IRISH ENUM FORUM

Final Report

20th October 2004

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Version: 4.1

EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is an output of the Irish ENUM Forum, which was formed in October 2003. The Forum was tasked with understanding ENUM and its applicability and relevance to the Irish communications markets and any associated opportunities and threats that it presents. Participation in the ENUM Forum was voluntary and guided by a specific Terms of Reference.

From the onset, the ENUM Forum approach was to advance the thinking and understanding of ENUM within the Irish communications industry, to develop a clear understanding of how a framework for ENUM could be applied in Ireland and to create an Engineering Trial that would prove the technical aspects of the ENUM concept.

This report includes:

- A presentation of the key elements of ENUM and associated findings in the Irish context
- A presentation of the Forum's key determinations based on its own thinking, international experience and relevant expert input
- A presentation on the Irish engineering trial and key outputs
- Recommendations on the next steps for ENUM in Ireland

1.2 BACKGROUND

ENUM is a protocol that matches phone numbers to the corresponding internet domain names. In this regard, it has been considered as a possible enabler for convergence of Next Generation Networks although the business case is not yet proven. This convergence is linked to the worldwide availability of telephone numbers as well as the capability of using telephone numbers to address applications other than voice, such as video and mobile data services. The ENUM protocol can allow for multiple services to be presented across domain boundaries, and thereby presents a shift from location to individual based communications addressing mechanisms.

The key question concerning ENUM is whether a business case can be substantiated. Much has been made of the fact that ENUM's 'killer' application is as an enabler to the adoption of VoIP[1] services, however it must be acknowledged that there are issues surrounding this concept – not least the fact that (realistically) VoIP requires broadband access and that VoIP services are possible without ENUM.

There are indications that ENUM can be successful, given the right market conditions. For a start, all network services require consumers to have used an addressing capability and telephone numbers have been used by consumers for generations. ENUM has the potential to unify many different communications standards and mechanisms and it is possible that it could enable the process of convergence. Nevertheless the remaining questions of economic benefits and return on investment remain unclear. This is due to

[1] There is a glossary of terms accompanying this report and readers are advised to refer to this when seeking clarifications on terms or abbreviations used.

the relatively high upfront capital costs of ENUM related services and the practical ongoing costs of authentication as opposed to what the market would be prepared to pay for such services.

1.3 A HISTORY OF ENUM

In 1999 the IETF created a Working Group on ENUM. The significant deliverable from this group was the RFC2916 which designed the ENUM protocol. Since then, there have been multiple workshops held on the subject and since 2002 many countries in the developed world have been working on ENUM trials and pilots.

The benefits of ENUM

ENUM has promoted great interest among public telecommunications operators, Internet service providers, ITU-T[2], IETF, the EU and some commercial actors such as software vendors and registry management companies. The primary reason for this interest is that ENUM may solve a problem that exists today in obtaining real connection speed with "IP telephony". ENUM transforms the end users' communications identities[3] in real time in connection with, for example, calls from the packet switched telephone network (PSTN) to the Internet or another IP network. Communications identities are obtained from the numbering plan for E.164 numbers and the name plan for the Internet domain names. ENUM can be viewed as a means for connecting these islands of VoIP in the communications world.

ENUM should help end users who wish to be able to be reached via various means of communication where various kinds of communications identities are used. For Internet Service Providers (ISPs) that are not eligible for an E.164 number, ENUM may offer an interesting functionality. They could, with the assistance of ENUM, be able to connect customers that have E.164 numbers directly to their IP network and with the assistance of these numbers arrange "IP telephony'" calls for their customers, although these E.164 numbers are actually allocated to another public telecommunications operator, the so-called access network operator.

However, it is not yet possible to assess the consequences of the introduction of ENUM or whether this use would be a marketable success.

1.4 ENUM IN IRELAND

In 2003, the Commission for Communications Regulation (ComReg) conducted a consultation on ENUM with the Irish communications industry and associated stakeholders (Data Protection etc). One output of this consultation was that Ireland, like many other European countries, should create an ENUM trial with a view to developing a deeper understanding of ENUM and its impact on the Irish communications and economic environment.

The Irish ENUM Forum was created in October 2003 and was hosted by ComReg. The objective within the Forum has been to advance the thinking and understanding of ENUM within the Irish communications industry, to develop a clearer framework for the operation

[2] International Telecommunication Union - Telecommunication Standardisation Bureau

[3] *Communications identity* is a generic term including both a name, a number or an address. For explanation of these three terms refer to ITU-T Recommendation E.191 [2]. This new English term is introduced in this report in absence of a suitable well-known generic English term covering both a name, a number and an address for use in electronic communications networks (e.g. PSTN, ISDN, PLMN, Internet and PSPDN)

of ENUM and to define an Engineering Trial that would derive practical learning opportunities that would subsequently assist any national approaches that might be made towards the introduction of ENUM on a commercial basis

1.5 THE DETERMINATIONS OF THE ENUM FORUM

Prior to evaluating ENUM itself, the ENUM Forum determined a number of inputs from other countries and also from particular subject matter experts. The determinations are outlined below:

1.5.1 Privacy and Public concerns about ENUM

There are public policy concerns about ENUM and these are principally divided into two categories:

- Privacy concerns that are inherent in the design of the ENUM protocol itself due to the fact that ENUM is based on the simple premise that all data is stored in the DNS and thereby publicly available to the world. It is therefore important that individual users can control the information listed in the ENUM record.

- Privacy and other concerns are largely dependent on the implementation of ENUM within each particular country. The issues concerning implementation can be listed as:

    - Opt In requirements for ENUM

      No ENUM record can be created without the consent of the subscriber

    - The need for clarity in the definition of Opt In

      The nature and effect of consent for “opt in” must be clearly explained to the user

    - Privacy of Registration Information

      The information that is made publicly available by the use of ENUM must be carefully managed

    - The need for control over ENUM DNS Records

      As the DNS records contain personal information, it should be possible for the subscriber to change the information and for such changes to be rapidly updated throughout the DNS

    - Authority to change DNS Records

      Only authorised ENUM subscribers can make changes to records and even then, these must be within a secure framework

1.5.2 ENUM Policies and Process

The registration and search of any ENUM domain name in the registry can only take place under the guidance of a clearly defined policy, which is transparent and fair to all parties

who wish to register. This policy is defined in a range of policy documents, which cover all aspects and issues, which might arise during the course of a registration.

It is apparent that any The Tier 1-Registry will establish a Policy Advisory Group (PAG) to advise on all issues relating to Policy. From the desk research of this report, it has been possible to commence the definitions of policies and processes for the ENUM environment. The elements described within this report are:

- Process descriptions that include:
    - Registration Process
    - Transfer Process
    - Registration Change Process
    - Renewal Process
    - Termination Process
    - Registrar/Name Server Provider Accreditation Process
    - Registrar/Name Server Provider Management Process
    - Dispute Resolution Process
    - Policy Development Process
    - Accounting Process
- Policy descriptions that include:
    - Authentication and Validation Policy
    - Accreditation Policy
    - Settlement of Conflict Policy

All the ENUM Policies and Process used are included in the reference document attached to the final report. These Policies and Process are in a draft form and they will need to be finalised at a commercialisation stage.

1.5.3 ENUM in other countries

The Irish ENUM Forum had always intended to:

- Build on trials carried out elsewhere and incorporate results in its summary of lessons learnt in order not to repeat work whose results are already available
- Interconnect with trials in other countries where it was advantageous

The Irish ENUM Forum studied ENUM initiatives from countries that were at a more advanced stage in their reflections on ENUM. In most instances, these countries had already run a trial or have one in progress. A detailed evaluation of each country and the lessons learned from that country are presented as part of this report. The lessons learned have also been incorporated into the structures, processes and policies that are used in this report. The countries reviewed are:

1. Austria

   Possibly the most advanced of all European nations with regard to ENUM, Austria has already announced the intention to move to commercialisation. There has been significant thinking in Austria with regard to privacy matters and the structures and roles of all the actors within the ENUM environment are

clearly defined. Representatives from Austria have addressed the Irish ENUM Forum in person and this report wishes to thank them for their input.

2. South Korea

   Outside of Europe, there have been many developments in Asia concerning ENUM. The first phase of an engineering trial existed in South Korea between March and June 2003. This trial has been expanded to offer additional services to customers. The Korean experience showed that there was a need to have the infrastructure and services in place before commercial organisation became interested.

3. Sweden

   One of the originators of the ENUM debate, Sweden commenced activities in 2001 with the National Regulatory Authority making its first submission to the relevant Ministry. In December 2001 a national trial was commenced with telecommunications and internet companies. The report on the trial was issued in July 2003 with the key conclusion being that a Government intervention would be required to create the initial demand for commercialisation. A member of the Swedish trial also personally addressed the Irish ENUM Forum.

4. The Netherlands

   The Dutch ENUM group was formed in October 2001. As with most European groups, there was broad participation with the regulatory authorities and the final report was produced in December 2002. The Dutch trial was focussed on discussions on the ENUM concept, applicability and conditions of working. The recommendations of December 2002 highlighted issues concerning privacy, security and trust and confidentiality.

5. UK

   This was the closest ENUM trial to Ireland and there was overlapping membership between the UK and the Irish Forums. The UK trial used a more complex structure of operation (multiple Tier 1) and there were issues concerning uptake. However the policy deliberations were significant with particular focus on market conditions and issues such as authentication.

6. USA

   The US ENUM Forum commenced in August 2001 and the original focus was to develop industry standard processes, procedures and requirements for both public and private instances of ENUM. In March 2003, the US Forum released specifications for all levels of the ENUM structure.

1.6 THE OUTPUTS OF THE ENUM FORUM

1. Guiding Principles

The Forum developed a number of guiding principles that were originally developed internationally and were adapted by the ENUM Forum as a result of discussions

concerning ENUM implementation in Ireland. These principles have been used to govern the use of ENUM throughout the Forum. The principles are:

- Trust

In order for a customer to register a number in ENUM all the players involved must be reasonably sure that the Registrant has the right to register that number and there must be a degree of certainty that the Registrant is who they say they are. The process to ensure this is an integral part of the ENUM registration system is known as Validation and Identification (V&I) and it requires that only the authorised telephone number assignee subscribes to, changes, or cancels their ENUM registration and thus prevents ENUM registration hijacking. The same applies to published data, which can only be populated, modified or removed at the behest of the Registrant. It is an essential precondition that all actors involved in ENUM services offer this degree of trust within the ENUM world.

- Equal Access

In order for ENUM to be a commercial success it must be ensured there are no artificial barriers to registration in terms of cost, timescale or restrictive business practices. There must be equal access for all prospective ENUM Registrants to enter any relevant Irish telephone number irrespective of a TSP's awareness of ENUM.

- Value

In order for ENUM to succeed, costs must be set at a reasonable and bearable level to the end user.

- Regulation

ENUM should not require regulation in the same way that the telephone system is regulated. A strict regulatory regime is likely to hinder the deployment of ENUM and the provision of new services or applications based on this technology. However, this should not mean that ENUM would operate in a policy vacuum. Some form of oversight will be needed and it will be important that developments are only allowed within the context of reasonable consumer protection.

