth in demand for basis voice services, especially on mobile networks, and correspondingly strong demand for new E.164 numbers. At the same time the explosive growth in the use of the Internet, with corresponding demand for IP names and addresses, continues
- the proportion of data traffic carried on networks is rapidly overtaking the proportion of voice traffic. In response network operators are moving from circuit switched to IP based networks. These will, in future, require a mix of E.164 numbers and IP names and addresses
- there is a proliferation of user roles, terminal types, types of network termination point, service offerings and service providers offering these services. As a result there is a rapid growth in the complexity of the relationship between these entities and new challenges for the naming and addressing schemes required to label and manage these relationships
- mobile services are becoming price competitive with fixed services leading to convergence and integration of fixed and mobile services. This puts new demands on the E.164 numbering plans
- we are likely to see a rapid growth in machine to machine communication as almost all electrical and electronic appliances in homes and offices acquire intelligence and communications capability. This could create massive new demands for addresses
- the proliferation of telecommunication services, and the expansion of the naming schemes which they use, will make it increasingly difficult for callers to find the name or number of the person or service they want to call. The current rapid developments in intelligent terminals, with storage, voice response, and data capability, will go some way to addressing this need. But there is also a strong need for improved and more comprehensive public directory services
- callers will face an increasing problem in getting information, and especially pricing information, from the number dialled. This leads to a requirement for:

[5] Such as the E.164 numbering scheme, domain names and IP addresses

services which provide this information in other ways

control over how service providers remove information from the number called eg the number portability services which are allowed

- we will see a growing use of alphanumeric character strings, rather than digits, to establish calls. This has implications for public directory services. It also means that the registration processes for names and numbers should offer protection of trademarks and intellectual property and prevent "passing off"[6]
- businesses and consumers will make increasing use of telecommunication services to purchase goods and services. They may use the billing function of these services to collect the money owed. This gives names and numbers an important new role in authenticating purchasers
- we will see a move from block allocation of E.164 numbers to individual number allocation. This will have important consequences for both utilisation of numbering space and the administrative procedures required.

1.3 The structure of this report

In combination the developments listed above pose major challenges for the development and management of numbering and addressing schemes used by Dutch citizens. So in this report we analyse the key developments in detail and assess the role the Dutch government might play in:

- influencing the development of the key numbering and addressing schemes
- managing these schemes in an effective way.

We start in Chapter 2 with a brief review of the naming and addressing schemes and the relationship between them. We then consider in Chapter 3 the convergence of voice and data networks and the numbering consequences of a long term move from circuit switched to IP based networks. Chapter 4 discusses how we might improve the effectiveness of public directory services while Chapter 5 deals briefly with demand for IMSIs. In Chapter 6 we assess the likely impact of the market developments listed in Section 1.2 on the Dutch E.164 plan. Then in Chapter 7 and 8 we consider administration of naming and addressing schemes - Chapter 7 looks at IP naming and addressing while Chapter 8 looks at administrative models for E.164 numbering. Based on this assessment we make overall recommendations in Chapter 9 for the revised role of the Dutch government in the administration of naming and addressing schemes. Finally in Chapter 10 we provide a summary of our conclusions and recommendations.

[6] Where one person pretends through a name or number to be someone else in order to win business from them

2 An overview of naming and addressing schemes

2.1 Numbers, names, addresses

Names and addresses are normally distinguished as follows in telecommunications:

- a ***name*** is a unique identifier of an entity that may be communicated with via a network. It does not normally indicate explicitly which network, or exactly where the entity is located. The name is used for identifying the calling and called parties within the service that is being provided. A name may contain some location information but this is not precisely related to the network structure.
- an ***address*** is a specification of the location of the entity in terms of network structure. It includes the identity of the network to which it is connected and some information about the location within that network

We use these terms in this way throughout this report. Figure 2.1 shows the relationship between names and addresses for telephony and current web applications. The differences between the Tiphon and SIP based solutions for telephony over IP are explained in Chapter 3.

Figure 2.1 Names numbers and addresses

	Telephony on switched circuit network	*Email*	*Tiphon solution for telephony on IP*	*SIP based solution for telephony on IP*
Name	E.164 number	user@host where host is described by a domain name	E.164 number	user@host, possibly with an E.164 alias for incoming calls from the switched circuit networks
Address	Routing E.164 number, or (routing prefix +E.164 number)	IP address	IP address	IP address

E.164 defines a public numbering system for the PSTN/ISDN. In practice it also includes mobile networks. For various historical reasons, E.164 numbers are a mixture of names and addresses, but the trend is to reduce the use of E.164 numbers as addresses and use them more as names. The move to operator and location portability are good examples of this trend. When addresses are needed in switched circuit networks, routing numbers are used instead of the E.164 name (number) or a routing prefix is added to the front of the E.164 number.

E.164 also has other problems in that it supports multiple terminal types with incompatible functionality, such as a telephones, faxes, and modems, and therefore in some sense supports different services. This disadvantage is counter-balanced by the benefit that it uses a digit string and therefore has much better compatibility across widely different cultures than any alphabetical system could have.

2.2 The basic characteristics of E.164 numbers

Length

International E.164 numbers have a maximum length of 15 digits, although most countries do not use more than 12 digits. The maximum length changed in 1996 to 15 digits from 12 digits. It is unlikely that a further increase would be agreed in ITU-T within the next decade. The current ITU review of country codes could, however, have an impact. One option under consideration is extending 2-digit country codes to 3 digits. This would reduce the number of significant digits available for national numbers in these countries from 13 to 12.

Structures

Most national geographic numbers are structured such that the first part of the number contains information that is perceived and used by many callers. For example, the first part may indicate:

- the service and thence the likely tariff level
- the location of the called party
- the operator that serves the called party

Tariff and location are the information of most value to the user. Operator information is of little or no value to them[7].

Number structures result in low ratios of used numbers to total number space because the number structure has to handle the largest number of numbers of each category.

Portability

Authorities already required certain numbers to be portable between operators. The extension of portability to services and location is prevented by the need for callers to obtain this information and any implicit tariff information from the number. Other means of obtaining tariff (tariff transparency) and location information are expected to increase and reduce the value of obtaining this information from the number itself. This may allow greater portability, which will in turn remove the significance of the structure from the number. Removing the structure will increase the maximum ratio achievable for used to total numbers.

Allocation

Most numbers, except some non-geographic numbers such as freephone, are allocated in blocks to operators, who sub-allocate them to their initial customers. Customers may subsequently port the numbers between operators. Block allocation is inefficient as it results in many blocks being lightly used. Individual allocation directly to customers would be more efficient but would require greater intelligence for routing within the networks. We expect a trend towards individual allocation that will facilitate more efficient use of numbers.

2.3 The basic characteristics of domain names

The domain name scheme used for web addresses and emails is working well and proving popular. The main problems concern the ownership of names and the possibilities for individuals or organisations to register names that look as if they would belong to other organisations or are likely to be requested at a later date by other organisations (speculative investment in names). To some extent the user friendliness of the domain names themselves is suppressing the development of directories, which were foreseen originally as an important part of communications on the web.

The domain name is the centre of the naming system and is used by various different protocols. Examples are:

- email address: dml@ovum.com
- document URL: http://www.ovum.com

In both cases the domain name is “ovum.com” and currently upper and lower case letters are not distinguished form each other. For the email address, “dml” is a local identifier under the Simple Mail Transfer Protocol (SMTP) protocol for email. For the document URL:

- http indicates the protocol to be used

[7] Although it may be useful in that it conveys tariff information as well.

- www indicates the server to used at the Ovum host

Domain names are structured. The highest part is at the right hand end of the name which is called the Top Level Domain (TLD). Values within each TLD are assigned by competing Domain Name Registrars under rules established by the Domain Name Supporting Organisation of ICANN. The assignments for each TLD are held in a single registry (one per TLD) and updated by the registrars.

The domain names are supported by the Domain Name Server (DNS) system which stores Resource Records. The function of the DNS system is to "resolve" a domain name to an IP address and other information relating to the name. The IP address is used by the routers which handle the packets.

Annex A provides more details on domain names.

2.4 The basic characteristics of IP addresses

IP addresses are strings of binary digits that are used to identify the destination of a packet by the routers that handle the packet in the IP Layer.

Currently the version of the IP protocol used almost universally is IPv4, but a later version has been defined (IPv6) and networks are starting the process of migrating from IPv4 to IPv6. See later in this section for more detail.

IP addresses are divided, in principle, into two parts:

- the identity of the network (eg the ISP)
- the identity of the host (the destination of the IP packet)

The identity of the host is assigned and managed by the network.

Annex B provides more details on IP addressing.

2.5 Other schemes

ATM End System Addresses (AESAs)

ATM End System Addresses (AESAs) provide an addressing scheme, defined by ITU - SG2, for use with ATM networks. ATM is used widely but primarily for permanent virtual circuits, which do not need AESAs. Switched virtual circuits do need AESAs and we understand that there is some use of this form of circuit. However we believe that AESAs are used primarily within networks and not across network boundaries. So management and allocation issues are not, as yet, important.

Operators will probably use IP to support most services in future but it is possible that a significant demand for ATM switched virtual circuits may will arise to support high bandwidth real time applications such as high quality video conferencing. These are not especially suited to the long packets of IP and operators might look to the shorter packets of ATM for better quality of service.

As defined, the current AESA scheme allows the embedding of names such as E.164 numbers, and the DCC and ICP versions of NSAPs. For the reason set out in Section 3.6 we do not believe that such embedding is sound from an architectural point of view. At the moment there is little interest in using or developing the AESAs scheme. But if such interest increases in future then we suggest that the addressing of broadband services that need AESAs should be rethought to allow a proper layered separation of names and addresses.

We do not think that there is sufficient interest in ATM switched virtual circuits to make it worthwhile for DGTP/OPTA to devote resources to this subject at present. If greater interest develops, then we recommend that DGTP/OPTA should study the subject in greater detail.

E.212 Land mobiles

E.212 is a scheme which identifies land mobiles (the IMSI) and is used during the terminal registration process. The numbers are held of SIM cards and contain the identity of the home network. They are not portable and do not need to be because the numbers are not called by users. We consider this addressing scheme further in Chapter 5.

X.400

X.400 is a declining service and its naming structure is generally regarded as too complex. It is expected to fade out over the next 5 years and we do not consider this scheme further in our study.

X.121

The use of X.121 does not appear to be increasing and is expected to decline as applications move across to IP. The distinction between ADMDs and PRMDs has caused difficulties and has not always been resolved adequately, but the future use of X.121 is not sufficiently great for it to merit further attention in this study.

3 Numbering for telephony over IP

3.1 Introduction and history

There are two distinct forms of telephony on the Internet:

- telephony over the public Internet available today
- the use of Internet technology to replace the current technologies used in public and corporate telecommunications systems today.

Both use the same basic technology but there are significant differences.

Telephony over the public Internet is used by some residential Internet users as a means of avoiding the high charges for international calls. A user needs additional software in his PC and dials into his Internet Service Provider (ISP) at a time arranged in advance with his correspondent, who must also dial into their ISP. He is then able to establish a call to the correspondent over the Internet. Quality is normally very poor but adequate for intelligible conversation provided that the Internet is not too congested. This service offers international calls at the price of a two local calls, which is very attractive to some users, and makes log conversations between friends and family members an economic possibility. But there is a growing consensus that voice over Internet applications will not be a significant development and we do not consider them further in this report.

In contrast there is a strong consensus within the telecommunications industry that all telecommunications networks will migrate to IP technology for both voice and data services, because it offers:

a single network that can support multiple services

significant cost savings, both from the greater efficiency and the economies of scale in the production of key components such as routers

This is a development with major consequences for both E.164 numbering and IP naming and addressing.

The migration is starting first in corporate networks and international bypass networks, but gradually the technology will be introduced into public networks such as KPN starting at the centre and working outwards. The technological developments needed to provide adequate quality and network security, as well as the support of call by call billing may take several years.

3.2 Standards for telephony over IP

The provision of telephony on IP technology (also referred to as voice over IP) is the area where the two different cultures of the traditional telecommunications industry and the Internet industry now meet.

The Internet culture has developed from the highly competitive data communications and computing industries, with a significant degree of leadership provided especially in the early years by academics. Standardisation is undertaken by the Internet Engineering Task Force (IETF) which produces Requests for Comments (RFCs), which have always been distributed freely in electronic form. Their stated approach to standards is to be "contribution driven" and totally democratic, although in practice the key RFCs, which become INTERNET Standards are carefully controlled and the Internet is supervised by the Internet Architecture Board of 12 elected members, each with a high degree of expertise.

Within the IETF, there is no formal system for specification such as the 3-stage model of service descriptions, information flows and protocols which is common in telecommunications standards making. The specification of protocols is normally limited to specifying messages and not the state machine behaviours of the communicating entity. The IETF approach is "rough standards and working code". Many of the practical

ambiguities that result from the less formal approach are resolved by Interoperability events where equipment from different vendors is tested together.

Standards making in the telecommunications culture is undertaken by the ITU-T and ETSI. In general, ETSI tries to complement ITU-T by:

- working faster and feeding inputs to ITU-T
- producing more narrowly specified European profiles
- producing more detailed specifications with more use of formal description and test specification methods.