- Free Market

The principle of a free market operates within ENUM and as a result it is understood that, although desirable, TSPs are not compelled to participate. Various business entities can perform multiple roles at Tier 2 and in some cases a bundled service may be provided.

- Responsibility

Each entity in the ENUM system has a responsibility to ensure that the systems and processes put into place are as fair and secure as possible.

- Duty of Care

The potential for misuse means that the entities in an ENUM system will have a duty of care on the management of the data they store and, in some cases, publish.

These could include contact details, authentication credentials, billing information and so on.

- Fairness

Service Providers are in a powerful position relative to potential customers, particularly in the early phases of provision of a new service area. To counterbalance this and to stimulate competition, as a general principle a customer should be free to choose the organisation from which they receive services

2. Roles and Responsibilities

   The roles and responsibilities between key actors in the ENUM environment have been precisely defined within this report. The roles defined are the Registrant, the Registrar, the Name Server Provider, The Tier 1 Registry, the Irish government and the actual number holder. Additionally, the relationships between these players and the critical positioning of accreditation have been precisely dealt with through the use of a defined set of policies and procedures.

3. Security and Privacy

   The Forum spent significant time evolving how authentication could be managed. Authentication is the mechanism through which security and privacy can be managed within the ENUM environment and the Forum has already determined options and resources to manage authentication.

   The ENUM Forum is firmly of the opinion in order to be successful, Irish ENUM Registrants must be comfortable that their personal data will not be compromised beyond the natural risk of having the data made available to an Internet DNS Service. The forum applied reasonable steps to protect the security of the information that is used in ENUM operations.

4. The ENUM Business Case

   The Forum also attempted to resolve the issue of the ENUM business case. It is understood that the innovation cycle within networks and communications may facilitate and drive a greater unification of communications, however it is unclear when and where they may occur. The Forum has evaluated the NGN economic model versus the Traditional Network model and is of the view that the business case for ENUM remains to be proven and that it could be 2008/2009 before such a case becomes apparent. This is in keeping with thinking in the international sphere however this does not mean that ENUM cannot be commercialised prior to that period.

5. International Participation

   The ENUM Forum participated in international meetings of RIPE, ETSI Plug test etc.

1.7 THE ENUM ENGINEERING TRIAL

The ENUM Forum created an engineering trial in July 2004. There were three phases to this trial. The first phase involved the procurement of equipment for UCD and the establishment of a Tier 1 registry operation. This also included finalising the organisational

and technical set-up of the trial. The second phase consisted of establishing the first set of communications to ensure that the overall environment is operating accordingly. The third phase aims at operating the complete engineering trial platform with UCD and MCI customers will continue until March 2005. The Engineering Trial has now completed Phases 1 & 2 and is currently entering Phase 3 where it will continue until March 2005. Within phase 3, it should be possible to further examine issues such as practical customer management, validation of the service model and an examination of the relationship between Tier 1 and Tier 2 operations.

1.8 CONCLUSIONS AND RECOMMENDATIONS

In this report the elements that are necessary to successfully run ENUM are presented. At this point in time, ENUM trials have been implemented in several countries although few have actually moved into a commercialisation stage, with the exception of Austria and Japan.

In this report an ENUM operating model with associated Registration Policies, available services and priorities are presented. Privacy issues concerning DNS information etc are also highlighted. The reality is that true operation of an ENUM environment will see issues such as availability, response time, etc being further discussed and resolved.

The economic case for ENUM is also presented although this is somewhat mitigated by the fact that ENUM Trials show very little take-up and the principal application of ENUM (VoIP) is masked by new technologies such as XDSL and WiFi. Clearly the economic case for ENUM should be felt in the corporate sector as it can replace existing equipment whilst preserving the existing dialling plan. There are regulatory and legislative issues to be resolved in this situation and these are also addressed within this report.

The ENUM engineering trail demonstrates that ENUM works however many potential issues remain to be resolved and it is incumbent upon Ireland to find its own way in this regard (e.g. authentication practical organisation, end users look-up tools…).

With this in mind the following roadmap for ENUM in Ireland is recommended.

1. The ENUM delegation in Ireland should be managed and controlled by ComReg (acting as Tier 1 Manager as described in ITU-T documentation), representing the Department of Communications, Marine and Natural Resources. ComReg should have a “light touch” supervisory role in administering the ENUM environment as it already regulates telephone numbering today. It is expected that the ENUM delegation (the Tier 1 Manager role) will remain with ComReg but the technical operations will be assigned to a Tier 1 registry operation on a licensed basis.

2. Ireland, as a small country, will have a single Tier 1 Registry operation and this operation should be selected using standard European procurement mechanisms. A condition of the Tier 1 Registry is that a Policy Advisory Group will guide it, which is representative of all relevant ENUM stakeholders in Ireland.

3. The Irish ENUM environment should use the registration policies and procedures as outlined in this report as a platform for the creation of an ENUM environment in Ireland. The Policy Advisory Group should be used to modify these policies and

procedures when determining the practical and volume implications[4] of issues such as:

a. Assignment of subscribers to ENUM services that are not bound to PSTN services

b. Competition between providers of ENUM services and in particular the Terms and Conditions for transfer of customer data from one provider to another

c. Transfer of data held by incumbent telephone operators to ENUM providers

d. Data privacy policies

e. Authentication and validation policies; The Opt In consumer consent policy is recommended for usage in Ireland and any change to this must be seriously considered

f. Policies concerning the bulk up-load of information from existing databases

g. Number portability policy

h. Universal access policy

i. Legal intercept policy

j. Security policy, including escrow

It is also recommended that the Tier 1 Registry should be responsible for maintaining communications and the exchange of information / best practices with operators in other countries.

4. The existing engineering trial and its associated measurements should continue until March 2005. At that point, a review of the trial should be conducted to ascertain if additional elements have been learned. This report may be updated at that point.

5. Post March 2005, Ireland should move ENUM to a commercialisation phase if sufficient interest is demonstrated in this. This commercialisation phase should be conducted through a procurement procedure as outlined in Recommendation 1 above. It is anticipated that the Commercialisation phase will take 6 months to conclude. The commercialisation phase should take the form of ComReg seeking a Tier 1 operator for ENUM for a period of 5 years, with an annual review of operations and developments. The criteria for selection of the Tier 1 operator should be based on technical capability, ability to develop the market and ability to manage the innovation cycle brought about by ENUM.

[4] The Forum has taken great care to develop Policies and Procedures that could operate in a conceptual sense. It will be the role of the Tier 1 operation and the Policy Advisory Board to determine how these Policies and Procedures would work in a volume environment.

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2. BACKGROUND

ENUM is normally considered to mean Electronic Number Mapping. This was for all intents and purposes a retrospective interpretation. Initially, ENUM was devised as a concept and not an abbreviation. The concept is that ENUM could facilitate elective communications through multiple channels using a single number. As such, ENUM is one of the new developments in the ICT world that **could** be used to unlock the convergence of networks and communications as envisaged in the technology roadmaps.

As with most new technology innovations, ENUM has a degree of promise but this must be couched in the context of varying input factors such as commercial propositions, ease of use, consumer confidence, consumer protection etc. Clearly, if any of these are lacking, ENUM will not commercially ignite, irrespective of its promise.

The Irish ENUM Forum was formed in October 2003. This Forum was tasked with understanding ENUM and its applicability and relevance to the Irish communications market and the opportunities and threats that it presents. The group was voluntary and operates under specific Terms of Reference. It is also worth mentioning that the Group was formed after a public consultation process in the early part of 2003. The Forum was hosted by ComReg (Commission for Communication Regulation).

The approach within the Irish ENUM Forum was to advance the thinking and understanding of ENUM within the Irish communications industry, to develop a clear understanding of how the framework for the operation of ENUM can take place and to define an Engineering Trial that would derive some additional learning, leading to conclusions that can provide guidance to Irish organisations on how to respond to ENUM.

This document is the final report of the Irish ENUM Forum. It includes:

- A presentation of the key elements of ENUM and associated key findings in the context of Ireland
- A presentation of the Forum's key determinations based on its thinking, other international experience and expert inputs.
- A presentation of the Irish trial and key outputs
- Associated recommendations on next steps about ENUM in Ireland

It is the Irish ENUM Forum will to make this document as clear and concise as possible so the reader can quickly identify the key elements he/she is looking for. Thus, a "reference document" is attached to this report. This reference document is a compilation of the key elements that were used by the Forum as inputs (e.g. presentation of other national trials, expert presentation) or outputs (deliverables such as the Irish trial key process and policies).

3. THE IRISH ENUM FORUM

This section presents the Irish ENUM Forum background. It includes:

- A summary presentation of the ENUM protocol (more details presentations are available in the reference document) and the associated operating approach.
- A presentation of the Irish Forum and the way it works (Participants, reporting mechanisms, working arrangements and external consultation).

3.1 BACKGROUND

3.1.1 What is ENUM?

ENUM (Electronic Number Mapping) is a key Internet DNS-based[5] protocol, supported by its own architecture of databases, that specifically targets the convergence of the traditional/historical telephony network (PSTN standing for Public Switched Telephone Network) and the Internet Protocol worlds (One possible application is to link the PSTN world and the Voice over IP worlds).

Because ENUM puts telephone numbers into the DNS, it allows for a wide range of applications based solely on a phone number. Probably the most exciting application is an improvement in Voice over IP, in which telephone calls can be made over the Internet. Other applications include addressing for fax machines, e-mail, instant messaging, and web sites.

ENUM protocol was designed by an IETF ENUM Working Group in the RFC 2916 issued in September 2000:
The first essential step in the ENUM process is to reverse the entire internationally formatted telephone number (using E.164 format), inserting a period after each digit, and then to add “e164.arpa” at the end. This effectively converts the telephone number into an Internet DNS domain, under the .arpa root. The well-established process of DNS querying then follows. A special record known as a NAPTR[6] resource record (containing all (electronic) contact addresses that the relevant number-holder wishes to make known) is then returned.
ENUM enables on the one hand for someone to indicate his/her preferences among the methods of communication that will work and, on the other hand for a caller to select the means of contact from these choices according to his/her own possibilities.

It is crucial to understand, as per the current situation, that any information stored into the DNS is normally public and therefore potentially accessible worldwide.

[5] The Domain Name System is a hierarchical structure of databases that provide a mechanism to allow the corresponding IP address to be found for every Internet Domain Name, thus allowing Domain Names to be used as practical addresses
[6] Naming Authority PoinTeR Resource Records

Figure 1 illustrates an Enum enabled communication and the associated steps required by the protocol.