Now the increase in performance of IP technology has made possible its use for providing telephony and the telecommunications industry has recognised the cost savings and advantages from using IP technology as a platform for all services (what ISDN was intended to be did not achieve). These factors have drawn the two communities together.

Because of the different Internet and telecommunications cultures, two different solutions are being developed for telephony over IP:

- IETF is developing a solution based on the Session Initiation Protocol (SIP), which copies, where appropriate, the design of the HTTP protocol that is used for the Web
- ITU-T and ETSI are developing a solution based on H.323, which is a protocol for the support of multimedia terminals. H.323 was developed originally for LANs but has been extended for wider application. H.323 is designed around the Q.931 (ISDN network - terminal protocol) concepts.

Behind the two cultures there are very different approaches to networks. The current Internet model is for largely open networks with no guarantees of call quality and no usage related charges. The telecommunications model is the opposite. Yet because the current work in ITU/ETSI is based on H.323, which was originally developed for an end system such as a LAN, ITU/ETSI do not appear to be giving sufficient attention to the issues of working across multiple interconnected networks, each with their own distinct boundaries. ITU-T is, however, planning to extend its work on Bearer Independent Call Control (BICC) to include the support of ISDN inter-exchange signalling (ISUP) over IP. BICC may be used by networks that use H.323 but is likely to be irrelevant to solutions based on SIP.

The situation can be described with the following analogy. Both H.323 and SIP treat the Internet as land that may be divided up and owned by different people, but where there are no fences or hedges at the boundaries. The current telecommunications models require careful control of boundaries and gateways because of:

- the need to charge for calls
- the need to provide at least some guarantee of quality
- the need to be able to intercept calls (lawful interception)

These aspects do not seem to be addressed adequately at present and this shortcoming may delay the migration to IP technology for public networks. Consequently there may be a significant delay between migration to IP for terminating networks (corporate and private networks) and the migration for public networks especially transit networks.

3.3 Market development

Few operators are offering clear views about the development of the market for voice over IP. This may be because:

- ISPs are too busy handling the rapid growth of the existing Internet services
- operators of switched circuit networks (SCNs) are still recovering from the re-organisations that followed liberalisation and the need to change plans from the previous view of an ATM based broadband future

A major factor for established SCN operators is their investment in PSTN/ISDN. These networks have potentially long lives and apart from the growth in Internet access, their traffic volumes are reasonably stable and may reduce as VoIP grows. There seems to be little point in replacing these networks, so it is likely that operators will build up an IP overlay that will provide for VoIP.

There is a general view that the public Internet may not be sufficient for good quality telephony and that more carefully controlled and better resourced IP networks will be needed. These and other factors suggest that the first phase of developments will be:

- corporate networks moving telephony from PBXs onto IP. This will probably start with using web pages to initiate calls to call centres (click to call). This move will provide better services and reduce costs.
- international bypass services using IP technology but with dial-in from and breakout to the PSTN. In this case IP technology offers reduced cost and more flexibility in handling traffic peaks through reducing codec rates adaptively.
- ISPs starting to offer IP based access, including dial-up access into the ISP, to the international services. This would be aimed at both the corporate and residential markets

The second phase will depend on the more established operators developing interconnected IP based networks with an appropriate commercial model for charging. These networks will interconnect corporate networks.

VoIP for the residential user will be greatly facilitated by the introduction of ADSL which will stimulate the introduction of LANs in homes with entertainment, computing, control systems and telecommunications all integrated together.

3.4 VoIP Technologies

VoIP is being approached from two directions by:

- the “Bellheads” in ITU and ETSI who are working on the basis of H.323
- the “Netheads” in IETF, who are working on the basis of SIP

There is a fundamental difference in the underlying philosophy of the two groups:

- Bellheads design “stateful” networks where there is knowledge information about a call which is retained in switches for at least the duration of the call. Stateful networks have to be constructed carefully and if everything does not fit together correctly then calls do not work. In other words stateful networks depend on an ***AND*** combination of tasks.
- Netheads design “stateless” networks where tasks are subdivided so that each element can undertake a task and then forget what it has just done. Stateless networks are designed to be highly resilient and independent of topology and interconnection arrangements. They depend more on an ***OR*** combination of tasks.

One paramount reason for statefulness is the ability to record and charge for individual calls (lawful interception). This approach is foreign to Netheads who are used to networks funded by subscription with a much lower overhead of administration. Many people think that call related charging will disappear eventually but it may need to be supported on early VoIP networks.

These fundamental differences surface in many forms over and over again. In particular we can see them when we look at the two rival protocols for carrying voice over IP ie:

- SIP and the associated PINT for PSTN and Internet interworking
- H323.

Annex C presents a description of these protocols and their differences.

3.5 Overview of current numbering for telephony on IP

The current situation on numbering for telephony on IP is confused and it is not possible to predict with confidence how the various issues will be resolved. The main causes of the confusion are:

- the absence of any agreed architecture for telephony over IP
- the absence of any common service description or agreement that all technologies are supporting the same service. The absence of the concept of a common service results in lack of recognition of the need for a common numbering system for use on all technologies.
- the wide range of possibilities created by the technology
- a desire to support many different new functionalities before the basic ones are established

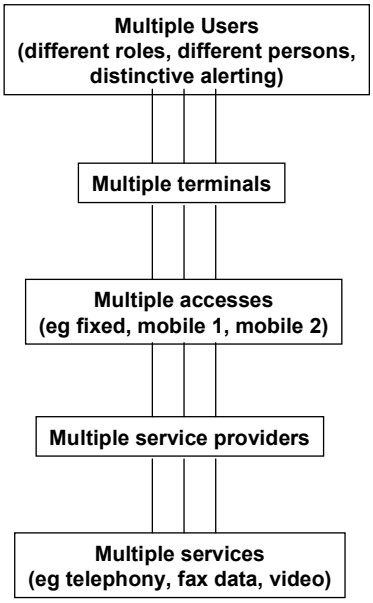
There seem to be three general objectives in the minds of the people involved:

- the development of solutions to the "multi-everything" problem discussed below
- the development of something that is more user friendly than E.164, but no one knows what
- the support of user and terminal mobility

The "multi-everything" problem is a name that Ovum has given to the multiplicity of associations now possible between user, terminal, access, service provider and service. In the past there was one user per terminal that was connected to one access and supported one service. Now there is a change to multiplicity at every level of the hierarchy as shown in Figure 3.1.

In this environment ITU, ETSI and the IETF are all working on various aspects of naming and addressing for VoIP services as described in Annex D.

Figure 3.1 Multi-everything



3.6 Unresolved issues

Given the multiplicity of work described in Annex D it is not surprising that there are a number of major issues currently unresolved. We describe these below.

A numbering scheme for a service

Within ETSI and to some extent ITU-T, there is a growing view that services should be defined in a way that is independent of the means by which they are implemented. Thus in principle there should be a single service description for voice telephony independent of whether it is implemented over PSTN, ISDN, GSM or IP or a private (corporate) network. In practice this has not been followed through consistently, but there have been attempts to reduce the differences between ISDN, GSM and corporate network standards.

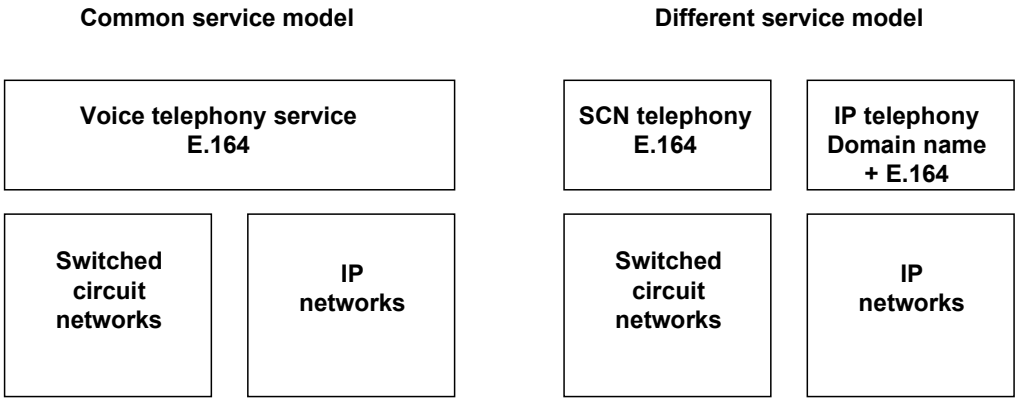
This view of services leads to the critical question of what service is to be supported over IP. Tiphon decided at its last meeting that it was working on the support of the existing telephony service, with the possible addition of some new functions. Tiphon decided that is was definitely not inventing a "new telephony". This question has not been considered within IETF.

The question affects the choice of numbering because interconnected networks that are providing a common service benefit form having a common numbering (naming) scheme. This leads to two alternative models:

- the common service model: Both switched circuit networks and IP are supporting the same telephony service, E.164 is the numbering scheme for telephony and therefore E.164 should be supported on IP in the same way that is supported on SCNs.
- the different service model: SCNs and IP networks support different telephony services each with their own different numbering schemes. Because the services are sufficiently similar to be able to interwork meaningfully, and because of the large volume of established telephone customers on SCNs and because most of those telephones cannot handle alphabetical characters, those IP telephones that need to interwork need to have an E.164 number in addition to whatever native naming scheme they may have within the IP based world.

These models are shown in Figure 3.2.

Figure 3.2 The two models of voice telephony services



Tiphon is using the common service model; currently it appears that the IETF is working mainly on the unspoken assumption of the different service model.

Figure 3.3 shows how the common service numbering would work. All operators obtain numbers through NRAs acting under ITU-T because E.164 is an ITU-T scheme. This includes IP based operators. the operators allocate the numbers to customers with support or portability as required under national or regional legislation. Those operators who use IP need to register the E.164 numbers and the IP address (normally of their gatekeeper) with an E.164 server system that could and probably should be modelled on DNS but would be physically separate from DNS. This server and its secondary servers would provide the translations from E.164 to the IP addresses of gatekeepers for call set-up. There would be

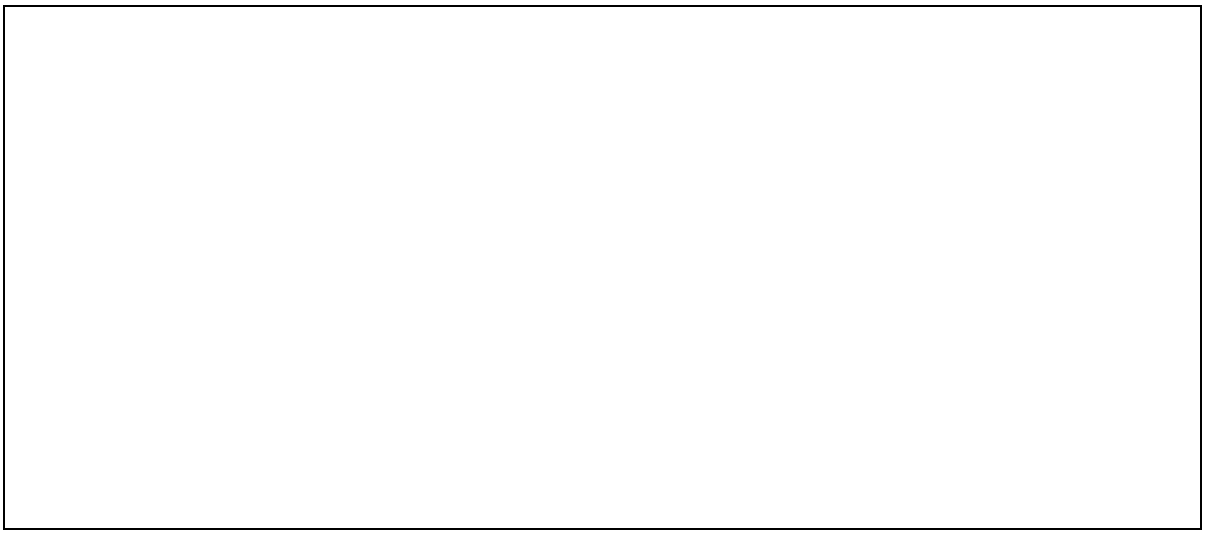
no registration of E.164 numbers with customers under ICANN and so no confusion of authorities.

Work in Tiphon on E.164 to IP resolution is at an early stage. Initial thinking assumed the need for a global system for resolution (like DNS), but if strong network boundaries are maintained, there may be a series of E.164-IP resolutions, each internal to a network, and the need for a global system may reduce or disappear. It is too early to predict the outcome with certainty.

Some parties argue that IP telephony is a different service because the supplementary services that will be supported are fewer than those for ISDN and because quality of service may be lower. These parties therefore argue that IP telephony should have distinctive numbering. Ovum's views on this issue are as follows:

- service categories defined for the purposes of distinctions in numbering should be defined from the perspective of the user and should not be based on fine technical distinctions (eg they should not be tied to whether or not separate service codes are needed in signalling)
- numbering should not become technology specific
- service providers and network operators should be allowed some choice over numbering eg geographic vs non-geographic numbering
- numbering arrangements for telephony services that are different for circuit switched and IP based networks will reduce competition, They will put IP network operators at a commercial disadvantage in winning customers currently served by the PSTN/ISDN.