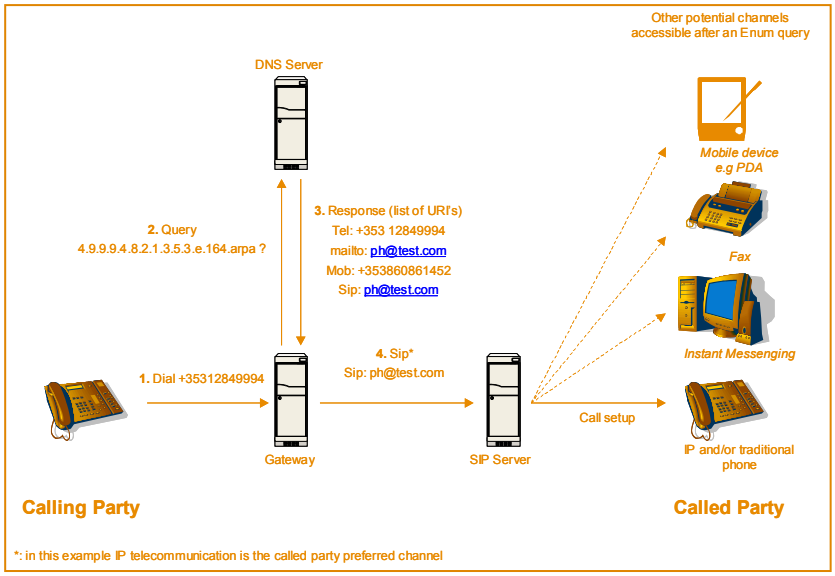


Figure 1: Example of a VoIP application using the ENUM protocol

A number of possible applications are described below:

- Users can send e-mails, faxes and other messages from a computer or mobile phone to a telephone number. The advantage of this is that telephone numbers are generally known, can easily be obtained or are programmed already. They are in the phone book or can be called up via a directory enquiry service. In this way, the email address of a private Internet user can be found through the phone book
- Users can use ENUM as a search mechanism on their PC, calling up an ENUM record holder's access information by reference to their telephone number using the Internet. Websites can also be found in this way. The person can then decide how to approach the registrant
- Companies may make their website accessible via their telephone number.
- Telephone traffic between telephone and computers equipped with VoIP becomes possible without assigning individual telephone numbers to these computers. The usual domain name or IP number is sufficient, and ENUM allows them to be phoned from an ordinary telephone on the public telephone network
- Using ENUM enables messages to enter at a single point and it becomes very simple. The registrant (business or private) can indicate that he or she wants to receive all incoming messages (email, fax, voicemail etc) in the same mailbox – (for example an email box) or can indicate a preference on where to receive individual messages.
- An ENUM record holder (registrant) only needs a single telephone number printed on his or her business card, and can notify changes by accessing information at a single point, namely the registrar. A business registrant can specify various alternative numbers with his or her priorities

3.1.2 How does ENUM work?

ENUM ensures that a registered number on the worldwide telephone network is translated into an Internet domain name. Beyond that domain name, it is possible to determine access information associated with that number and therefore, existing numbers and structures are linked to each other.

The ENUM protocol enabling this translation makes use of the Recommendation E.164 of the International Telecommunications Union (ITU) and the Domain Name System through which the Internet operates. The Internet domain name e164.arpa has been designated globally for this purpose.

To make a domain name from a telephone number, the number must be reversed. This is because Internet domain names start with person specific features and end with the generic features of a number (hence COMREG.IE). With telephony, it is exactly the other way around; they start with a country code and then have a region and personal number.

An illustrative example would be:

- +353-1-8049600

This becomes on reversal

- 00694081353

Dots are applied between numbers

- 0.0.6.9.4.0.8.1.3.5.3

And the domain name e164.arpa is added.

- 0.0.6.9.4.0.8.1.3.5.3.e164.arpa

In essence, ENUM is a mechanism that translates the number into a domain name with the requested address or number associated with this, sends the translated number to the relevant DNS Name server as a query and recovers corresponding address information stored against it.

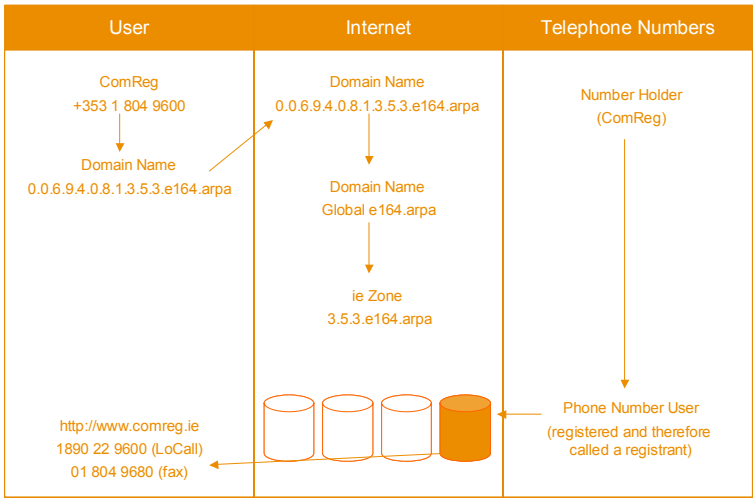


Figure 2: Overview of ENUM mechanism

The ENUM protocol identifies a number of parties based on the "DNS like" architecture at international/national levels and the necessity to authenticate a subscriber, validate his/her personal data and bill him/her.

- **Tier 0:** e164.arpa domain managed internationally
- **Tier 1 Registry:** operates the Tier 1 service (3.5.3.e164.arpa) within a country or region (country for Ireland) and has pointers to the Tier 2 Name Server Providers for all ENUM enabled telephone numbers in the country
- **Tier 2 Name Server Provider:** in charge of hosting and providing registrants NAPTR records.
- **Tier 2 Registrar(s):** in charge of processing registrants name registrations. The registrar will provide the Tier 2 Name Server Provider with the necessary information to set up the registrant NAPTR record. The Tier 2 Registrar can be in charge of liaising with an authentication function to authenticate and validate customers' telephone number. In addition, this registrar can host personal registrant data such as address, bank details, national telephone service provider (TSP) mainly for authentication and/or billing purposes. Registrars could act as Name Server Providers.

The following figure illustrates the relationship betweens these actors in an ENUM "transaction"

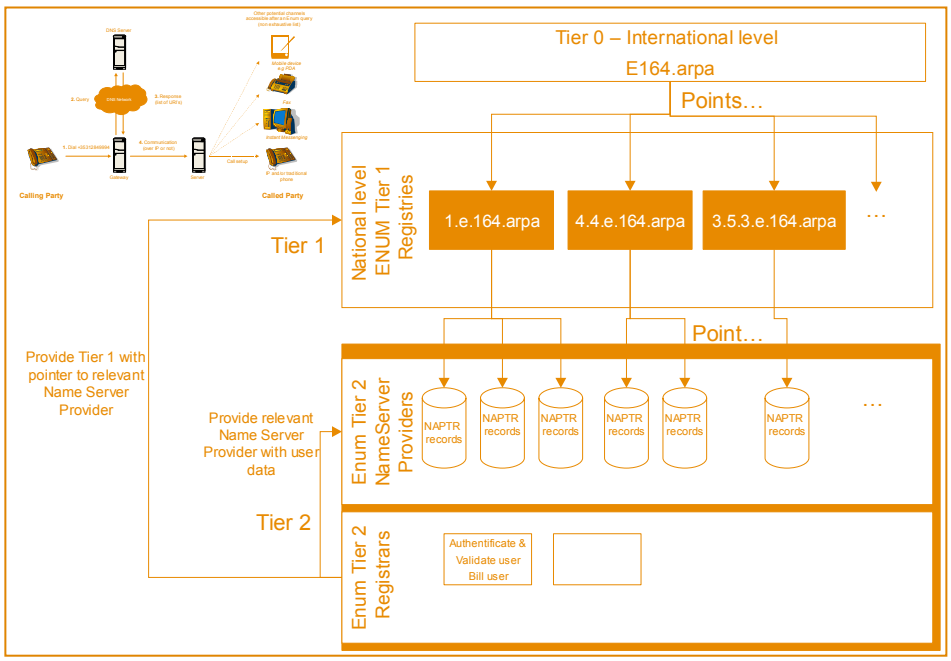


Figure 3: Relationship between the actors involved in an ENUM "transaction"

3.2 OPERATING APPROACH

The Irish Commission for Communications Regulation (ComReg) published a consultation paper relating to ENUM[7] in March 2003. This consultation paper mainly aimed at identifying the needs and wishes of potential Irish players on the national ENUM market by requesting comments on issues surrounding ENUM including the need for a trial in Ireland.

Based on the outcomes of this consultation paper, ComReg issued a Response to Consultation document[8]. This document presented the answers given by the respondents, in particular their strong support for setting up an industry forum. ComReg decided then to set up such a forum involving all the parties potentially interested in running the trial.

The objectives of the Irish ENUM Forum were:

- To determine the key objectives of the Irish ENUM trial (For example, verification of the business case and/or national-level advantages/disadvantages with proceeding to commercial implementation, demonstration/validation of most suitable model for Ireland etc)
- To determine the key parameters of the ENUM trial i.e. its scope and duration, its technical infrastructure and sourcing of this, rights and responsibilities of trial participants, deliverables, etc
- To agree the key deliverables and their timescale
- To oversee the implementation, the ongoing performance and the winding up of the trial
- To assimilate as much knowledge as possible from similar trials carried out elsewhere, with the aim of avoiding any unnecessary repetition.

[7] Reference document: 'ENUM: Accessing Multiple Customer Services Through Telephone Numbers', Consultation Paper, ComReg 03/36, March 2003
[8] Reference document:'ENUM: Ireland's Next Steps', Response to Consultation, ComReg 03/96, August 2003

3.3 PARTICIPATION

The Forum was open to the following organisations, with representative bodies being preferred to individual companies in the case of any interested parties that do not intend to participate directly in the Trial:

- Fixed line network operators
- Mobile operators
- Internet-based Service Providers offering DNS or DNS-like Registry or Registrar/Authentication services
- Internet-based Service Providers offering VoIP, SIP, H.323, messaging or other communications services which could benefit from ENUM
- IT or other developers proposing to develop add-on services to ENUM, which they wish to trial
- End-user representatives, especially those with a focus on usage of customer data
- Data protection bodies, especially including the Office of the Data Protection Commissioner
- Government or Public bodies with an interest in ENUM, including Departments, ComReg, Industrial development bodies etc.

The participants:

Organisation	**Name**
Afilias	Desiree Miloshevic, Philip Grabensee, Tom Wade
ComReg	Oonagh O'Reilly, Albert Redmond, Pat Walsh
Conduit	Tom Hickey
Data Protection Commissioner	Sean Sweeney
Department of Communications, Marine and Natural Resources	Leona Dunne
Eircom	Robert Mc Coy, Gerry Watchorn
eircom net	Alan Judge
Esat BT	Sean Cannon, Natasha Dawe, John Dunbar, Emer Kennedy, Phil Rushton, Katie Taaffe
ICB	Paul Kane
IEDR	David Curtin, Conor Daly
ISOC (Irish Chapter)	Niall Murphy
MCI	Ronan Lupton, Lisa Murray

Organisation	Name
Mquery	Ross Brennan
Neustar	Marco Bernardi
Ntl	Carol Maybury, Peter McEntee
O_2	Helen Martin
UCD	Cxemo Pico, Niall O'Reilly
PA Consulting Group	Colm Reilly (Enum Forum Chair), Emer Mc Donagh
Vodafone	Elizabeth Ryan

3.4 DOCUMENTATION AND REPORTING MECHANISMS

3.4.1 Leadership

The leadership of the ENUM Forum consisted of a Chairperson (Colm Reilly – PA Consulting Group), who presided at the ENUM Forum meetings and facilitated adherence to the ENUM Forum Principles and Procedures[9].