Figure 3.3 Common service numbering



Operating across different service domains

IP networks support a range of different services. Clearly many applications will want to initiate telephony calls. The use of a protocol indicator such as

tel: +44 20 7551 9000

is wholly appropriate for initiating an activity in another service domain with a different naming system. In practice "tel:" says " I want to use the telephony service. "+44 20 7551 9000" says "this is the number that I want to call with the telephony service".

Embedding

The practice of embedding a number used primarily for one service in a different naming or addressing space is becoming common. Examples are:

- the use of E.164 numbers within NSAPs (a Network Service Access Point address is the identity of the access point at the top of the Network Layer in the OSI model. Despite the use of the word "address", this is really a name in telecommunications language, so this is a name within a name.)
- the use of E.164 numbers within AESAs(an ITU-T design), which are addresses (a number within a name)
- the use of IP addresses at the application level in some IP applications such as ftp (an address within a name)
- the option in IPv6 to use NSAPs within IP addresses (a name within an address, even an E.164 number within an IP address)

There is also:

- the proposed use of E.164 numbers in domain names (see ENUM)
- the proposed use of E.164 numbers within IP addresses (see IPng draft)

Embedding is normally done by using a numbering scheme identifier followed by the embedded number. It is not easy to determine exactly what embedding really means. There seem to be two possibilities:

- it is an escape code indicating that the communications should be routed to a gateway and then into the different service domain where the embedded number is normally used.
- the area that is using the embedded number is copying the structure and allocations of the embedded numbering system. This in turn suggests that practical problems may be worst where the numbering (naming) scheme has a structure, such as the geographical structure of most of E.164.

Embedding raises a question of authority. For a particular service type there is normally an established authority system for the allocation of numbers, to avoid duplication and to follow whatever principles are needed. If a number type from one authority system is used in a different service area that is under another authority system there is a risk of confusion. It would therefore appear to be essential that, if embedded numbers are used, the system that embeds them must be slaved to the authority system that supervised the embedded number. The means that if the system that uses embedded numbers wants a new number then it will have to make application to the authority over the embedded numbering system.

Figure 3.4 illustrates the authority issue in relation to the ENUM proposal. Registration of E.164 numbers under e164.int should be controlled only by the entities that allocate the E.164 numbers. Otherwise an individual could register with DNS a number that belongs to someone else and could relate that number to their own domain name. Thus there could be traffic stealing. Let us assume that:

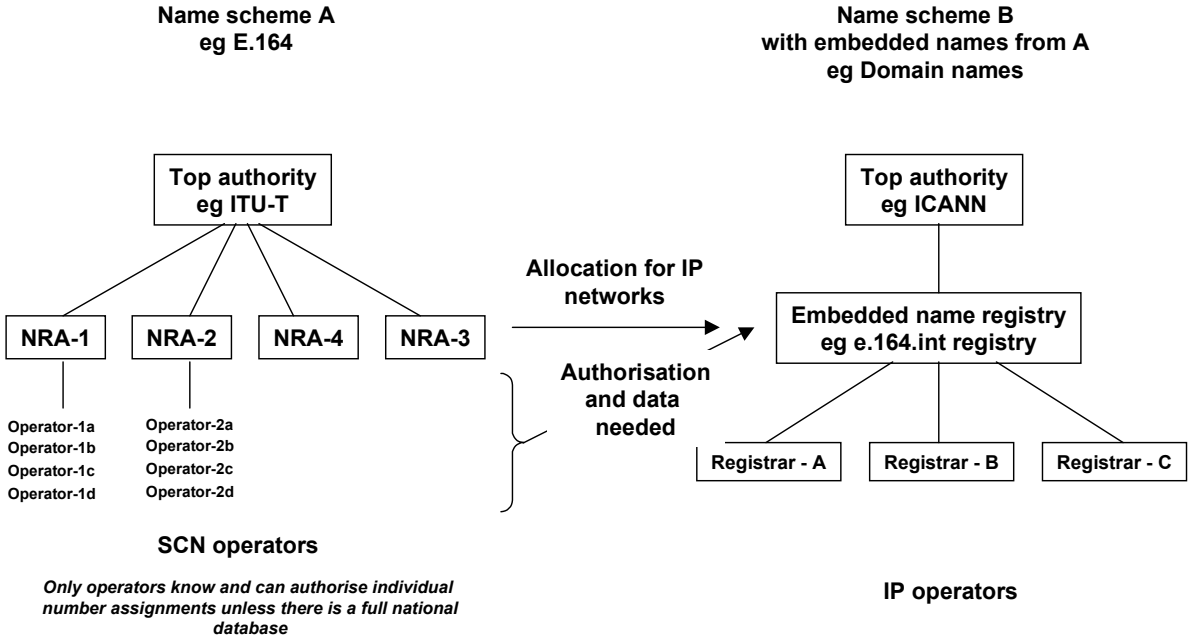
- customers of SCN operators want their numbers included in the domain name structure
- customers of ISPs want to receive their E.164 numbers from their ISPs

Then:

- the SCN operators, who alone know and can authorise individual SCN numbers (unless there is a national database) would need to input authorised data to the E.164 domain name registry, otherwise the registry would be incomplete
- the domain name registry would have to obtain allocations from the SCN NRAs of blocks of numbers for allocation to ISPs thought he competing registrars.

It should be noted that according to what is proposed the e164.int registry needs to know the existence of an E.164 number served on the SCN in order to perform its service of offering alternative routes. This is because the proposal is more sophisticated than the provision of just a basic call where it could be assumed that the absence of an entry in the registry means that the called party is reachable only on SCN.

Figure 3.4 Problems of embedding an E.164 number in a domain name



Comparison of Figures 3.3 and 3.4 shows the greater simplicity of the common service numbering approach.

The possibility of embedding E.164 numbers in IPv6 addresses through the NSAP option is even more problematical. A true address needs to be related to the network architecture. The address therefore needs to contain explicitly the identity of the serving network or ISP. The opposite is true of E.164 numbers which are increasingly required to be portable between operators. Thus if a customer changes network, the E.164 number would normally change but the address would not. If the E.164 number is embedded in the IP address then portability becomes impossible because IP addresses are not portable. The root cause of this problem is the confusion created by mixing up the layering structure.

The use of IP addresses in higher layer protocols could also cause problems if the resulting names were made available for general correspondence, because the name would not have the properties normally required of a name. However the short term use this technique by only a few people normally does not cause problems.

Ovum recommends that great caution should be exercised over the use of embedding and that it should be avoided unless it is found to offer some special advantage, and has been checked thoroughly to see that there is no great disadvantage.

Labels and user friendly calling

Both SPAN2 and HF in ETSI are discussing the use of labels. The concept of a label is not very clear yet but the objective seems to be to recognise that an entity that has one name may have several different roles or other qualities that need to be distinguished. This issue is also being considered by ENUM.

An example is that a person may have several different roles such as:

- employee
- family member
- member of club

and may want to receive communications separately for each of these different roles.

These groups are also concerned that E.164 is not user friendly. They are therefore considering whether it is possible to design a unique user friendly identification system that will include naming and labelling functions. A critical distinction between names and labels is that names need to be carried across networks whereas labels are for use only at the calling end to decide within name to use.

The distinctions between labels and names and addresses are shown in Figure 3.5. The table contrasts the views proposed by Ovum in this report and those of the ETO.

Figure 3.5 Labels, names and addresses: ETO and Ovum views compared

	Label	*Name*	*Address*
Use (row added by Ovum)	Selection of name by caller	Unique identification of caller and called parties	Unique network orientated identification of network interface for caller and called parties
Where used (row added by Ovum)	Only at origin of call	In networks, especially at origin and destination	In networks
Portability	Between services, locations and SPs	Between locations (with limitation) and SPs	No
Tariff indication	ETO: No Ovum: Not relevant	Yes	No
Routing aggregatability	ETO: No Ovum: Not relevant	No	Yes
Uniqueness	ETO: Yes Ovum: No	Yes	Yes
User friendliness	Very high	ETO: Medium Ovum: Not needed	No
Existence of a plan	ETO: Yes Ovum: No, only a format	Yes	Yes

Acknowledgement: ETO contribution to SPAN2

Work on labels is only just beginning and it is too early to say where it is likely to lead, but there are some fundamental questions that need to be asked about the needs that such a scheme would meet.

The three main needs seem to be:

- user friendliness for the caller, who wants something easier than E.164 numbers. This is taken to mean alphabetical strings (words)
- uniqueness so that networks can have a single common identification system to work from
- uniqueness for the purpose of exchanging information between users on how to call each other

There are three factors that may prevent the achievement of these goals:

- there is far too much duplication of alphabetical strings to achieve both user-friendliness and uniqueness. Any system that can distinguish between the many John Smith's in the UK is unlikely to be very user friendly.

- any unique system requires the strings to be correct, and this reduces user friendliness because of the difficulty of remembering and entering long string correctly. Spelling difficulties are a related factor. Also a string that is user friendly in one language may be very difficult for people not familiar with that language
- different scripts are used in different cultures

Directory services, intelligent terminals and user friendly calling

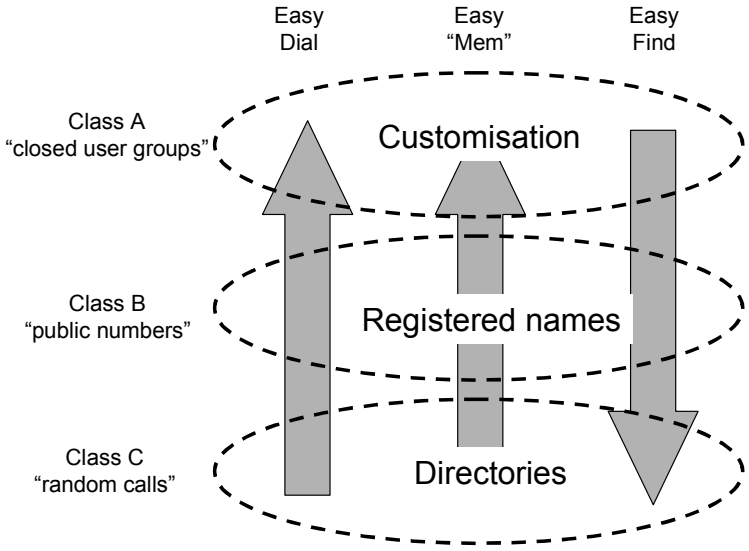
There is an alternative approach to greater user friendliness in calling which relies on the use of intelligence in terminals and better directory services. Proponents of this approach argue that future needs for numbering should be seen from the perspective of the customer. Numbering is a man-machine interface issue and should take account of the rapid development of intelligent terminals and the desirable trend to push intelligence to the periphery of networks.

Calls (not just telephone but also data, fax email etc) can be categorised into three types:

- Type A: regular and frequent calls between informal or formal groups (colleagues, family, other activities) for which the main issue is easy call establishment. Type A calls requires a high degree of customisation with personal address books, voice response etc and can be handled by developments in terminals. It does not require standardisation.
- Type B: occasional calls to advertisers or major organisations or services (transport, Government, large retailers) where the relationship of a number to an alphabetical string provides useful association and improved memorability. Type B calls requires registration of alphabetical strings and names but because of the problem of duplication needs to be restricted by applying threshold criteria. There are too many people with the same name to make alphabetical names available for all. This is not a technical limitation but a limitation intrinsic in the established use of names.
- Type C: random calls to other destinations. Type C calls requires good public directory services so that terminals can find out the correct number quickly from incomplete searching information when a call is initiated.

Figure 3.6 shows the characteristics of each call type and the suggested solutions.

Figure 3.6 Categorisation of calls and their needs



None of these requirements calls for a new formal universal naming scheme nor any extensive changes to networks. The main developments needed concern directories. Directories should hold "informal" keywords given (not necessarily selected from a list) by

the subject about themselves. Directories can also hold the different numbers and addresses for different call categories eg telephone, fax, email etc and so provide a solution to the labelling issue.

Directories can and should be at the periphery of networks and can be provided competitively by specialist service providers rather than network operators. However the successful development of the directory market will depend on directories being able to obtain the necessary base information from network operators, and some general regulation may be needed to ensure that this information is available, subject to laws on privacy. Directories could be linked to share and so improve the availability of information. The essential issue for directories is probably to use existing descriptors and allow customer choice of their own descriptors and to avoid any shoe-horning into a standardised pattern. In this way directories can grow flexibly and adapt to local cultures. We discuss the development of directories in more detail in Chapter 4.

This discussion does not addressed mobility management which cannot be pushed to the periphery of networks so easily. Mobility is a home network issue and can probably (or should probably) be separated from the "finding the number" issue. But multiple roles and different terminal types can be supported by using multiple E.164 numbers. The Directories can then store information on the type of terminal supported and the various roles of each individual.

These considerations suggest that no great changes are needed for networks and that the combination of:

- incremental terminal led developments
- directories
- greater use of numbers to distinguish roles and different terminal types

should be sufficient. This is attractive as the introduction of new facilities into networks is expensive and involves very long lead times.