The chairperson was responsible for ensuring the efficient progress of the Trial in meeting its objectives in a timely manner, while avoiding any unnecessary tendency to drift into open-ended work. The chair was to:

- Oversee development of a practical project plan and monitor its progress over time
- Convene and chair regular meetings of the Forum in an objective and neutral manner, taking account of the interests of all parties
- Facilitate progress in preparations for and implementation of the various trial activities listed under "Scope" above and any other activities deemed relevant by the Forum. This means initiating position papers and opening contacts with individuals and organisations, as necessary and in agreement with the Forum members. It also includes exercising control over the trial itself in terms of project-managing the positions agreed within the Forum
- Allocate responsibilities equitably and as appropriate among Forum members for work that needs to be carried out between meetings, apart from that being carried out by the chair itself
- Ensure all issues of costs and liabilities, if any, are dealt with by the forum and its members in accordance with agreed procedures and no such issues remain outstanding at the point of winding up the Forum
- Set-up Forum working groups (WGs) if needed to progress specific aspects of the Forum's work

[9] Reference document: 'ENUM Forum Principles and Procedures'

- Prepare working papers, analyses and slides as needed to form a sound basis for discussion at Forum meetings and position papers, results statements and reports as needed to record Forum outputs and conclusions
- Prepare Agendas for Forum meetings
- When necessary (in the chair's view) to achieve rapid results in as fair a manner as possible, exercise a single casting vote in the Forum
- Wind up the Forum when its task has been either totally completed, or at least completed to the extent deemed by Forum members to be sufficient to meet Trial objectives and their own needs
- Prepare, or have prepared, a final report which inter alias, describes the Forum's conclusions and recommendations and proposes next steps, if any, for ENUM in Ireland.

3.4.2 Decision making and appeals process

The ENUM Forum established two main processes relating to decision making and possible appeal following a decision.

Decision Making Process[10]

"The ENUM Forum and its Working Groups shall operate by mutual agreement and consensus. Consensus is established when the members present for consideration of the subject at hand have reached substantial agreement. However, where necessary as decided by the chair, decisions may be taken by vote. Where the subject matter has a material impact on the trial and on individual trial participants, only trial participants shall vote. In all other matters, all Forum members may vote. For all decisions that require a vote, only a two-thirds majority of the active members voting (excluding abstentions) is required to reach a decision. Each organisation participating in the Forum shall be limited to one vote, with directly linked affiliates being included in the parent body's vote. An active ENUM Forum member is defined as one that has participated in two of the last four full ENUM Forum meetings electronically or otherwise. Consensus requires that all views and objections are considered, and that a concerted effort be made towards reaching a full agreement on the resolution of the issue at hand. Where consensus is not achieved, and a vote is 'tied', the Chair shall have a single casting vote."

Appeal Process

"Any ENUM Forum member or interested party that believes it has been or will be adversely affected by a procedural act or failure to act by the ENUM Forum shall have the right to appeal such procedural action or inaction. Parties are encouraged to discuss procedural concerns with the Chair first. If a satisfactory result is not obtained, the complaining party may submit a written appeal to the Chair with a copy to the ENUM Forum email exploder list.

The ENUM Forum Chair shall issue a written response within 30 calendar days of the receipt of the appeal. This procedure does not preclude the complainant from addressing their concern directly with the ENUM Forum at any time or from pursuing other recourses."

[10] Extract from the Reference document: 'ENUM Forum Principles and Procedures'

3.4.3 Website and Email Exploder Lists

All ENUM Forum documentation and information was distributed electronically via the Forum website (www.consult.odtr.ie/enum) and the email exploder lists. The contents of the website shall be open for viewing by all parties involved in the Forum.

Members and other registered users had the ability to post documents onto this website using the upload function on the website.

3.5 WORKING ARRANGEMENTS

3.5.1 Meetings

Meetings of the ENUM Forum and its Working Groups were to be face-to-face, via conference call or using virtual meeting technologies.

The ENUM Forum established a meeting schedule based upon need. It was envisioned that meetings would be held on a monthly basis unless agreed otherwise with the membership.

In the interests of efficiency, organisations were to minimise the number of their representatives at the Forum, preferably to one. Members were expected to co-operate with the chair and lend their full support to it to ensure steady and efficient progress. Trial and/or Forum members could be excluded if this was deemed necessary by the Chair and following a vote to that effect in the Forum.

A meeting notification and draft agenda were communicated at least seven days prior to a meeting. A preliminary agenda for the next meeting was agreed upon at the end of each meeting.

Meeting[11] notes were taken for all ENUM Forum meetings. These meeting notes shall serve as the official record. The meeting notes shall include

- A register of attendees
- Agreements reached
- Listing of contributions
- Action points for each agenda item

The ENUM Forum Chair and ComReg provided all support functions needed by the members. These functions included providing or arranging meeting venues, recording and publishing ENUM Forum meeting minutes, establishing and maintaining the ENUM Forum website and email exploder lists, providing notification of all meetings, publishing and distributing agendas and other such duties and the ENUM Forum members deem appropriate.

ComReg provided meeting facilities and secretarial support free of charge. It also provided the chairperson.

Each organisation was to fund its own participation in the Forum and in the Trial. Technical infrastructure offered free-of-charge by individual participants and/or interested parties that were necessary for the trial were in general accepted unless similar offers

[11] Reference document: 'Minutes of the Irish Forum Meetings'

were received from more than one entity. If more than one offer was made, then the Forum agreed upon efficient procedures that led to a rapid and equitable choice among the candidates, taking account of any issues that may arise in respect of competition, confidentiality, trial effectiveness etc.

3.6 GUIDING PRINCIPLES

There are a number of guiding principles that have been developed internationally and were adapted by the Irish ENUM Forum concerning ENUM implementation in Ireland. These principles have been used to govern the use of ENUM throughout the Forum.

3.6.1 Trust

In order for a customer to register a number in ENUM the all players involved must be reasonably sure that the Registrant has the right to register that number and there must be a degree of certainty that the Registrant is who they say they are. The process to ensure this trust is an integral part of the ENUM registration system is known as Validation and Identification (V&I). The V&I parts of the registration process are known collectively as the Authentication Process. This requirement ensures that only the authorised telephone number assignee subscribes to, changes, or cancels their ENUM registration and prevents ENUM registration hijacking. The validation function shall occur both upon initial subscription.

Of course, once a registration is in place, the published data represents a Registrant's contact details; there is a measure of trust that these are correct. Thus it is important that this data is populated, modified or removed only at the behest of the Registrant. Authentication of requests for addition, modification or removal of contact data sent to a DNS Service Provider will also need to be carried out; if not then it would be possible for an attacker to hijack the Registrant's ENUM data. Without authentication of requests sent to the Registrant's DNS Service Provider, all the good work of ensuring that the registration was correctly provided is wasted.

The issue of trust is a particular concern for both the TSP (Telephone Service Provider) customer and the TSP itself: the TSP customer is concerned that their number not misused within the ENUM system leading to the possibility of communications to them being misdirected or personal distress. Their TSP is concerned that the number is not misused, as this might reflect on their general competence and cause a loss of revenue in their ENUM-unrelated business.

ENUM registration and data hijacking can be regarded as the most serious risks to ENUM if the registration process is not implemented in an acceptable manner.

3.6.2 Equal Access

In order for ENUM to be a commercial success it must be ensured there are no artificial barriers to registration in terms of cost, time-scale or restrictive business practices. There must be equal access for all prospective ENUM Registrants to enter any valid IRISH telephone number irrespective of a TSP's awareness of ENUM.

This causes a problem for the ENUM registration system in that, although a TSP authentication system is probably the most robust system available, not all TSPs will be willing to be involved in this process. This brought forward the concept of a Participating TSP (PTSP), which can be defined as a carrier who is willing to participate in the authentication part of the registration process for their users in a non-restrictive manner. Also, there is recognition that not all TSPs will be able or willing to participate so there must also be a secondary process allowing customers of a non-participating TSP to complete the ENUM registration process.

It was agreed by the Irish ENUM Forum that if a TSP participates then the recommended process should be to channel authentication requests through the participating TSP to ensure a robust (trusted) authentication.

3.6.3 Value

In order for ENUM to succeed, costs must be set at a reasonable and bearable level to the end user.

Given the Forum agreement that the recommended process should be to channel authentication requests through the participating TSP, there is some concern that this monopolistic position may lead to the TSP electing to set unreasonable charges in order to restrict the uptake of the service.

Therefore, if a TSP decides to participate in the trusted authentication process, they should provide authentication data and service at a reasonable cost in order to allow the ENUM Registrant successfully to authenticate the number. It will be the responsibility of the group appointed to oversee the ongoing implementation of ENUM in Ireland to monitor and ensure TSPs, and any other source of trusted data required for validation and identification, provide their services and data at a reasonable costs and do not act in a way that may negatively affect the services offered by the Authentication Agency.

The authentication process should be designed to be as automated as possible to reduce processing costs.

3.6.4 Regulation

There is a general consensus that ENUM should not require regulation in the way that the telephone system is regulated. A strict regulatory regime is likely to hinder the deployment of ENUM and the provision of new services or applications based on this technology. However this should not mean that ENUM would operate in a policy vacuum and indeed existing regulatory rules governing usage of E.164 telephone numbers will continue to apply as before. Some form of oversight will be needed. Ideally this would be achieved through a self-regulating framework with participation from stakeholders. This body could deal with disputes, accreditation issues and could be overseen as a facilitator for the creation of an independent authentication entity (funded by Stakeholders).

3.6.5 Free Market

A principle of a free market operates within ENUM and as a result it is understood that, although desirable, TSPs are not compelled to participate.

Various business entities can perform multiple roles at Tier 2 and in some cases a bundled service may be provided.

3.6.6 Responsibility

Each entity in the ENUM system has a responsibility to ensure that the systems and processes put into place are as fair and secure as possible.

The Data Protection Commissioner has the overall responsibility for representing consumers' rights with respect to protection and privacy issues. It is understood that the ENUM system will be organised to best protect customers. However, more thought should be given to this area before commercial launch. ComReg, as the Number Administrator

for Ireland, has the overall responsibility with regards to telephone numbers and representation of customers regarding these numbers.

The Trial Forum did, however, reach consensus that it is the responsibility of the Registrant to inform the Registrar and/or any other relevant parties in the ENUM system if an event occurs that would change the nature of the ENUM subscription, for example: termination of telephone service associated with the ENUM domain or porting of the telephone service to another provider.

In other words players in the ENUM registration process will NOT take a pro-active role in ensuring that the ENUM registration is constantly valid. After the initial identification and validation, it is assumed that ENUM registrations will remain valid until they are due for renewal, unless the Registrar is otherwise informed by the Registrant.

3.6.7 Duty of Care

The potential for misuse means that the entities in an ENUM system will have a duty of care on the management of the data they store and, in some cases, publish. These could include contact details, authentication credentials, billing information and so on.

Safeguards will be required to minimise the risk of fraudulent registrations or unauthorised manipulation of a user's ENUM data; these particular problems are known as number hijacking and data hijacking respectively.

Some of these concerns will be addressed either by existing legislation on data protection and privacy or by ComReg regulation. Others could be handled by the framework for codes of practice and accreditation suggested in this report.

Where hijacking has occurred, the first point of recourse is to the fraudulent Registrant or attacker. However there may be a level of liability accepted by the Registrar and Authentication Entity as part of the V&I process, and potentially by the DNS Service Provider who publishes the Registrant's data (and may have a duty of care to ensure that any request for publication comes from the Registrant).

3.6.8 Fairness

Service Providers are in a powerful position relative to potential customers, particularly in the early phases of provision of a new service area. To counterbalance this and to stimulate competition, as a general principle a customer should be free to choose the organisation from which they are provided service. A service provider should not be able to block a customer from using a service feature provided by another, or to transfer to another provider for the service they currently offer. Thus, although a particular organisation may provide a set of ENUM-related services, a customer may choose to be provided each of those services from a different supplier, where this is technically feasible.

One aspect of this lies in control of an ENUM registration; it is the customer's registration, not that of any service provider. The essential qualifier for ENUM is that a customer is provided a communications service via a telephone number (or number range). A customer should be able to retain their ENUM registration as long as they are provided with a communications service, regardless of the organisation that may be providing it.

3.7 CONSULTATIONS

The Forum set up relationships (not to extend beyond its own lifetime), with ENUM groups in other countries, with Standardisation bodies, Numbering bodies (e.g. the Numbering Advisory Panel "NAP") or with whomever else it considered appropriate – entirely at its own discretion.

Several experts were invited at Forum meetings:

- Patrik Fältström – Main inventor of the ENUM Protocol
- Bill Woodcock – PCH Research Director
- Richard Stastny - Austrian Trial representative
- Michael Haberler - Austrian Trial representative

The Forum would like to thank them for the valuable contribution to ENUM in Ireland

In addition, the forum collected an important number of elements documenting other countries experiences and recommendations following trials (e.g. Austria, Korea, UK).

Their participations were extensively useful for the Irish Forum members allow them to build their point of view on how the trial should work and how ENUM should be implemented in Ireland.

4. DETERMINATIONS OF THE FORUM

This section gathers productions from the Forum in terms of

- Desk Research
- Benchmarking of other trials (Austria, Korea, UK, US, The Netherlands)
- Inputs from experts such as Patrik Fältström, Sean Sweeney, Bill Woodcock
- Inputs from the Forum participants (Proposal of authentication solution, registry specification…)
- An analysis of ENUM in the world and the risks/opportunities associated with ENUM in Ireland.

4.1 DESK RESEARCH

4.1.1 Privacy and Public Policy concerns about ENUM

Public policy concerns about ENUM can be divided into two categories

- Privacy concerns that are inherent in the design of the ENUM protocol itself
- Privacy and other concerns that largely depend on the implementation of ENUM within each particular country

A. DESIGN OF ENUM PROTOCOL

The entire ENUM protocol is based on one simple premise – contact information is stored in the DNS and is thus completely exposed to the world. This privacy concern is highlighted when an individual or company choose to place multiple contact methods in the ENUM DNS record world unless a proxy server is used (see below). In such a case, all of the contact information is available to the world. Such broad disclosure of, for example, telephone and fax numbers could result in unwanted telemarketing. The inclusion of an email address could likely lead to an increase in unsolicited 'spam' emails.

For many people, the exposure of personal contact information through an ENUM DNS record will not be acceptable. It is however possible to protect individuals actual contact information behind a 'proxy server' that will only disclose portions of the contact information according to the rules and procedures set by the number holder.

It will be critical that each Number holder is able to control what information is listed in the ENUM record. Thus users may choose to list office voice and fax numbers but omit an office email address.

B. IMPLEMENTATION CONCERNS

The privacy issues discussed in above arise due to the fact that contact information is placed in a publicly available e164.arpa domain name hierarchy. A host of other privacy and public policy concerns will arise out of the administration of ENUM, including the registration of ENUM numbers and control over information in the associated ENUM NAPTR records.

i. 'Opt-in' Requirement for ENUM

The general expectation is that **no** ENUM record will be created for a given telephone number without the consent of the subscriber. However, this approach cannot be guaranteed. There is nothing in the protocol that would prevent either the

- Wholesale inclusion of all telephone numbers within a given jurisdiction in an ENUM system
- The inclusion of individual telephone numbers without the consent of the telephone subscriber

ii. Clarity over what 'opt-in' actually means

In order to understand "the nature and effect of such consent" and what 'opt-in' actually means, it is necessary that a person be aware of the likely use of their data, including the nature of access to the database. If there are uses/disclosure that would not be reasonably understood by a person, then even where a person supplies data (opts-in) to ENUM, that person has not given consent to these non-obvious uses.

iii. Privacy of Registration Information

What personal information is required to obtain an ENUM record?

In the case of domain registration for a website, the owner of the domain is required to list (in the wholly public WHOIS database) their current contact information. This could include a home address for an individual. If similar information is required in order to create an ENUM record in the DNS and if that data must be similarly publicly available, then the potential harmful risks posed by ENUM are vastly increased.

iv. Control over ENUM DNS Records

An ENUM record can, in some cases, disclose important personal information. The authorised subscriber must be able to make changes to that information, and the changes must be promptly implemented through the DNS update system.

v. Authority to change ENUM DNS Records

Only authorised ENUM subscribers can make changes to an ENUM record

Those changes must be made in a secure framework.

One person should not be able to change another persons ENUM record without specific and verified authority.

4.1.2 ENUM Policies and Process

The registration and search of any ENUM domain name in the registry can only take place under the guidance of a clearly defined policy, which is transparent and fair to all parties who wish to register a domain name. This policy is defined in a range of policy documents, which cover all aspects and issues, which might arise during the course of a registration.

The Tier 1-Registry will establishes a Policy Advisory Group (PAG) to advise on all issues relating to Policy. The day-to-day operations of the board are managed by an executive elected by the members of the board.

Described Process include:

- Registration Process
- Transfer Process
- Registration Change Process
- Renewal Process
- Termination Process
- Registrar/Name Server Provider Accreditation Process
- Registrar/Name Server Provider Management Process
- Dispute Resolution Process
- Policy Development Process
- Accounting Process

Described policies include:

- Authentication and Validation Policy
- Accreditation Policy
- Settlement of Conflict Policy

All the ENUM Policies and Process used are included in the reference document attached to the final report. At the time the report is issued these Policies and Process are at a draft form and they will need to be finalised when commercialisation is to commence.

4.2 BENCHMARKING AND LEARNING FROM OTHER ENUM TRIALS

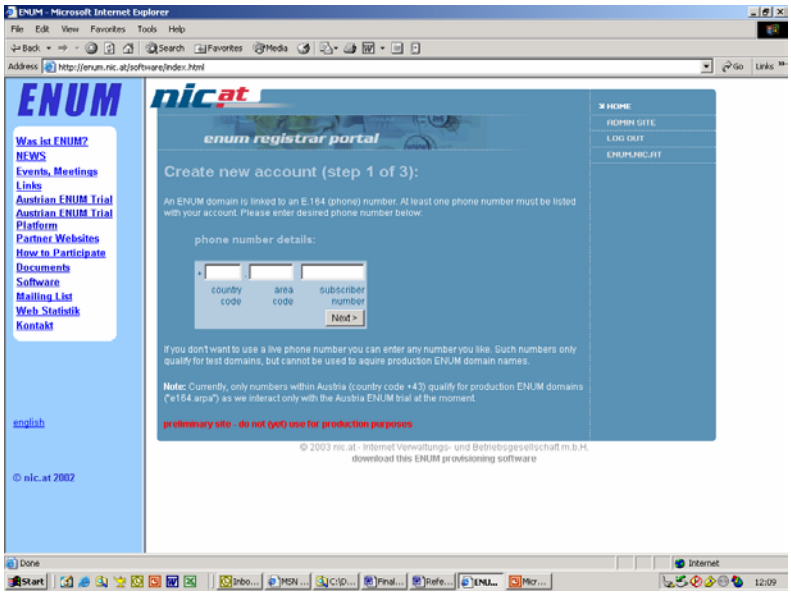
It was part of the Forum scope to:

- Build on trials carried out elsewhere and incorporate results in its summary of lessons learnt in order not to repeat work whose results are already available
- Interconnect with trials in other countries where it was advantageous

Thus, the Irish ENUM Forum studied in more details ENUM initiatives from countries that were at a more advance stage in their reflection or that even run and finished trials. Particularly interesting initiatives are presented in this section

4.2.1 Austria

After a public consultation in August 2001 run by Austrian Telecommunication Regulatory Body RTR (Rundfundk & Telekom Regulierungs – GmbH) and a presentation event in February 2002, participants expressed their interest in a national trial. Consequently, RTR supported the trial by obtaining the delegation of managing the "3.4.e164.arpa" domain by the Austrian National telecommunications Authority.