In order to facilitate the development of directories based on search engines, Ovum recommends that DGTP and OPTA should consider applying requirements similar to those in the ONP Voice Telephony Directive Article 6 (that organisations that assign numbers must make the necessary information know to the providers of directory services) to all parties that assign numbers or domain names.

3.7 Ovum's view of the best way forward

It is very difficult to predict how the various discussions will develop. The degree of confusion is considerable making it difficult for issues to be isolated, pinned down and resolved. The difficulties are compounded by attempts to introduce new functionality before even the basics have been agreed.

In Ovum's view, the following would contribute greatly to progress and a sound foundation for the future:

- acceptance that there is one telephone service that needs one public global numbering system that is E.164
- the development by a small group of both SCN and IP experts of a basic "architecture" for numbers and IP addresses to be used for telephony over IP. This architecture would not attempt to include all the future ideas about naming and would be separate from a directory system
- a freeze on all schemes of number embedding, especially any schemes that embed higher layer numbers in lower layer addresses
- use of the DNS type technology for supporting translations from E.164 numbers to IP addresses and the reverse (for lawful interception), but run as a separate duplicate system to avoid any risks of disturbing DNS

- the development of a search engine style directory system with open protocols to provide "easy find".

3.8 A role for the Dutch government

Starting from the perspective that governments need be involved only where there is a scare resource that has related public interest considerations, Ovum recommends that DGTP and OPTA should:

- clarify the position that numbers are principally allocated on a service and /or geographical basis and not on the basis of technology. Therefore networks that provide telephony over IP will qualify for numbers according to the same criteria as SCNs.
- at least discourage the embedding of numbers into addresses, or add a requirement to the numbering conventions that this practice shall not be followed
- ensure that servers that do translations from E.164 to IP maintain adequate security and receive regular updates from the organisations responsible for allocating the E.164 numbers.
- maintain awareness of the technical issues by participating in at least some of the development work within ITU-T, ETSI, and IETF

Involvement of the Government in issues such as the migration from IPv4 to IPv6 does not seem to be necessary.

4 Improving public directory services

4.1 The benefits of improving public directory services

There is a good case to be made for improving public directory services:

- today's public directory services offer poor coverage. Many users, especially of new services, are not included within directories
- directory services lead to call stimulation. In the UK for example each call to the voice directory service typically generates two network calls
- comprehensive, easy to use, and low priced public directory services should lead to substantially higher levels of use of both directory service and subsequent network calls. This in turn should lead to more effective use of investment in telecommunications and information services in the Netherlands.

4.2 Public directory services today

Traditionally users have consulted printed directories or called voice directory enquiries (DQ) services provided by the incumbent operator. But over the past few years we have seen substantial growth in the use of electronic text based directory services using CD ROMs and the Internet. In the UK these text-based services now represent a substantial proportion of directory enquiries from businesses.

There are two main problems with today's public directory services:

- they offer poor coverage
- there is relatively little competition – especially in mainstream voice directory enquiry services.

The poor coverage of today's services

There are a number of reasons for the poor coverage of current public directory services:

- users are concerned about their ***privacy*** and refuse to provide information for use in public directory services
- service providers are concerned about ***competitive issues***. Many operators, and especially new entrants, are reluctant to provide others with the information needed for a public directory because this is a list of their customers. This attitude is especially prevalent among mobile operators who guard lists of their subscribers carefully. In many countries there is no requirement on service providers to share information
- there is a ***proliferation of services***, with the introduction of mobile, fax, email and web services, which makes it hard to collect comprehensive information. Only on the web do search engines provide directory like functions for finding documents
- there is a ***proliferation of service providers***. Mobile is a good example. Airtime resellers of mobile services guard customer details from their network operator. At the same time pre-paid subscribers value anonymity. Many are reluctant to register their details for directory purposes even when given incentives such as free calls
- some incumbents, including KPN, have in the past claimed ***copyright control*** of their directories
- few terminals offer the capability to access text based Internet services.

The lack of competition in voice DQ services

There is relatively little competition in mainstream voice DQ services in many countries. Two reasons are often given:

- there are economies of scale in providing such services which makes entry difficult
- many operators see DQ services as a universal service obligation rather than as an opportunity for service innovation and profit generation.

Possible solutions

What measures could the DGTP take to overcome these problems in the Netherlands?

We present in the next section a long-term view on how directory systems might develop to provide comprehensive public directory service. In doing so we focus on the procedures and rules needed to establish a comprehensive master database of directory information.

Then in Section 4.4 we list measures which the DGTP/OPTA might implement to enable competition in mainstream voice DQ services.

4.3 A comprehensive public directory database

In the ideal world a public telecommunications directory database would contain:

- the full name and address of all subscribers
- a list of numbers and telecommunications names, each related to the type of service (mobile, fax, email) and the role of the person (job, home, etc)
- a list of user provided identification information that could help the person to be identified by a potential caller with incomplete information, eg red hair, tennis enthusiast.

Factors affecting the architecture of the database

The architecture of a comprehensive database system is potentially complex because there are multiple sources of information and authorisations.

Sources of information

The sources of information are:

- number or name assignment authorities
- service providers
- the numbered or named party (for additional information)

For many fixed geographical services, the same organisation is both the assignor of numbers or names and the service provider. But with number portability and new arrangements for assigning numbers direct to customers[8], these roles will be increasingly separated.

The assignor of the number is the key source for directory information. But it faces practical problems in that its records of the address of a customer may become out-of -date because it does not need to maintain an ongoing relationship with that customer in the same way that the service provider does for billing.

With multiple number assignors there are multiple master lists of information and the possibility that the address information held by different assignment authorities or service providers for the same person may be inconsistent. Ideally some form of unique identity number for each person should act as a key to enable these lists to be merged. But this may not be legal under current Dutch law.

[8] eg for freephone numbers

Authorisation

Authorisation is potentially complex. For example:

- the named or numbered party should authorise the disclosure of certain categories of information, including the selection of the privacy level required
- service providers may be required to confirm that a name or number is currently active
- employers may be required to confirm that the party is an employee to prevent people pretending to be an employee in order to receive communications intended for a competitor

Structure of the public directory database

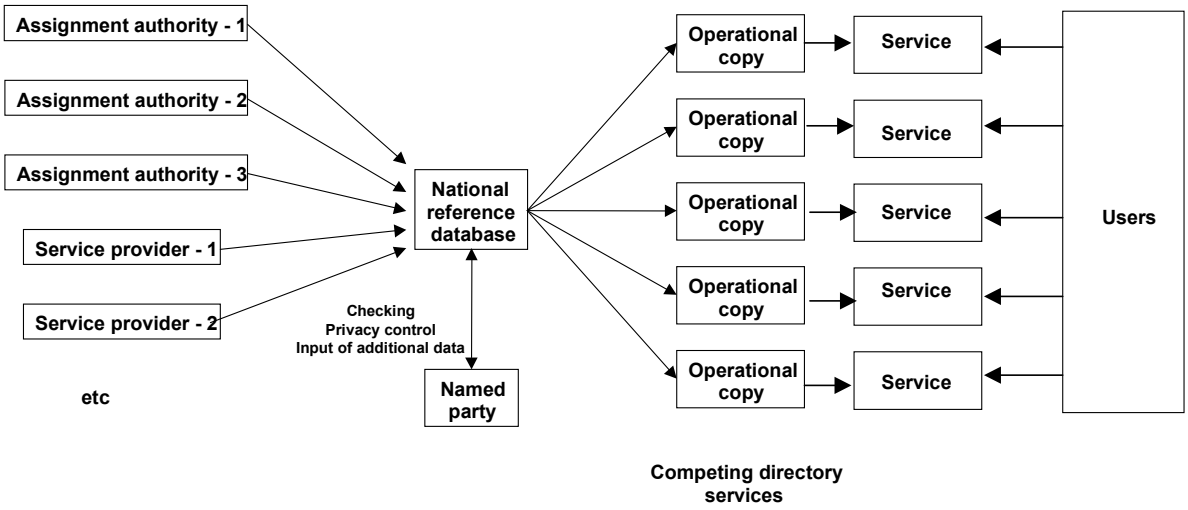
Figure 4.1 shows a possible structure for a comprehensive directory database. There are potentially three levels of information:

- the original distributed master information (held by the number or name assignment authority, service provider and numbered party)
- a reference set of combined information that can be checked by the numbered party and used for any authorisations
- an operational database that provides service using the reference set of information

The first of these levels is unique. The third is readily opened to competition. The issue is whether the second should be performed by a single national reference database with charges for copies of the information subject to regulatory control or be open to competition. On balance, we consider that a single national reference database would be preferable because:

- inputs from the numbered or named user are required and they would be needed only once if there is a single national reference database
- the task of co-ordination between the database and service providers is minimised if there is only one database
- inevitably various discrepancies in information will have to be resolved and they are handled more easily if there is a single combined master database
- privacy policy can be controlled more easily.

Figure 4.1 Structure for the support of competing directory services



Access and user friendliness

Directories could be accessed in several ways:

- by data communications with the response on a display (eg web access, SMS access, ISDN D-channel access)
- by voice, keypad with automatic voice response.

The developments in both voice recognition and voice synthesis should ensure that the system can be used over most access technologies. The minimum requirement would be a telephone with a DTMF capability.

Privacy issues

A comprehensive public directory system raises various issues of privacy:

- the system would hold a great deal of valuable information and clear rules would be needed about its use by third parties purposes, eg for marketing, political lobbying or appeals for charity
- some customers would wish to be totally ex-directory. Others would wish to have some information ex directory
- rules may be needed about the query information needed to allow an answer to be given. For example BT will only give out a telephone number of an individual if the caller knows the name and street address. The name and town alone is not sufficient even if there is only one person of that name in the town.
- checks would be needed on authentication for changes to the information so that malicious third parties cannot change data relating to other people

Additional information could improve the system from the point of view of the called party. For example:

- the system could include information on whether or not the customer would accept cold calling from advertisers
- the system could store times when incoming calls are not wanted, eg from 2200-0730

Ovum believes that the best way to deal with these difficult privacy issues and to strike an appropriate balance between the desires of the calling and called parties is to give the called party choice about what information is available for what purposes on the directory database. A business customer may choose to provide all relevant information to all callers

at all times. Individual consumers may choose to specify a wide range of conditions before allowing callers to use services which complete calls to them or gives access to their numbers.

Role of Government

There is a key role for Government here in determining the extent to which the Netherlands moves towards the comprehensive directory database outlined above. In particular the DGTP will need to weigh carefully:

- the economic benefits of moving towards a comprehensive directory system like the one outlined above *against*
- the social and political risk that such a system will lead to a reduction in privacy for Dutch citizens.

Already under the ONP Voice Telephony Directive, voice telephony operators with significant market power are required to make available information for the purpose of providing public directory services. But this requirement is inadequate to enable the development of better and more comprehensive directory services. To enable such development the DGTP would need to take the following actions:

- require all numbering and naming assignment authorities to provide information for inclusion in a reference database
- establish more sophisticated policies on privacy and the rights of users with respect to public directory services
- facilitate the establishment of a national reference database with appropriate regulatory controls – for example one run under a special licence.

In taking action in this area the Dutch government will need to take account of the European Commission's expressed wish "to update and clarify the Telecoms Data Protection Directive" so as to take account of technological developments and convergence.

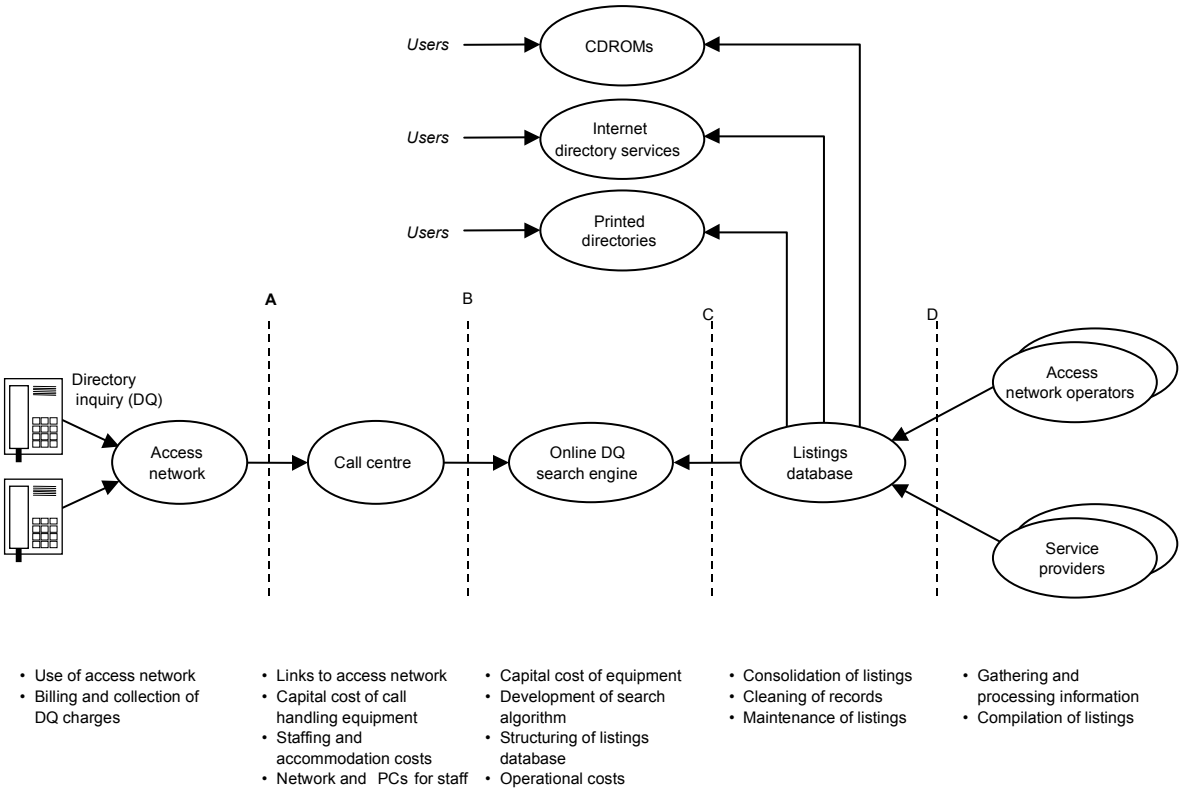
4.4 Enabling competition in voice directory services

What short-term measures could the DGTP take to enable competition in basic voice directory services? These could lead, through competitive processes to more efficient, lower priced and more innovative directory services.