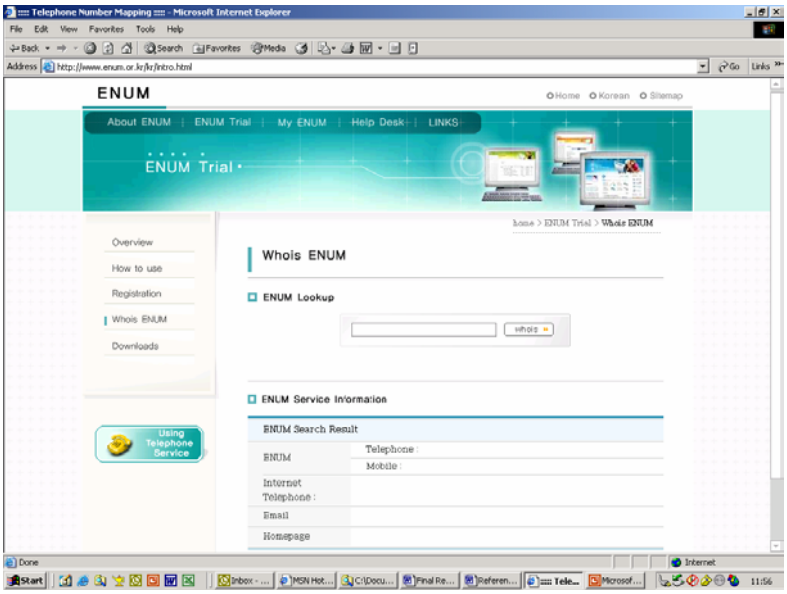
Scope and objectives of the trial	Parties involved	Key Findings
• Provide a DNS-based infrastructure for the implementation of the ENUM System within the domain 3.4.e164.arpa on the Internet, comprising of ENUM Tier 1 Name Servers, an ENUM Tier 1 Registry, ENUM Tier 2 Name Servers and Registers for zone file creation. • Regarding the application aspects: - Provide the trial users with ENUM Client-SW (e.g. a stand-alone ENUM Application and/or application specific ENUM clients) to query the DNS and to retrieve NAPTR records containing URIs related to the E.164 Numbers in the above mentioned ENUM DNS infrastructure. - Provide the applications pointed to by the URIs defined for the trial to the ENUM End Users, if necessary and not available on the Internet (e.g. VoIP services). • Provide a manual Registrar Service for the E.164 numbers used within the trial and a simple provisioning interface (web portal) for the modification of the NAPTR records by the ENUM End Users participating are provided. • Test the ENUM Service by using the clients and evaluate the feedback of the trial participants. • Monitor other national trials for compatibility to allow inter-working. Duration of the trial: 13 months	• ENUM Tier 0 Name Servers and Registry RTR forwarded a request to ITU TSB and RIPE to delegate 3.4.e164.arpa to Nic.at. ITU TSB has formally approved the request and the appropriate delegation has been made by RIPE/NCC to NIC.AT in June 2002. • ENUM Tier 1 Name Servers and Registry Nic.at operated the ENUM Tier 1 Name Server and the ENUM Tier 1 Registry for the ENUM trial period. For the avoidance of doubt, this shall in no way prejudge the final selection of a Tier 1 in Austria. Tier 1 Administration management was held by RTR • ENUM Tier 2 Name Servers and Database (Register) TO BE COMPLETED • ENUM Registrar The ENUM Registrar was the same entity that was operating the ENUM Tier 2 Name Servers, called ENUM Service Provider. An ENUM End User needed to have an Austrian E.164 Number out of the range defined valid for the trial. It was up to the ENUM SP to verify the identity of the ENUM End User and to validate the number (e.g. looking up his own database if the ENUM SP is also the TSP or be checking the phone-bill, etc.)	To ensure integrity of the E.164 numbering space and to ensure consumer protection, a proper administration of the database is necessary. It is necessary to define a national policy framework or a code of practice before commercial applications may be implemented. The trials have shown how to implement the ENUM policy framework for the administration of ENUM and they have also shown that the basic technology works. Even if not all potential applications of ENUM have been identified yet, it is clear that the primary application for ENUM is VoIP and related telephony services (e.g. SMS and MMS), and that it can be expanded to IP Communications in general. The original business model of ENUM for residential subscribers with opt-in for existing numbers has some problems (privacy problems with multiple services (email spaming), validation and re-validation problems) that could be an obstacle to the utility of the network (=(number of users)^2) - New approaches for IP Communications with ENUM are e.g. ENUM for IP-based private networks ("PBX") with direct dial in calls from the Internet and from the PSTN are terminating on the same line: ○ Automatic Validation is not necessary There is no privacy problem with companies ○ Companies may interconnect with each other via ENUM and Internet ○ One company brings in many users Non-geographic ENUM-only number ranges for IP Communications, using ENUM for Routing ○ Calls from the Internet and from the PSTN are terminating on the same line ○ Automatic validation is no problem, because the domain is the number ○ Privacy problem may be handled by aliases
Next steps	Commercialisation by the end of 2004	

4. Determinations of the Forum

Reference documents (See Trial session in reference document)	1.Austrian Enum Trial Platform – Trial Introduction 2.Austrian Enum Trial Platform – Provisioning Procedures 3.RTR-GmbH's General Terms and Conditions for the ENUM Field Trial in Austria 4.Richard Statsny's presentation to the Irish Forum 5. Michael Haberler's presentation to the Irish Forum Website: http://enum.nic.at

4.2.2 South Korea

The Korean Ministry of Information and Communication (MIC) implemented the first phase of an ENUM trial from March to June 2003. The initial stage involved testing and demonstrating their system and the trial has since been expanded and offered services to customers from October 13th 2003 to January 9th 2004. The Korean Network Information Centre (KRNIC) is running the trial as part of its Internet Address Resource Management Basis Project.

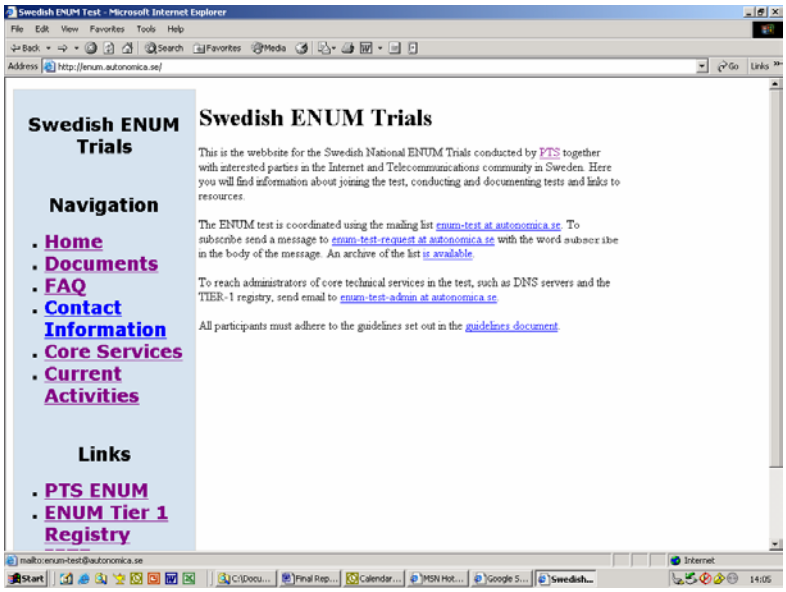


Scope and objectives of the trial	Parties involved	Key Findings
• The ENUM Trial had initially two main objcitves: - To learn about VoIP, IE application and NAPTR DNS techniques - To inform the public on ENUM • • The ENUM Trial System is composed of the following four elements: - ENUM API: A client program required in accessing ENUM - ENUM DNS: DNS that performs ENUM information queries and returns. - ENUM Registration System: ENUM registration website - ENUM Telephony System: System that establishes telephone calls through ENUM	• 2 parties were involved in the ENUM project group - TTA : Korean Telecommuncation Standardization Association. - ENUM PG : Founded in Oct. 2002	• It is extremely hard to get involvement of commercial bodies without showing them any prototype or trial results.
Next steps	• Preparation for commercialisation of the ENUM Service in 2005 - •System : Tel no. verification system, application service system (fax, SMS …) - •Policy Issues: Security, Number Plan, Service Model, Administration System …..	
Reference documents (See Trial session in reference document)	Presentation of the ENUM Trial in Korea Website: www.**enum**.or.kr	

4.2.3 Sweden

Sweden's approach to the ENUM debate started earlier than most. In 2001, the National Regulatory Authority (NRA) made a submission to the Ministry responsible for Posts and Telecommunications outlining 6 key recommendations, primarily focussed on permanent introduction of EMUN and the need for a national trial.

In Dec 2001, the Ministry both together a national trial with interested authorities and telecommunications and Internet players.



Scope and objectives of the trial	Parties involved	Key Findings
• The key issues within the trial were centred on: - Responsibility for ENUM - Personal security and integrity - Competition aspects - Subscriber information protection - Commercial models (payments etc) - Regulatory environment - State involvement in a commercial ENUM environment. • The Swedish trial looked at three specific work streams: - Applications (Study which applications could be used in an ENUM trial) - ENUM domain name and customer process (registration and customer procedures for ENUM, commercial models and Tier 2 roles) - Infrastructure (common infrastructure for the field trial and the roles within that infrastructure).	• ENUM Tier 1 Registry In the Trial, NIC-SE volunteered to be the Tier 1 Registry. There was an agreement signed on this during the trial and the delegation of 4.6.e164.arpa was requested after this agreement was signed with PTS (Post och Telestyrelsen - National Regulatory Authority) • ENUM Tier 2 Name Servers and Database (Registrar) SUNET, Netnod, Telia and Digisip provided Tier 2 Name Servers. • ENUM Validation Authority The registered Telephone Service Provider were in charge of the Tier 1 Validation	The report on this exercise was released in July 2003 with an emerging finding that whilst the market have an opportunity with a field trial, the Government may need to intervene to create initial push. This is a typical outcome for Sweden where the Government will always attempt to intervene in areas of market failure (and a very enlightened one).
Reference documents (See Trial session in reference document)	Trial presentation at the IETF Vienna congress in 2003 Website: http://enum.autonomica.se	

4.2.4 The Netherlands

The Dutch ENUM group was formed in October 2001. It consists of a broad representation of parties that are interested in contributing to the ENUM implementation debate. Participation was voluntary and the Director General for Telecommunications and Post acted as chair of the group.

The Dutch ENUM group produced a final report in December 2002[12]. They included a discussion on ENUM applications and workings within the report. However it was felt within the report that the most important areas were that of registration, deregistration and interim changes. This was positioned within the legal framework in which ENUM would operate. The field trial was not part of this work and it is interesting to note that the Dutch ENUM group has front loaded their work with a discussion on the motivation behind ENUM, the concept, its applicability and the conditions for it to work properly.

The following recommendations were published in December 2002[13]

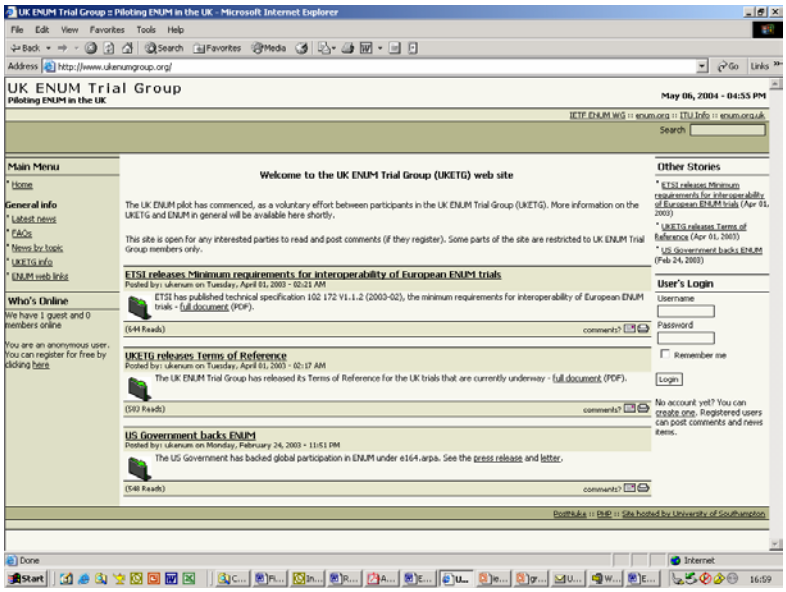
- Registration in ENUM must be in accordance with the 'opt in principle; that is, the registrant expressly registers, and he himself indicates what information he wants registered
- Registration in ENUM requires confirmation of the registrants identity
- Registration in ENUM requires verification that the application is being made by or on behalf of the registrant
- Registration in ENUM requires a check as to whether the telephone number being registered is actually in use by the registrant
- When the access information is introduced into the NAPTR records or modified, it is necessary to verify that this is being done by or on behalf of the registrant
- A registrant who inputs the NAPTR records or arranges for them to be input must be authorised to use this access information
- If it turns out that a registrant has included access information on a third party, or arranged for it to be included, in the NAPTR records without being authorised to do so, registration of the telephone number in ENUM will be cancelled
- If, after registration in ENUM, the registrant's use of the telephone number concerned ends, the number must be removed from ENUM
- Is a user no longer uses a telephone number, the number holder is authorised to have it deleted from ENUM
- There is no reason why the government itself should manage ENUM and the operational aspects of doing so. As far as possible implementation of ENUM must be left to the market
- The government must investigate whether there are alternatives to how delegation is presently implemented. The eventual choice can be made after consulting market players and on completion of the field trial
- Start a field trial of ENUM if there is sufficient interest. The aim of this trial is to test the framework presented in the report, to translate it into concrete terms and to collect market information

[13] 'ENUM in the Netherlands', A Report by the Dutch ENUM group (NLEG), December 2002

4.2.5 UK

An ENUM trial has commenced in the UK and is being run by an ad-hoc industry body, UKEG, with input from the department of Trade and Industry (DTI) and telco regulator (Oftel).