Figure 4.2 shows the how a national voice directory enquiry (DQ) service is delivered. There are five main components:

- ***the access network.*** Users call the DQ service using an access code. For the convenience of users who access DQ through a variety of access networks the codes are often standardised. The access network operator might offer its own DQ service or buy it at wholesale rate from a third party DQ service provider
- ***the call centre.*** At the call centre the service provider deals with the query by accessing an online DQ search engine. A typical enquiry takes 30 to 40 seconds to process
- ***the DQ search engine.*** The online DQ search engine examines a database to try to find the directory number from the information given by the call centre operator
- ***the listings database.*** The database which the search engine examines is compiled from a listings database of numbers supplied by access network operators and service providers. This is used by other directory information services such as printed directories, Internet services and CD-ROMs as well as by the standard voice DQ service
- ***the basic information on numbers and subscriber information***. Access network providers and service providers compile information to supply the listings database provider.

Figure 4.2 The components of a national voice DQ service



To enable competition in this service the following measures are required:

- require all access network operators to supply the directory information they collect to organisations wishing to compile listing databases in return for a reasonable charge (Point D of Figure 4.2)
- require KPN, as the dominant operator in the Netherlands, to offer its listings database to others at a reasonable and non-discriminatory price ie a charge which is the same as the transfer price which it charges to its own voice DQ subsidiary (Point C of Figure 4.2)
- require KPN to offer access to its online search engine at a reasonable and non-discriminatory charge (Point B of Figure 4.2)
- structure access codes for competitive DQ service providers so as to enable them compete on equitable terms with access network operators like KPN when offering DQ (Point A of Figure 4.2). For example Austria, Germany and Ireland use the codes 118XX for this purpose. In Austria customers can continue to dial a default code (1181) to reach the DQ service provider chosen by their access network operator. In Germany and Ireland callers must call a valid 118XX code if they are to reach a voice directory service provider. In the Netherlands customers dial 118 to access the directory service provider of the access network operators choice and short numbers in the 800 or 900 ranges to access independent directory service providers.

We understand that some of these measures have already been implemented in part or in whole. The DGTP may wish to consider action on others.

5 IMSI's

5.1 Introduction

The International Mobile Station Identity (IMSI) is an identification number for mobile terminals and Subscriber Identity Module (SIM) cards in public mobile telecommunications. Unlike the telephone number used for a mobile, which is portable, the IMSI carries explicitly the identity of the mobile network. The IMSI is used during registration to identify the mobile terminal and the home network. It is not used for the routing of calls through switches.

The IMSI is a number of up to 15 digits. The first 3 digits are the Mobile Country Code, the next 2 or 3 digits are the Mobile Network Code and the subsequent digits are the Mobile Station Identification Number. Figure 5.1 illustrates.

Figure 5.1 IMSI structure

5.2 Current situation

IMSIs are defined in ITU-T Recommendation E.212, which allocates the Mobile Country Code 204 to the Netherlands. The adjacent code 205 is not assigned and is available for expansion if needed.

DGTP published in 1998 a national plan for IMSIs indicating that although the existing GSM networks have 2-digit network codes, in future 3-digit codes would be assigned to make allowance for growth in the number of networks. According to E.212 foreign mobile networks are required to analyse only 6 digits of the IMSI and therefore the plan uses all the available capacity.

5.3 Discussion

There could be significant growth in the demand for IMSIs and Mobile Network Codes in the future resulting from:

- increasing user demand
- continuation of the practice of allocating IMSIs in blocks to service providers who do not re-allocate IMSIs released by customers who terminate their contracts including moves to another service provider. This means that market churn wastes IMSIs
- market entry to provide third generation systems
- the development of virtual mobile networks. A virtual network operator runs only a billing system and a home location register and its customers roam on other physical networks
- mobility in fixed networks with physical SIM cards plugged in to new forms of fixed terminal or software SIM cards running in laptops.

At present it is too early to say how these last two forms of mobility will develop and to what extent there will be a large number of service providers who use third party networks. So far the development of a separate service provider market segment has not materialised in fixed networks as quickly as some people expected. But the advent of VoIP and the potential for ISPs to offer voice may change the situation.

Ovum therefore thinks that:

- the DGTP has taken the right decision in establishing a plan for IMSIs and in taking steps to ensure that Mobile Network Code capacity is not wasted unnecessarily
- the DGTP should discuss with the industry whether ways can be found to re-use IMSIs released by the termination of contracts, after a suitable sterilisation period
- no further actions are called for until the way in which the market is going to develop becomes clearer.

6 Potential shortages in the Netherlands E.164 plan

6.1 Introduction

There are a number of market developments which could both increase and decrease the probability of future shortages in the Dutch E.164 numbering plan. We try to quantify these effects in this chapter. In doing so we look separately at the following categories of E.164 numbers:

- the geographic ranges (01, 02, 03, 04, 05, 07)
- the mobile ranges (06)
- the new service and specially tariffed ranges (08, 090)
- the reserved range (remainder of 09)

A high degree of uncertainty is inevitable in an exercise of this kind. The risks mentioned below carry varying degrees of probability, and some are quite unlikely; however we aim to err on the side of prudence.

6.2 Market developments affecting E.164 numbering plans

Figure 6.1 summarises the main developments which are likely to affect E.164 numbering. The key market developments highlighted in this figure are as follows:

- ***new services:*** Many of the market developments considered may lead to the introduction of new services, but at present there is considerable uncertainty over their nature. Some of them[9] could actually relieve pressure on other parts of the numbering scheme, such as the geographic range. Overall, however, the E.164 numbering plan needs to allow additional capacity for new services
- ***role management:*** Multiple numbers per line may be needed to enable users:

  to distinguish between and manage multiple identities, eg employee, job function, family role, role in social organisation

  to distinguish between different users of the same terminals or NTPs, eg between members of a single family

  to manage mobility in both fixed and mobile networks

  to manage multiple terminals and network termination points on the same account. This will apply for fixed networks in houses where there may be several lines and many terminals, and for mobile networks where a user may have a handy, a laptop and a carphone

  to manage multiple services

- ***alphanumerics:*** Despite a variety of implementation problems, we expect alphanumerics[10] to become more popular. However we do not expect such developments to have a major impact on demand for numbers

[9] Such as services based on corporate numbering which already exists

[10] "words" spelt out using the letters on telephone key pads

Figure 6.1 Summary of developments affecting numbering

	Development	*Effect*	*Significance*	*Likelihood*
1	Introduction of new services	Increased demand for ranges, blocks and subscriber numbers	High	Likely
2	Improved role management and distinctive alerting leads to demand for more different numbers for different roles, and different numbers for each occupant in a house	Increases demand for subscriber numbers per person by 3-5 and occupants by 2-3	High	Likely
3	Increased alphanumerics	Increases demand for subscriber numbers with individual allocation	Low	Likely
4	Increased communications with machines, cars domestic appliances etc (includes LANs in homes)	Increased demand for subscriber numbers fixed and mobile	High	Likely
5	Virtual networks	Increased demand for blocks	High	Uncertain
6	VoIP	Increased demand for blocks (for new operators) and subscriber numbers	Medium because of portability	Likely
7	Payment for products via telecoms bills	Increased demand for blocks (for suppliers) and subscriber numbers	Medium	Uncertain
8	Integration of mobile terminals with position fixing	Potential for new services	Low	Likely
9	Increased mobility and more mobile operators	Need for revising and expanding IMSIs	High	Likely
		More MSRNs		
10	Increased portability	Less block allocation, higher % use	Medium	Uncertain
11	Increased individual allocation	No block allocation, higher % use	Medium	Uncertain

- ***humans and machines:*** Most communications involves human users at present either directly, eg telephony, or with some time shift, eg messaging. A small proportion of data communications involves only machines (ie machine to machine, where the information communicated is unlikely to be seen by a human user except in some summary form). The proportion of machine to machine communications is expected to grow fairly rapidly due to factors such as:

  remote control

  remote diagnostics

  remote polling

  personal user agents who screen data on mobile terminals and present only a subset of the data received to the user

  Machine processes will require numbers but the need to provide information within the number (tariff, location) will be lower than for communications with greater human involvement. Thus the use of non-geographic numbering with higher usage densities than geographic numbers will be practicable. Houses will follow businesses in adopting a LAN infrastructure for all types of fixed terminals. Increasingly domestic appliances will be connected to the LAN for remote control and will require addressing. E.164 addresses could be used. Alternatives are sub-addresses or other types of addresses sent to a central LAN controller. Households could have a range of DDI numbers

- ***virtual networks:*** The growth in mobility (in both fixed and radio access) and roaming will make it possible for virtual networks to be introduced. These are networks that implement marketing, customer service and mobility control functions but rely wholly on other networks for transport and access. One such network started recently in Scandinavia but went bankrupt. Large growth in this area is unlikely but any

developments will lead to increases in demand both for subscriber numbers and network identifiers

- ***voice over IP:*** IP based users of VoIP will require E.164 numbers to be callable from SCN networks and also for presentation as CLI in out-going calls. There is no single numbering arrangement for VoIP and a growing consensus that numbering should not be based on technology but on service, location and tariff in the same away as for SCN technology. This means that numbers will be needed from all existing ranges for VoIP with the choice of range depending on the nature of the service supported
- ***billing (with non-telecom services):*** Common bills will be used for services other than telecommunications eg electricity supply, or services bought by telecommunications will be billed by the telco. An example is buying coke cans by mobile phone. The need for itemised bills could possibly mean that E.164 numbers would be used to identify the service used (one number for coke another for beer etc) but this would not be a very user-friendly method of describing the service
- ***mobile – navigation services:*** Integration of position fixing devices in telecommunications terminals will open possibilities for a variety of new services, eg providing tailored information on traffic conditions or nearby restaurants. A small economy in number use may also be achieved, as the same number could be used to re-route to point to different destinations at different locations. Overall, it is not clear that this development is likely to lead to a great demand for new numbers
- ***mobility and roaming:*** Mobility and roaming will be supported increasingly on fixed networks as well as mobile. This will create a need for IMSI or IMSI equivalents in fixed networks as a SIM card address that carries explicitly the identity of the home network. Integration into a common system such as the IMSI would make sense and give a less technology dependent solution. There is therefore likely to be a need for IMSIs for use by a large number of fixed network operators and service providers. IMSIs have generally not been allocated in a way compatible with a large growth in the number of operators and this is a potential problem area. Mobility and roaming are unlikely to lead to significant changes for E.164 numbers apart from an increased proportion of numbers to be used as mobile station roaming numbers for the re-direction of calls. Prepaid mobile subscriptions, in particular, are significantly fuelling demand for mobile numbers. This is amplified by the high level of churn in the mobile market and the fact that current systems do not permit the re-use of either IMSIs or the associated E.164 numbers.

6.3 Quantification of market effects

We describe in Annex E our quantification of the effects described above and the extent to which they might lead to shortages in the Dutch E.164 plan. We have:

- ascribed percentage growth in demand for numbers or number blocks in 5 and 10 years time
- applied these growth scenarios to existing levels of use to estimate future demand for numbers
- compared these projections with the likely capacity of the Dutch E.164 plan.

On the basis of this analysis we reached the following conclusions:

Conclusion 1: There is a real risk of premature exhaustion of many existing geographic NDCs, especially those with 3-digit codes. However the geographic range as a whole, with some possible restructuring, should continue to have adequate capacity indefinitely. To minimise the number of NDCs requiring relief, and to provide relief if and when it is needed, we recommend:

- a continuation of existing good practice in efficient assignment management

- moving as soon as possible to 1000-number block allocation (number pooling)[11], and possibly within the next 5 years to single number allocation if that seems desirable in particular areas[12]
- preparing contingency plans to ensure that 3-digit codes in areas with potential capacity shortages do not end in 0 or 1, so that each group of 3-digit codes starting with the same 2-digit codes can readily be merged into a single new 2-digit code area with no change to procedures for dialling into the area[13]. Special consideration would also be needed for 3-digit codes ending in 9, since currently 9 is reserved from use as the first digit of local numbers.
- preparing contingency plans for the relief of exhausted areas with 2-digit NDCs within the existing framework (the options are an overlay or a split)
- relieving any early exhausted areas in accordance with the contingency plans
- in (say) 5 years' time, should widespread exhaustion seem a real likelihood, deciding on a long term strategy for geographic relief. Options will include (in rough order of how radical they are):

  widespread implementation of the contingency plans, so that all or nearly all NDCs have 2 rather than 3 digits

  an additional digit on local numbers, possibly applied only where needed to minimise disruption, or possibly across-the-board so as to retain uniformity

  moving to a closed scheme, with first regional and later national geographic number portability. Historically, the Dutch public has favoured an open scheme; however this preference could change in future[14].

  It is not sensible to try to make this decision at present, since it is impossible to tell whether or when it will actually be needed. Also, the choice among these options will depend on factors which cannot at present be predicted with any accuracy, such as future tariff levels and structures, and the take-up of new types of CPE.

Conclusion 2: Capacity for mobile services may well be adequate indefinitely, provided that the entire 06 range can eventually be made available for mobile numbering, and that the range is managed with a view to good husbandry and efficiency,. However we do recommend as contingency measures holding in reserve two sub-ranges:

- one sub-range to permit easy expansion to an additional digit for mobile numbers, should this be needed, and
- one sub-range which could be used from the start with longer numbers

Conclusion 3: The new services and specially tariffed ranges appear to have ample capacity for all foreseeable demands, apart from the very popular short number ranges. Consideration could even be given to allowing more space for the short numbers, with the proviso that they are charged for on an economic basis.

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[11] We understand that this is already in prospect, with the focus on potential problem areas in order to make the best use of limited capacity in routing tables.

[12] Individual number allocation requires IN technology, and we understand that currently there are no plans for IN to be available to the extent that would be needed for this purpose. Bringing forward the necessary investment is however a possibility, whose merits could be considered in the context of any impending number shortage and the options for dealing with it.

[13] It appears that this can be done within the groups in question by a simple change of the 0 and/or 1 to an unused final digit, with two exceptions: 0511 and 0591

[14] Because of factors such as a falling proportion of calls being locally dialled, more use of telephones with memories, and increasing demand for portability.

Conclusion 4: Any requirements for numbering space for new applications where numbers are dialled only or mainly by machines rather than human beings, should be granted at the longest practicable digit length[15] in whatever range seems most appropriate to the particular application – for entirely new services, probably one of the unused 08 (or possibly 06 or 09) sub-ranges. Differential charging may be needed to incentivise operators to use the longer numbers

Conclusion 5: Urgent action is needed in the light of an impending shortage of 1XX carrier selection codes. Various solutions are possible. To decide which is best would require detailed consideration outside the scope of this study.

[15] If possible, the full 13 significant digits permitted by the international 15-digit limit (with a 2-digit country code).

7 Management of domain names and IP addresses

7.1 A historical perspective

Internet domain names and addresses used to be managed by the Internet Assigned Numbers Authority (IANA). IANA was run from the University of Southern California Information Sciences Institute (USC-ISI) by the late and very well respected Jon Postel.

The role of IANA was to:

- allocate Internet Address Space to Regional Internet Registries (RIRs)
- allocate Protocol Identifiers
- maintain the Root of the Domain Name Server System including overseeing the operation root name servers, and registering Top Level Domains

IANA was funded until March 1997 by the US Government Department of Defense's Advanced Research Projects Agency (DARPA), which had funded much of the early development of the Internet (initially called ARPANET) as a communications medium for university related research. The withdrawal of funding by DARPA , plus the increasing recognition that the Internet had grown into a major general communications system and was in practice fully international, triggered discussions to create a more permanent and international system of central management.

This change was characterised by the view that Internet was now too important to be run on a amateur basis and needed a more professional core. Thus large businesses and governments started to become involved. However there remains a strong desire that the Internet should be managed independently of Government and Government officials are the only category of person barred from some senior positions in the Internet structure.

The changes led to the formation of Internet Corporation for Assigned Names and Numbers (ICANN), which replaces IANA. ICANN has become fully established with a permanent Board of Directors elected in October 1999. ICANN is structured to be fully international and both ITU and ETSI have representatives involved in the management of ICANN. Annex F provides a detailed description. The European Commission assisted, largely informally, in putting pressure on the US to internationalise ICANN.

Historically the US Government has acted as if it “owned” the Internet. This reflects the fact that:

- DARPA funded the development of Arpanet that grew in to the Internet
- the US Government’s Department of Commerce, in co-operation with NSI through InterNIC, has run the main A-root server, and several other of the 13 root servers; the registry for ***.com, .org and .net*** and the main domain name server for ***.com, .org and .net***

But in June 1998 the US Government issued a White Paper: "Management of Internet Names and Addresses". The White Paper stated the desire of the U.S. Government that a private, non-profit corporation be formed to assume responsibility for the Domain Name and IP addressing systems and certain related functions, and called for proposals to be submitted to accomplish this goal. The White paper also proposed that ICANN should “preserve, as much as possible, the tradition of bottom-up governance of the Internet, and Board Members should be elected from membership or other associations open to all or through other mechanisms that ensure broad representation and participation in the election process”. This proposal led to the equal balance on the Board of an At Large membership of individuals and representatives of the three Supporting Organisations.

After the initial formation of ICANN, the US Government signed an MOU with ICANN. No other Government has such a relationship. However the basic foundation of ICANN is international and the remaining effects of the US influence are expected to become negligible within 3 to 5 years.

7.2 Allocation methods for domain names

The root server system

ICANN handles the management of the root server system which consists of a set of thirteen file servers, which together contain authoritative databases listing all Top Level Domains.

The function of the root servers is to resolve from the Top Level Domain name to an IP address by which a Top Level Domain Server can be contacted. The Top Level Domain server then resolves the Second level Domain name into an IP address by which a Second Level Domain server can be contacted.

Types

There are two types of Top Level Domain (TLD) names:

- generic domains (gTLDs) such as ***.com, .org, .net, .edu, .gov, .mil, .int***
- country code domain names (ccTLDs) such as ***.jp, .nl, .uk*** issued in accordance with the ISO 3166 standard.

ICANN decides whether, how, and when to add new generic top-level domains (gTLDs) to the domain name system.

Registrars and registries

A master registry is maintained for each TLD name. Allocations of Second Level Domain names (SLDs) are made by registrars who update the registry.

Generic

For .gov, .edu .mil and .int there are only single registrars, but for .com, .net and .org there are now competing registrars who issue Second Level Domain names. The system was changed in 1999 from single (monopoly) registrars to the new shared registry system in response to proposals from the US Government in its Green and White papers.

Netherlands

For the ccTLDs, the registry for the Netherlands suffix **.nl** is the Foundation for Internet Domain Names, which also runs the main DNS server for **.nl**. There are over 400 competing registrars (also called participants in the registry), most of which are ISPs.

Principles for Domain Name Management

ICANN is continuing the principles described by IANA in RFC 1591. Managers are regarded as trustees with a duty to serve the community, and not as the owners of a domain. Managers are required to:

- be equitable and fair to all groups
- apply the same rules to all requests in a non-discriminatory manner
- publish their policies
- not stipulate that any particular application, protocol or product must be used

ICANN has adopted a Domain Name Dispute Resolution policy. There is a procedure that must be activated if there is a complaint that:

- a domain name is identical or confusingly similar to a trademark or service mark in which the complainant has rights; and
- the user has no rights or legitimate interests in respect of the domain name; and
- the domain name has been registered and is being used in bad faith.

Accreditation and activities of registrars

For accreditation as a registrar an organisation must meet certain objective criteria. Once accredited it must then provide real time public access to specified information on the registry

SLD registrations are assigned on a first-come, first-served basis by the registry. Existing SLD holders may renew their registrations through the accredited registrar of their choice. Any registrar may take over a registration from another registrar.

Reverse address mapping

The DNS resolves domain names to IP addresses. There is a one-to-one relationship between domain names and IP addresses and so provision has been made on an optional basis for the reverse process, from IP address to domain name. Reverse mapping is likely to be important for lawful interception and this may lead to calls for reverse mapping to be made mandatory. If so there may be a need for a facility whereby users can request that their domain name pairs are made "ex-directory" for normal callers.

Problems with Domain Name management in the Netherlands

According to NLIP, the Dutch association of ISPs, there are no significant problems or need for Government involvement.

7.3 Allocation methods for IP addresses

IP addresses are allocated by Regional Internet Registries (RIRs) in accordance with policies set by ICANN. There are three RIRs:

- Asia Pacific Network Information Centre (APNIC) with 2001:0200:: /23
- American Registry for Internet Numbers (ARIN) with 2001:0400:: /23
- Réseaux IP Européens (RIPE NCC), located in Amsterdam with 2001:0600:: /23

Each RIR allocates IP addresses to Local Internet Registries, which are commonly Internet Service Providers (ISPs). These Local IRs operate under the authority of the Regional IR and hold allocations for assignment to users. The term "allocation" is used for space held by IRs for future assignment to users. Only assigned space is used by networks.

Principles

The goals of the allocation and assignment system for IP addresses are:

- uniqueness
- aggregation, to facilitate routing
- conservation
- registration

Aggregation and conservation are sometimes conflicting.

Arrangements for IPv4 addresses in Europe

RIPE NCC has produce a carefully written and detailed manual about its policy and procedures for the allocation and assignment of IPv4 addresses. The Local Internet Registries are expected to apply this manual in their dealings with users. The general principles are as follows:

- assignments are based on a 2-year forecast of demand

- quite detailed information is required about the network, its traffic and its interconnections
- no reservations of addresses are allowed
- additional address space is allocated to Local IRs only when 80% of the current address space has been assigned

New arrangements for IPv6

IPv6 has a much larger address space than IPv4 and is structured differently so that aggregation is built in to the structure. Thus there is no provider independent address space as there is with IPv4. RIPE NCC has published it principles for IPv6 allocation.

Problems for Dutch users in managing IP addresses

According to NLIP, the Dutch association of ISPs, there are no significant problems or need for Government involvement.

7.4 Issues for the Dutch Government

There are few issues for the Dutch Government to tackle in the administration of domain name and IP address systems. Current processes seem to be working reasonably well.

The use of aggregation in IP addresses does in principle cause a problem because addresses need to be changed if an ISP changes its connections to the backbone network. But the solutions for making these changes relatively easily seem to work reasonably for IPv4 and should work well for IPv6. In any case, the Dutch Government could not easily alter this structure now and could cause serious problems if the router technology could not handle the resulting complexity of the routing tables.

The other area that may need further consideration is reverse mapping (IP address to domain name). Lawful interception authorities may require the ability to obtain domain names from IP addresses to be made mandatory.

8 Models for administration of E.164 numbering plans

8.1 Introduction

This chapter looks at models for administration of E.164 numbering plans. In particular it assesses the role which governments and other public bodies play in the administration of a national E.164 numbering plan. It looks at:

- the current model used in the Netherlands
- the administrative models used in the USA and Australia
- likely future developments in the E.164 numbering administration and how they might affect models for administration.

We use this chapter as input to an analysis of what role the Dutch government might play in future administration – not just of the E.164 plan but also of the domain names and IP addresses. This is set out in Chapter 10.

8.2 The current E.164 numbering administration model in the Netherlands

The Dutch government currently takes a central role in the administration of the national E.164 numbering plan. The DGTP sets the policy for the administration of this plan and the independent regulator, OPTA, implements the policy. Broadly speaking Figure 8.1 sets out the division of administrative activities between the two bodies.

Figure 8.1 E.164 numbering administration in the Netherlands

Type of function	*Function*	*Now responsible*
Policy	Revising the structure of the E.164 plan	DGTP
	Authorising and co-ordinating changes to the plan	DGTP
	Establishing, modifying and publishing national conventions for the use of ranges within the plan	DGTP
	Seeking industry and consumer input on policy issues from the National Numbering Forum	DGTP
	Providing input to international forums	DGTP
	Setting policy on new numbering issues as they arise eg number portability, individual number allocation, charging for numbers	DGTP
Operational management	Enforcing conditions of use for access codes numbers and number blocks	OPTA
	Allocating number blocks to service providers and, as appropriate, individual numbers to service providers and/or users	OPTA
	Monitoring use of the current plan	OPTA
	Identifying number shortages and recommending solutions to the DGTP	OPTA
	Recovering number blocks and, where appropriate, individual numbers which are unused	OPTA
	Maintaining and publishing the allocation and reservation of blocks from the national number plan	OPTA
	Charging for numbers as appropriate	OPTA

In short the DGTP sets ***policy*** for numbering administration and OPTA carries out ***operational management*** functions required to implement that policy.