A wide range of companies participated in the forum and the trial (Afilias, Atlas Internet, Bango, BT, Firsthand, ICB, ICC, MCI, Neustar, Nominet, Nominum, Roke Manor Research, Telcordia, University of Southampton, Vodafone).



Scope and objectives of the trial	Parties involved	Key Findings
• To produce interim and a final reports covering all aspects needed to meet the specified requirements of UKEG to identify technical and policy issues that need to be addressed prior to launch of a commercial implementation of ENUM within the UK and make recommendations based on experience gained during the course of the trial where appropriate • To evaluate processes/interfaces/protocols for the interactions between the different parties involved (Tier 1 Registry, ENUM Domain Name System (DNS) Provider, ENUM Registrar, Application Service Provider, Number Assignment Entity, Authentication Agency and Telephone Service Provider); • To determine technical and operational requirements to provisioning ENUM records at Tier 1 Registry and ENUM DNS Provider level and assess DNS requirements/ implications in the provision of ENUM services; • To test from a technical and user perspective applications based on the use of ENUM capabilities; • To evaluate and refine economic benefits and costs of supporting ENUM; • To consider and implement where appropriate inter-working capabilities with other ENUM trials.	• ENUM Tier 1 Registry 3 companies: ICB, Neustar and Nominet • Tier 2 Registrar 3 companies: Afilias Atlas Internet and BT • Tier 2 Name Server Providers 2 companies: Atlas Internet and Nominum • Authentication Agency 1 company: BT • Application Service Providers 9 companies: Bango, BT, Firsthand, ICC, MCI Worlcom, Roke Manor, Telcordia, University of Southampton, Vodafone	Authentication is not trivial; the fact that no central database exists in the UK (each Telco has its own) makes the task complicated for registrars. The fact that a National Telephony Operator handles it should help. The Tier 1 Registry should be a monopoly to avoid conflicts of interest. Tier 1 Registry should have a minimum role (thin Their 1) consisting in operating the registry
Next steps	Government consultation in Q3 2003 with an expected RFP by summer 2004 for commercialisation	
Reference documents (See Trial session in reference document)	Trial presentation at the IETF Vienna congress in 2003 Website: www.ukenumgroup.org	

4.2.6 US

In August 2001, The United States ENUM Forum, comprising interested parties from the Internet and tecommunications industries, was established to investigate the possible implementation of ENUM in the US. The ENUM Forum was established to develop industry standard processes, procedures, and requirements to implement both public and private instances of an ENUM Domain Name structure for E.164 numbers that reside within the U.S. and potentially other countries of the North American Numbering Plan.

In March 2003 the forum released specifications for ENUM in the US[14]. The specifications document includes detailed requirements relating to Tier 1, Tier 2 and Registrar activities.

No trial has been launched yet in the US. Nevertheless it is in question to create a LLC (Limited Liability Company) that could sponsor a trial in the US starting May 2004.

[14] 'ENUM Forum Specification for US Implementation of ENUM

4.3 EXPERT INPUT

Patrik Fältström –author of RFC 2916 made a presentation of ENUM including its history, the way it works, its current status and the expected next steps. *The detailed presentation is included in the reference document.*

Bill Woodcock – PCH Research Director presented PCH (Packet Clearing House) views on how supply and demand influence the changing shape of the global network to the Irish ENUM Forum. *The detailed presentation is included in the reference document.*

Richard Stastny – Chairman of the Austrian ENUM Forum presented to the Irish ENUM Forum the current status of ENUM in the world including lessons learnt from other trials with an emphasis on the Austrian trial. *The detailed presentation is included in the reference document.*

Michael Haberler - chairman of Internet Foundation Austria (the registry for .at domain names) and co-founder of .at ENUM registry made a presentation of ENUM from a commercial perspective. *The detailed presentation is included in the reference document.*

4.4 STAKEHOLDERS AND PARTICIPANT INPUT

Forum members actively participated in the group's thinking. Their inputs are extensively used all along this final report. Key inputs are presented below regarding data protection and authentication process.

4.4.1 Data collection and data processing in the ENUM context

Sean Sweeney – Irish Data Protection Compliance Officer issued as a contribution to the Irish ENUM Forum a paper presenting the data protection issues concerning ENUM and the associated two areas: the data collection and the data processing. *The detailed paper is included in the reference document.*

4.4.2 Authentication process (Identification and validation)

There are two aspects to authenticating a registrant:

- To confirm the registrant is who he/she is (Identification).
- To confirm the telephone number that the registrant wants to register is the registrant's telephone number or that is authorized to register this telephone number on the behalf of another party (Validation).

Different solutions are available to proceed to the identification and/or validation of a registrant (See next page):

Combined validation and identification solutions

Solution	Description and example	Issues and way forward
Direct Query to Registrant's Telephone Service Provider (TSP)	This solution requires an independent be-spoke solution to be designed and agreed between the TSP, the Authentication Agency (AA) and either the Registrar and/or Registrant. A TSP may possibly use the TSP account number as means of I&V or may use some other secure process. The advantage of this solution is that a robust authentication takes place by the owner of the prime trusted data source i.e. the customer's TSP. The disadvantage is that it relies on the customer's TSP participating in the ENUM space.	In principle the TSP account number is a secret that should only be known to the customer and the TSP. Revelation of this ID to the Registrar and Authentication Agency (unless the AA is the TSP) remains an issue. The TSP that provides service for a particular number to a customer may consider the Account Number to be privileged information to be used internally and shared only between themselves and the customer - this is its use as a Validation proof. However, if this information is passed via a Registrar and a (potentially third party) AA 'in a transparent form', then is has been exposed to those third parties and might be considered to be weakened as a validation proof in this process. There are risks in transfer of this Account Code in a transparent form; the entities receiving this can store it and use the data to act on their own behalf, without further TSP customer involvement or requests. One option is to ensure that they are covered by the same duty of confidentiality as the TSP itself; this would (at least) require a strong enforcement procedure as part of the Registrar (and AA) accreditation process. In short, the intermediaries are instructed not to misuse the data. Another option is to not pass the Customer Account Number directly via intermediaries as part of the validation process. Instead, a secure code based on the Account Number and a secret selected by the TSP could be used; thus a secure hash over the Customer Account Data would be passed via the Registrar and AA, and this could be decoded only by the TSP on receipt. This raises the question as to how the potential registrant generates this code; in practice, a number of TSPs likely to participate in the validation process already have online Bill Viewing web services, and generating a secure hash to be used by the customer in subsequent registration requests would be a very minor addition to these services. It does add an initial step for the potential registrant - logging into a Bill Viewing Web service provided by their TSP to collect a code that can be passed in a registration request. However, this allows the data to be passed in an opaque format, maintaining the confidentiality of the data whilst still allowing it to be used for Validation. Whether a requirement placed on the Registrar and AA not to misuse the Customer Account Code is considered acceptable, or instead the participating TSP generates a secure hash for their customer to use is an interesting policy question that should be included in any consultation process. There is a "trade off" between security and cost. There are precedents in the existing Number Portability and Carrier Pre-selection Service processes (particularly the latter, as there is now an automated system to allow activation); choices for ENUM need not be more stringent than those made for other processes.

Hook into number portability process	In principle, every number should be portable and thus a number portability process exists for every number. In order to port a number the parties involved must first ensure that that the customer requesting the port has been assigned that number. This is the same check that must be implemented before a registrant can register an e-number. The number portability (NP) process may use the TSP account number along with the name, address and telephone number to validate and authorise the export/import of a number. The UK Trial Group have had informal talks with the Number Portability Industry Group (for geo numbers) and have agreed that, in principle, the NP process could be enhanced to answer a query along the lines of "don't port the number, just check these details match". However, this would be a manual process: although preferable, an automated would system would have implementation costs and may therefore be more of an issue. The introduction of the Carrier Pre-selection Service provides another mechanism that may be adapted to serve this purpose, at least for those TSPs that have Significant Market Penetration and so must support the service.	The UK Trial Group have agreed that although a mimic of the 'commercial process' can and will be tested during the trial, a true implementation of the envisaged fully automated process cannot be progressed until either ENUM moves to commercial phase or there is some compelling reason, financial or otherwise, for the NP Group(s) to participate. When the participation of the Number Portability Group is formalised the next steps can be as follows: i) Design and agree a manual process with the NP Group ii) Evaluate and discuss options for an automated link into the geographic NP process iii) Approach the Mobile NP Group to agree the principle of hooking into the mobile NP process. iv) Evaluate and discuss options for an automated link into the Mobile NP process

Separate identification solutions

Solution	Description and example	Issues and way forward
Send pin/password to address	The entity performing the identification stage would send (through the post) a pin number or password to the registrant's address. The registrant would then use the pin as proof of name and address, as the information would have been posted to the Registrant directly. Similar processes are today in use to validate the identity of credit card holders, Internet banking users etc. and proved to be reasonably safe and efficient.	The main advantage of this solution is that is not dependent on involvement of an external part (TSP). However, the need to send and use a password/pin to complete the validation process is likely to make the process longer and more costly than a purely electronic solution.
Use credit card payment	During the ENUM registration phase if a credit card was used as a means of payment then a positive authorisation from the credit card company could also be used as proof and provide the audit trail for the connection of name and address	The main disadvantage of this solution is that it is dependent on the involvement of an external party (Credit card company) and therefore possibly more difficult and expensive

Separate validation solutions

Solution	Description and example	Issues and way forward
Use of paper documentation	In order to validate a number, the ENUM registrant is requested to send a recent paper copy of the telephone bill to prove that they have the right to use a number. In order to be sure that the telephone bill has not been forged, the AA should try to ring the number to be sure that the number is still active and assigned to the registrant (in the case of a mobile number, the check could also be done by sending a SMS).	The solution has the disadvantage that it requires the exchange of paper documentation and some interactions between AA and ENUM registrant. There is also an issue of data protection and security. The holding of paper copies of bills may also be an issue.
Use of a Direct Query database	The right for a user to register an E.164 number is validated by checking the associated numbers/user names in the DQ database. The solution has the advantage of using an already publicly available service. The clear disadvantage of the solution is that only a portion of UK numbers is listed in the DQ system (40% of UK numbers are ex-directory and only a small percentage of mobile numbers are listed) and for some type of numbers like DDI there is not an accurate match between number and user name.	If an AA were to choose the DQ route to validate a Registrant's details there are now a number of Directory Enquiries companies offering services using the number range 118 XXX. Eircom is one of a number of 118 companies providing DQ services. The Terms and Conditions of most of these companies clearly state that enquires must not be used to provide a commercial service. Therefore, it would be misleading to suggest that use of the 118 DQ services is free for commercial ENUM implementation. The Trial Group is also unaware of any automated link for queries into any of the DQ companies. If the validation and registration process is to be quick and low cost an automated link should be investigated with the individual 118 companies. The database that provides the raw data to the 118 companies is known as OSIS and is provided through a licensing scheme to the 118 companies. If an AA required a link into the OSIS database then a license would certainly be necessary. Way forward - Investigate the design, costs and provision of an automated feed from the OSIS database and/or directly from the 118 companies.