The Dutch government is required by the EU to carry out or supervise many of these functions. For example:

- the Interconnect Directive (97/33/EC and 98/61/EC) requires that member state governments should:

  ensure an adequate supply of numbers and number ranges for public services

  co-ordinate their inputs to international forums with other member states

  ensure that the national numbering plan is controlled by the NRA

- the Interconnect Directive also requires that NRAs ensure that:

  the process for allocating numbers and number ranges are transparent, equitable and timely and that allocations are done in an objective, transparent and non-discriminatory way

  the national number plan is published and kept up to date

  certain number portability services are introduced by the beginning of 2000

  charges for number portability are reasonable

  sub allocation of numbers avoids undue discrimination.

In its 1999 review document[16] the European Commission highlights a number of issue on which it might, in future, take action. In the E.164 area for example it proposes:

- to encourage greater dialogue between the bodies involved in E.164 numbering and IP naming and addressing to develop a common European position
- to extend operator number portability to mobile users
- to consider mandatory interoperabilty of national IN databases so as to facilitate pan-European service provision
- to confirm the rights of NRAs to withdraw allocations of numbers on efficiency grounds.

8.3 Administrative models in other countries

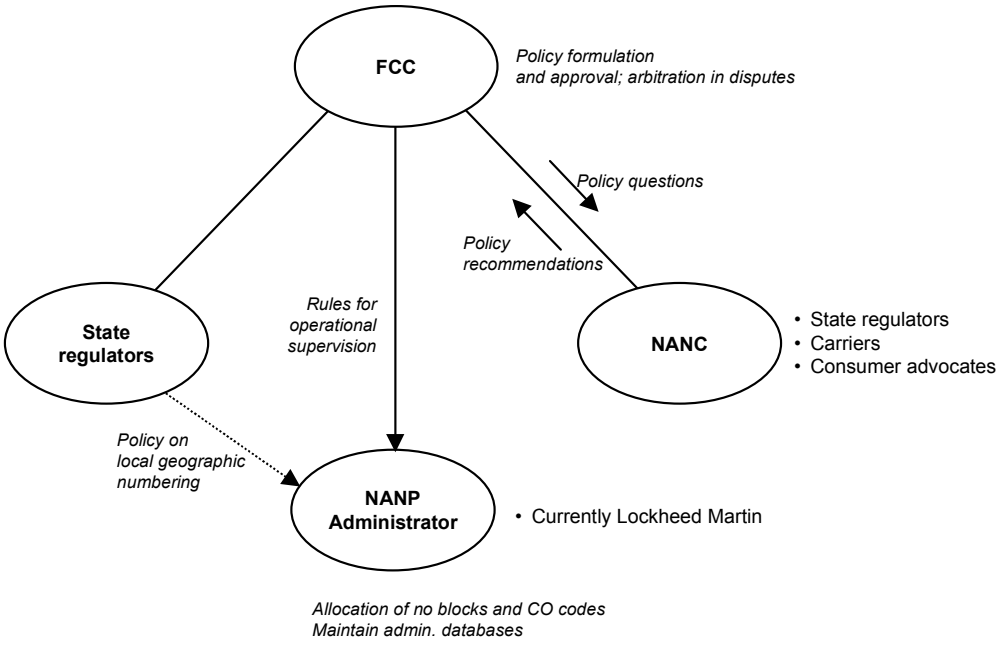
It is useful to examine models of E.164 numbering administration in other countries. For this purpose we have selected for comparison two countries which have lengthy experience of numbering administration in a competitive environment – the USA and Australia.

The USA

Figure 8.2 presents a diagram showing the different bodies involved in the administration of the North American Numbering Plan (NANP) and the interactions between them.

[16] COM (1999) 539

Figure 8.2 E.164 numbering administration in North America



The current structure was introduced in the mid 1990s. Prior to that Bellcore, which is jointly owned by the Regional Bell Operating Companies, carried out the administration of the NANP. But with the RBOCs facing increasing competition in the late 1980s and early 1990s this situation became increasingly unacceptable to many industry players.

There are four main parties involved in the administration of the NANP:

- the FCC has overall control. It approves all policy, initiates policy changes and sets the overall terms of reference for the NANP Administrator. In carrying out this role the FCC needs to take account of the fact that the NANP covers Canada and the Caribbean as well as the USA
- the North American Numbering Council (NANC) formulates policy recommendations in response to FCC initiatives. A federal advisory commission established in 1997, its members include state regulators, carriers and consumer advocates. It runs open meetings and seeks consensus before making any recommendations
- the state regulators to whom the FCC has delegated responsibility for certain geographic numbering policy such as decisions between NPA overlays and NPA splits
- the NANP Administrator. This is a non government entity, independent of any particular telecommunications industry segment, which carries out day to day functions such as allocation of number blocks to service providers, central office code allocations, and maintenance of administrative databases under rules approved by the FCC. It does not have any policy functions and is financed by a levy on the revenue of the carriers. Lockheed Martin was appointed as the NANP administrator recently following a competitive bidding process judged by the NANC.

The NANC has operated for two and a half years. Based on discussions with the FCC and NANP Administrator we believe that the NANC has the following important characteristics:

- the NANC has real power. Formally it is an advisory committee to the FCC. So it has no decision making power. But it has strong influence. So far the FCC has accepted all recommendations made by the NANC
- the NANC is reasonably balanced between the different industry players. No one carrier is big enough to dominate the Council. According to some observers it is unlikely that

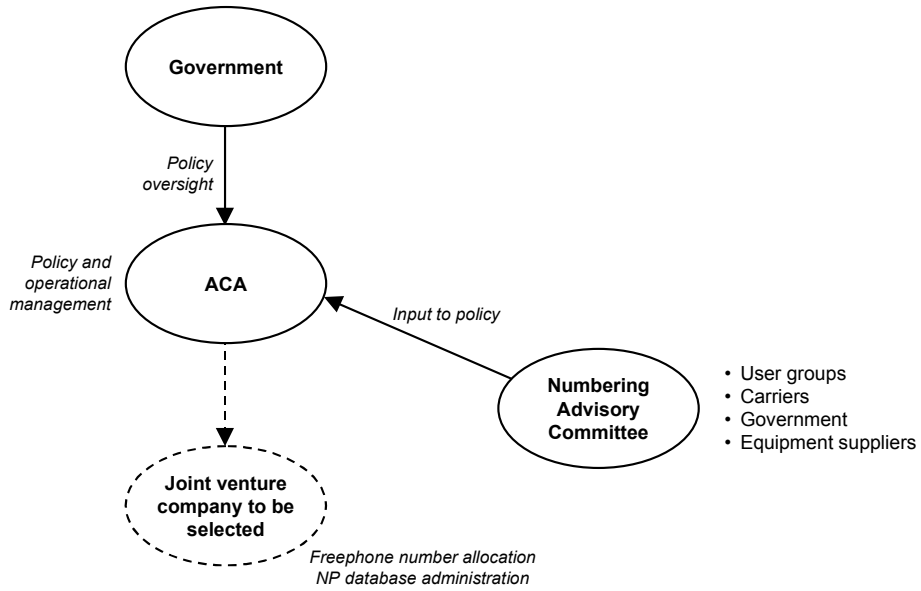
the Government would have given the NANC such a powerful role in the days before divestiture of AT&T in 1984

- the industry players on the NANC dominate. There are consumer advocates on the Council. But they do not have the expertise and resources which the carrier members can devote to Council issues
- the NANC works slowly as it searches for consensus. But it does tend to get there in the end, driven by a desire to develop an industry based solution rather than to have the FCC impose a solution when it cannot agree. For example the NANP expansion plan has already taken six years to develop. It may take another six to reach a final decision.

Australia

Figure 8.3 illustrates how E.164 numbering administration is carried out in Australia. Based on previous work we have done in Germany and the UK on E164 numbering administration, we believe that the Governments in these two countries have broadly followed the model of this figure.

Figure 8.3 E.164 numbering administration in Australia



The Australian government moved numbering administration from the incumbent to the regulator Austel in 1991 when it introduced competition in telecommunication services. It then disbanded Austel in 1997, following full liberalisation. It transferred Austel's competitive function to the competition authority (the ACCC) and its technical functions, including numbering administration, to the Australian Communications Authority (the ACA).

There are now two main bodies involved in numbering administration in Australia:

- the ACA formulates numbering policy, under oversight from the Government, carries out number allocation and recovery functions, charges for numbers[17] and is responsible for number portability issues
- the Numbering Advisory Committee provides advice to the ACA on request. This committee consists of user groups, operators, representatives of the Government, and members from the telecommunications equipment supply industry.

[17] It raised $A60 million in this way in 1998/1999

Many countries which have introduced competition have followed a model broadly similar to that of Figure 8.3. The following features of the model are worth noting:

- policy and operational management functions are carried out within a single body (the ACA) rather than split between two bodies (as they are in the Netherlands between the DGTP and OPTA) or three bodies (as they are in the USA between the FCC, the NANC and the NANP administrator)
- the numbering administrator seeks advice from industry experts through an advisory committee. This committee provides input on policy formulation but it is not responsible for policy formulation as it is in North America
- the ACA has special responsibility for number portability issues, even though this involves consideration of competition issues which are primarily in the domain of the ACCC. This problem is probably unique to Australia. Most countries which follow the model of Figure 8.3 keep responsibility for competition and numbering administration issues in a single NRA and do not split them as Australia does
- the ACA is preparing to outsource day to day functions involving the allocation of individual freephone (and related) numbers and associated operational issues involved in maintaining number portability databases. The ACA believes that such outsourcing makes sense but only for functions which are stable and where it is possible to provide a strict specification of the operational rules which the outsourcing body should follow.

8.4 Likely future developments in E.164 numbering administration

How will the functions of E.164 numbering administration change in future? Based on an analysis of the findings of previous chapters we have identified the following likely major developments:

- the administrator will need to deal with a rapidly growing demand for ***individual number allocation*** (INA) rather than block allocation. Individual number allocation provides users with a wider choice of specific individual numbers. At the same time, as technology make it cheaper, INA becomes an increasingly effective way of dealing with number shortages
- the administrator may need to deal with a big ***growth in operational functions*** in the numbering area. It may, depending upon the implementation chosen, be responsible for the registration and/or operational number databases for number portability, INA and directory listings
- the administrator will need to deal with complex ***interactions between numbering issues and competition issues***. For example equal access to numbers is not necessarily economically optimal. The administrator will need to decide when to impose expensive number changes to ensure equal access to numbers (eg numbers of the same length) and when to avoid such changes. It will also need to co-ordinate with the body responsible for competitive aspects of issues such as number portability and competition in directory enquiry services
- the administrator will probably have to modify national numbering conventions to deal with the gradual ***move away from the current position in which the number conveys information to users***. For example in will need to take decisions on when and how to expand domains within which numbers are portable
- the administrator will face ***increasing number shortages*** in specific parts of the plan and will have to take measures to deal with these shortages eg through number recovery, stricter allocation, number rationing and number pooling as well as through expansion of parts or all of the numbering plan
- the administrator will face a complex and, as yet, ill define ***interaction between E.164 numbering and IP naming and addressing***. The big investment in IP based networks which is currently going on will lead to major interworking between IP based networks and circuit switch networks over the next two decades. So IP network users

will require E.164 numbers for telephony service – both to provide calling line identity for outbound calls and a name for inbound calls.

Taken together these likely changes suggest that the Dutch E.164 numbering administrator:

- will continue to face complex problems of policy formulation involving issues in which there is a conflict between the interests of the Dutch citizen and the interests of the Dutch telecommunications industry
- will continue to need to liaise closely with those responsible for competition policy before taking decisions
- will face a growing burden of operational management functions eg to run master databases for INA and number portability. Such functions are obvious candidates for outsourcing.

We need to take account of these trends in assessing the best future role for the Dutch Government in E.164 numbering administration.

9 The future role of the Dutch Government

9.1 Introduction

What future role should the Dutch government play in the administration of the three most important naming and addressing schemes:

- the Dutch E.164 numbering plan?
- domain names?
- IP addresses?

We use the term government in this chapter to refer to both the DGTP and OPTA. We do not consider the allocation of functions between these two bodies but leave that as a matter for internal debate. Instead we focus on analysing the appropriate allocation of administrative functions between public bodies (governments and their agents) and private bodies based around players from the telecommunications industry.

9.2 Approach to the analysis

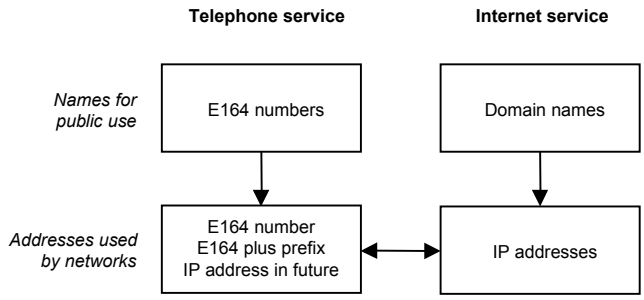
We take a ***fundamental*** rather than an ***incremental*** approach to our analysis. We do not ask what changes we can make to the current position in the Netherlands. Instead we re-examine from first principles the role which governments should play in administration of naming and addressing schemes. The starting point for our analysis is that governments should leave administration entirely to private bodies unless there is good reason to do otherwise. We then apply the following test to each of the three naming and addressing schemes:

- will the scheme continue to offer an adequate supply of names or addresses if administered by a private body?
- will private administration lead to inequitable access for service providers?
- will private administration damage the user friendliness of the scheme?
- will private administration jeopardise consumer rights?

In combination these tests cover all the main principals which currently guide the DGTP in its administration of the Dutch E.164 scheme.

We can see immediately that this approach is likely to lead to different answers, and hence difference roles for government, in administering each of the three schemes under study. As Figure 9.1 shows the three schemes have different roles to play in enabling telecommunications services.

Figure 9.1 The roles of E.164 numbers, domain names and IP addresses



9.3 Maintaining an adequate supply

Will each of the three schemes continue to offer an adequate supply of names or addresses if administrated by a private body? Our analysis is as follows:

- there are no supply problems for ***domain names*** given the open structure of the scheme and almost infinite supply of names which it can generate. This test does not therefore justify a Government role in domain name administration
- there is no immediate danger of the ***IP addressing*** scheme of IPv4 reaching exhaustion. There are also adequate plans by the telecommunications and Internet industries for migration to the massive address space available from IPv6. So again this test does not justify a Government role in administration of IP addresses
- as Chapter 6 indicates, the Dutch ***E.164 scheme*** could face potential shortages in certain key ranges in future. The cost of overcoming these shortages, through expansion or through reallocation of E.164 numbering resources are substantial[18]. Most of these costs fall on users. As a rule of thumb numbering changes generates user costs which are ***ten times*** the industry costs of change. In these circumstances private administration, and especially administration by the industry can lead to a major conflict of interests. Operators, quite naturally, want numbering resources allocated to them on requests. They do not want strict tests applied to number allocation and recovery procedures so as to conserve numbering resources. But without such tests numbering resources become exhausted more quickly and the costs of further increasing the supply falls mainly on users. This is a strong justification for government playing a central part in the administration of the E.164 scheme and in setting allocation and numbering conservation rules which balance the desires of industry for a ready supply of numbers with the desires of citizens to minimise the number of expensive numbering changes which are required.

9.4 Equitable access for service provider

Will private administration lead to inequitable access to numbers for service providers? Our analysis is as follows:

- ***domain names*** are allocated to end users rather than service providers. So private administration does not lead to problems of equitable access for service providers
- equitable access to service providers is an important issue in administration of ***E.164 numbers***. Administration is carried out at a national level and in most countries, including the Netherlands, there is one major client – the incumbent operator. In these circumstances, there are natural concerns about private administration which, if done without strict government supervision, could lead to inequitable access in favour of the

[18] Experience in the UK suggest that they could run to millions or even billions of Guilders

dominant client. So there is a requirement for government to play at least a supervisory role to ensure objective, transparent and non-discriminatory processes and to deal with any complaints

- ***IP addresses*** like E.164 numbers are allocated to service providers. So in theory private administration could lead to problems of inequitable access. But there are important differences between E.164 numbers and IP addresses here. In particular:
    - IP addresses are allocated by an exclusive regional basis by one of three organisations in the world. Each of them deals with many hundreds of service providers and the danger of dominance by any one is very substantially reduce
    - there is no reservation of IP addresses as there is for E.164 numbers
    - service providers must demonstrate that there current allocation is at least 80% used before they can receive a new allocation.

9.5 Maintaining a user friendly scheme

Does private administration lead to loss of user friendliness in the scheme? Here is our analysis:

- ***IP addresses*** are used by networks rather than end users. So this question is irrelevant to IP addressing
- current ***E.164 numbers*** convey significant information[19] to users. Many operators are keen to reduce this information so as to give themselves more flexibility in the services they offer and the prices they charge. In contrast users, and especially consumers, value this information. So again there is a conflict of interests and a role for government in balancing these interests. There is now a clear trend towards reduced information in a number and so there is also a role for government in managing this trend. This might involve changing the national numbering convention which govern what information the number conveys only when there is economic and social justification for doing so
- administrative decisions on ***domain names*** can affect their user friendliness by restricting the choice of TLD or SLD. So there is a need for the Government to consider a possible future role here.

9.6 Consumer rights to use of names

Does private administration jeopardise consumer rights to use of names? Our analysis is as follows:

- ***IP addresses*** are used by networks rather than end users. So it is not possible for user rights to be jeopardised by private administration
- ***E.164 numbers*** are a national resource to which users acquire rights when they buy the service associated with the number. Again there is a natural conflict between service providers and their customers over what these rights should be. So there is a role for government to determine the balance of rights, to make consumer rights to numbers explicit and to ensure that these rights are not infringed. Such rights include non-discriminatory allocation of individual numbers, rights to ported numbers, rights for service providers to charge users for individual numbers and any rights for users in secondary trading of numbers
- given likely market developments we can see no reason why consumer rights to ***domain names*** should not be equivalent to rights for individual E.164 numbers in future. Both are used and valued by end users. This suggests a possible government role in specifying and upholding consumer rights to domain names which are broadly similar to those

[19] On the price of a call, the service called, and/or the location of the called party

listed above for E.164 numbers. Global domains are outside the jurisdiction of the Dutch government. But there is a potential role for the Dutch government in defining and upholding rights to names in the **.nl** domain

9.7 The future role of the Dutch government

Figure 9.2 summarises the analysis of the previous four sections in terms of the role which a government might play in the administration of naming and addressing schemes.

Figure 9.2 A possible government role in naming and addressing schemes

Government role required in administration to ensure:	*Naming and addressing scheme*		
	IP address	*Domain name*	*E.164 number*
adequate supply of names or addresses in an economically efficient way	No	No	Yes
equitable access for service providers	No	No	Yes
appropriate level of user friendliness	No	Yes	Yes
adequate rights of use to individual numbers	No	Yes	Yes

We conclude that:

- there is no role for the Dutch government in the administration of IP addresses beyond monitoring developments at ICANN and RIPE. We recommend a policy of "eyes on, hands off"
- there is a continuing strong role for the Dutch government in the administration of the E.164 plan – both to ensure the right balance between the interests of users and the industry and, to a lesser extent, to ensure equitable access to E.164 numbers for rival service providers. We discuss the precise nature of this role in Section 9.8
- the Dutch government has a possible limited role to play in the administration of domain names – to ensure that consumer rights to these names are broadly consistent with those provided to consumers for E.164 numbers and that any restrictions on user friendliness of names does not conflict with the long term interests of Dutch citizens.

The first two conclusions require relatively little action. But the third is more of a problem. At the moment names in the **.nl** domain are assigned by the Dutch Foundation for Domain Name Registration and, as we understand it, the Government does not currently have the day to day authority to regulate the activities of this organisation. In this situation the Government has a number of options. It might:

- leave the current procedures unchanged and simply monitor the activities of the Foundation and ISPs which allocate names to see whether there is any development which significantly damages the interests of Dutch consumers or businesses
- act now to extend the Government's powers under existing laws to cover domain names as well as E.164 numbers. We understand that this would require a ministerial decree rather than primary legislation. The Government could then, if it wished, establish administrative principles and user rights to domain names against which to judge the activities of the Foundation
- go further and transfer the Foundation's activities to OPTA so that the NRA is responsible for both E.164 numbering and domain name allocation.

We can see little merit in this last option given the dissimilar nature of the two naming schemes and the processes involved in administering each of them. But the merits of the first two options are more finely balanced. The second option could for example lead to greater public confidence in use of domain names while avoiding the expense, time, and

uncertainty involved in any civil court action which might follow a dispute. But on balance we recommend the first option for four main reasons:

- the current system appears to work reasonably well in the Netherlands
- any move by the Dutch government would conflict directly with the philosophy underlying the formation of ICANN and its subsidiary bodies. There is a deliberate policy here to exclude governments from the development of administrative processes
- current domain name management policy already incorporates principles of transparency, non discrimination and objective allocation criteria. The main problem lies in the fact that any enforcement mechanism on the Foundation or Dutch ISPs is not within the immediate control of the Dutch government
- where there are disputes plaintiffs can use civil laws and courts to resolve them.

There is a study underway to review the allocation of domain names in the Netherlands. The Government may wish to review our recommendation when the findings of this study are published.

9.8 The future role of the Dutch government in E.164 numbering

We conclude in the previous section that the Dutch government should continue to play a strong role in the administration of the national E.164 numbering plan. But what does this mean in practice? We believe the Government has three main choices to make.

First it could move to the US administration model where an industry lead body formulates policy recommendations rather than simply providing policy advice. We believe that this model is appropriate for the USA but not the Netherlands because of different industry structures in the two counties. In the USA there is a balance of competing players requiring access to E.164 numbers; in the Netherlands there is one dominant player requiring numbers. Instead we suggest that the Dutch government should follow the Australian model. This means that:

- it should, through some combination of the DGTP and OPTA, continue to play a central and active role in policy formulation for the E.164 plan
- it should continue to seek the advice of the Netherlands Numbering Forum on policy formulation.

Secondly it could give OPTA a more important role in policy formulation while retaining overall authority for numbering policy and all international aspects of such policy. The advantages and disadvantages of a move of this kind are finely balanced. On the one hand it:

- brings together policy formulation and operational management functions. Experience in the UK suggests that a good understanding of how operational functions work in practice helps improve policy decisions
- brings closer together those responsible for competitive and numbering issues. In a number of areas these issues interact strongly.

But such a move also weakens the checks and balances inherent in current arrangements in the Netherlands and could lead to actions which are best for the NRA rather than the Netherlands as a whole. For example it:

- could lead to an inappropriate balance when assessing whether to expand number supply or to use number conservation measures to deal with a shortage
- could lead to inappropriate bargaining in which operators implement regulatory decisions in return for access to numbering resources.

We make no recommendation here. This is a matter for the Government to decide. In doing so it will need to take account of the findings of an ongoing study on how to make the Dutch numbering plan more flexible.

Thirdly it could outsource certain functions. Experience in other countries and in other industries suggests that there is scope for significant gains in cost efficiency by transferring routine operational functions from Government departments to the private sector. We therefore recommend that the Government consider outsourcing to a private company, chosen by competitive tender, operational functions where:

- the rules for the function are stable and can be strictly codified
- the resources required for the function are substantial enough to justify the one off cost of outsourcing.

Such a move would be consistent with developments in numbering administration in other countries described in Chapter 8.

9.9 Rights of use to E.164 numbers

There is a growing need to define explicitly the rights which users and service providers have when they are allocated numbers or blocks of numbers. This need arises for a number of reasons. For example:

- numbers are of growing importance to users and especially business users who often brand numbers[20] so that they are recognised by the public as associated with the company. In these circumstances users want to know when the number might be changed or withdrawn
- there is a trend towards charging for numbers, either on first allocation or on subsequent transfer of use (secondary trading). Such charging is a useful way to ensure efficient allocation of individual numbers in which those who value numbers most get to use them. But it immediately raises question as to what users are buying and under what circumstances the numbers they are paying for will be changed or withdrawn

In specifying rights of use the DGTP needs to take account of:

- the rights of a user to charge when transferring a number to another
- the rights of a service provider to charge for numbers which it issues
- requirements to ensure that anyone who sells a number is the bona fide holder of rights to that number
- the rights of the NRA and service providers to recover unused numbers and number blocks
- any parallel rights to domain names which exist
- rights of use to ported numbers
- any conflict of interest between end users and service providers over rights of use
- the possibility of OPTA charging for the individual numbers which it allocates. Such charges would help to reduce the windfall gains which secondary trading might otherwise generate and redirect these revenues to the Government rather than to private citizens.
- possible use of numbers as alphanumeric names. It is economically efficient if a number with significant alphanumeric meaning goes to the user who can generate most calls from it. So a freephone number such as 0800 KLMKLM is best used by KLM rather than a private citizen. There are two obvious ways to encourage efficient allocation of this kind – through secondary trading or through some kind of registration process[21].

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[20] Like freephone numbers

[21] For example one in which an administrator applies threshold criteria on the usefulness of a number to an applicant before allowing registration.

The ACA in Australia has already defined a basic set of rights of use and is now working on issues of secondary trading. Oftel in the UK is also in the process of defining rights of use. We recommend that the DGTP should also study these issues in detail.

9.10 Charging for E.164 numbers

At various points in this report we identify possible future requirements for NRA to charge for numbers or number blocks. For example:

- OPTA might charge for short numbers in the 0800 range to ration use there
- OPTA might introduce differential block charging between normal and long numbers to encourage machine dialled services to use the latter
- OPTA might charge for individual numbers in high volume ranges such as freephone

At the moment the Dutch government does not have powers to charge for numbers beyond the level required to cover administrative costs. On its own this may not be enough to produce efficient behaviour. We therefore recommend that the Government consider introducing legislation to allow it to charge at higher rates. But if it does so it is important to limit the extent of these charges, both to reassure the industry that they are not a tax on telecommunications service providers and to comply with EU requirements. The obvious constraint is that the Government should only have the power to set charges which can be justified on the grounds that they enable efficient allocation and use of numbers.