The full document is available in the reference document attached to the report.

4.4.3 ENUM Registry and Messaging Platform

This document is a contribution from the UK ENUM Trial Group (UKETG). It provides an overview of issues associated with Authentication (Identification and Validation of Registrant and Registrant data) with ENUM as well as a recommended authentication process (from the registrant's information collection, identification and validation to the registry insertion and registrant notification). In addition the document includes an analysis of the different authentication solutions.

The detailed document is presented in the Reference document attached to this report.

4.4.4 ENUM Registry Specification

This document is a contribution from the UK ENUM Group (UKEG). It presents in details the registry platform that is used in the UK Trial made up of the following components:

- Extensible provisioning protocol (EPP) server
- E-mail "Automaton" server
- WHOIS server
- Third-party verification tools

The detailed document is presented in the Reference document attached to this report.

4.5 RISKS AND ISSUES FOR IRELAND

It is very likely that the first ENUM users will be big national/international companies using ENUM in their VoIP roll out to reduce communication costs. Ireland is willing to promote their national ICT capabilities; it is necessary that the country proves knowledge of ENUM to the large companies market.

It may be possible to create a VoIP hub in Ireland for all telecommunication in Europe. There may be an opportunity to develop further opportunities within the Irish ICT Cluster concerning the ENUM environment but this will require further evaluation.

4.6 CURRENT STATUS OF ENUM WORLDWIDE

Following the publication of the RFC 2916 in September 2000, a number of national initiatives were launch nationally (See section 4.2) via the creation of national forums gathering the local NRA, TSP, Telco and ASP companies potentially interested in ENUM.

Most of these forums proceeded to national trials aiming at:

- Examining the technical availability of ENUM
- Examining the best organisation and division of roles between the Tier 1 Registry, Tier 2 Name Server Provider(s), Registrars, Authentication Function…
- Testing and updating provisioning procedures and policies
- Assessing the best way to go forward with the commercialisation of ENUM services

As ENUM is an Internet protocol based on the Domain Name System, international organizations which carry responsibility and perform a management role within DNS: the Internet Architecture Board (IAB) and the RIPE Network Coordination Centre (RIPE NCC) must be concerned, even at a national level. In addition, the use of international telephone numbers within ENUM means that the International Telecommunication Union (ITU) has an interest.

Currently within the Internet, DNS takes care of the conversion of domain names to technical addresses: the IP addresses. For example, it provides the correct IP address in relation to a web page that is sought, by reference to which the server on which the web page runs can be found. A relatively new DNS facility is relevant for ENUM: the use of NAPTR records. Using these records, a multitude of information can be associated with a single domain name.

The DNS, and therefore ENUM, operates according to the principle that every domain name must be unique and can only be assigned once. The system is therefore arranged in a strictly hierarchical way. In DNS terms the manager of a domain name has acquired the ‘delegation’ of that domain name and he is responsible for assigning other domain names, which are assigned under ‘his’ domain name. Thus the Department of Communications, Marine and Natural Resources has the delegation of the .ie. domain and is responsible for assigning the names in that domain (this responsibility is currently assigned to the IEDR).

In the case of ENUM the zone e164.arpa has been chosen. This zone has been delegated to the Internet Architecture Board (IAB). The technical management of e164.arpa has been contracted out by the IAB to RIPE NCC. The IAB is, as it were, the administrative manager, RIPE NCC the technical manager. In the management hierarchy of the DNS, IAB is responsible for drawing up the rules under which names can be assigned, and RIPE NCC is responsible for the implementation of these rules and the management of the required technical facilities, the name servers.

RIPE NCC takes care of the delegation of the various country codes within ENUM. For that purpose it has received instructions from the IAB, which stipulate how applications are to be handled, and under what conditions approval for the delegation of a country code within ENUM is requested from the Telecommunication Standardization Bureau (TSB) of the ITU. The TSB is the bureau responsible for assigning the country codes for

telephony. When an application is made for delegation of a country code within ENUM, TSB checks that the authorities of the country concerned consent to it.

All delegations of zones within the DNS are also subject to a number of general rules, such as rule RFC1591. This describes the requirements imposed on the delegated party of a so-called 'top-level' domain . As regards the appointment of the delegated party it is important that he/she should be regarded as the representative of the interests of both the local and worldwide Internet community. He must handle applications for domain names in a non-discriminatory way and his technical competence must enable him to perform his tasks properly. If that is not being done, the delegation can be withdrawn.

RFC 1591 expressly provides that for delegations to underlying zones the same principles apply as for RFC 1591 itself and that these zones are not subject to any additional requirements.

5. KEY FINDINGS OF THE FORUM

This chapter gathers the key findings of the forum based on the trial that has been run, the forum discussions, presentations that were given during the forum's meeting, experts' advices and other trials experience.

The key findings cover the following subjects:

- Roles and Responsibilities among the ENUM actors.
- Security (with a emphasis on the authentication process)
- Different possible scenarios to will enable to go from the trial to commercialisation
- Business Case
- Data Protection

5.1 ROLES AND RESPONSIBILITIES BETWEEN KEY ACTORS

The figure below describes the necessary functional roles for ENUM implementation.

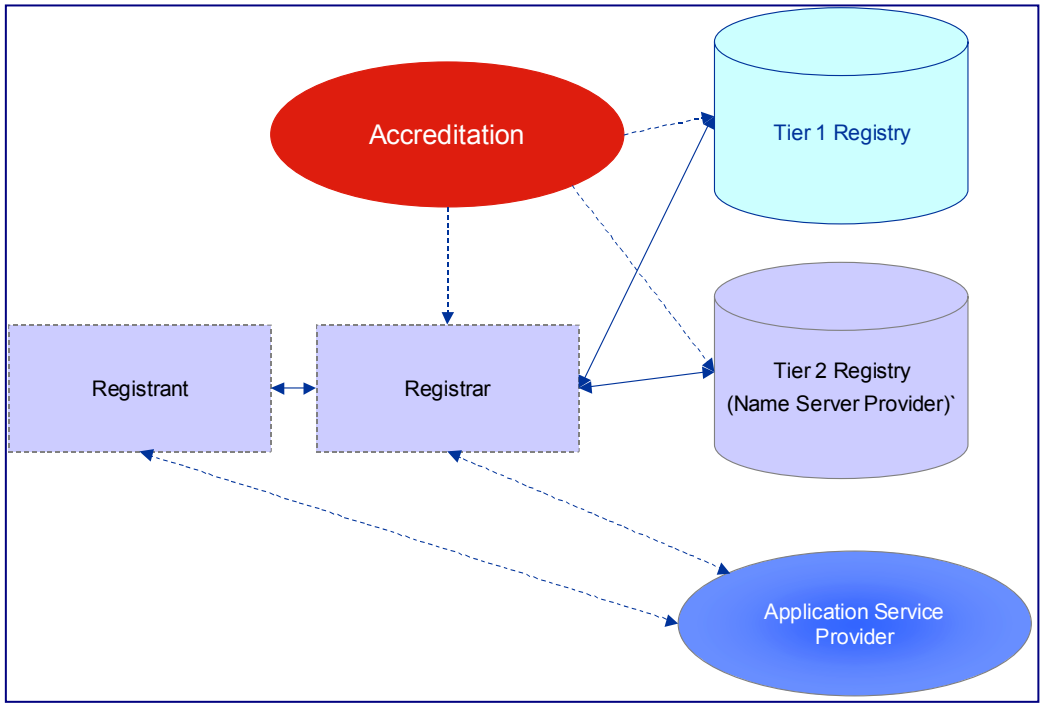


Figure 4: functional roles involved in the ENUM protocol

Various parties are involved with ENUM, and these roles and designations of these parties are covered in the following paragraph.

5.1.1 The registrant

The registrant is the person who makes his/her access information available to others through ENUM, selecting a Registrar to accomplish the registration. The ENUM domain name by which that is done has been derived from a telephone number whose registrant

is the number user within the meaning of the Irish Telecommunications Act. The registrant is thus the individual whose information has been included in ENUM and must not be confused with the person who uses the Internet to find an address through ENUM.

5.1.2 The registrar

The Registrar is responsible for taking registration requests from Registrants, validating the Registrant's authority to register the number in question and interfacing with the Tier 1 Registry to establish a pointer to the Registrants Tier 2 Name Server from the Registry's Name Server. The Registrar also acts as an agent to input the Registrants NAPTR records into the Tier two Registries. The Registrar may also provide, directly or through outsourcing the Tier 2 Name Server function. Alternatively, they may interact with a different Registrant selected Tier 2 or ASP to provision NAPTR records on behalf of the Registrant. They should have access to the Tier 2 Name Server to load, amend and delete NAPTR records in the format being used Ireland.

5.1.3 The Tier 2 Name Server Provider

The Tier 2 Name Server Provider holds the NAPTR records in the format being used by Ireland. . It is responsible for provisioning the NAPTR records requested by the ENUM registrant. The Tier 1 Registry needs to point to this or these Name Server(s).

5.1.4 The Tier 1 Registry functions

The Tier 1 functions consist of the Tier 1 Manager, to which the Irish ENUM zone, or 3.5.3.e164.arpa is formally delegated and the (technical) registry function which contains all pointers to Tier 2 NAPTR records. The manager, which ensures that the operation of Irish ENUM – and specifically at Tier 1 level – is in accordance with agreed procedures at Irish and international levels, may be ComReg or some other entity agreed with the DCMNR.

The Tier 1 registry forms, as it were, the top of the Irish ENUM operational pyramid and ensures that reference is made to the appropriate Tier 2 Name Server or registrars' servers on which the access information is located.

Because of the hierarchical structure of the DNS, there should be only one Tier 1 registry for the Irish ENUM zone as the extra complexity of >1 could not reasonably be justified. To prevent abuse of this position, requirements will need to be laid down regarding the impartiality of the registry and the costs and quality of its service. This has already been dealt with in the Internet world but must be addressed more specifically for ENUM.

5.1.5 The government

At the present time DCMNR has authority over the Irish ENUM hierarchy and will play a role in the appointment of the registry and/or the Tier 1 Manager. The government also has a role within ENUM based on its position as the national contact point for the ITU-T (which authorizes RIPE to delegate the various national Tier 1 registries) and by reason of the social importance of the Internet, but wants to remain at a distance from actual implementation. Responsibility for the administration of the Irish national numbering scheme rests with ComReg, under the EU Framework Directive, as transposed by S.I. No. 307 of 2003.

5.1.6 The number holder

Telephony services providers comprise a specific section of the number holders. They enable their users to use individual telephone numbers from the number blocks assigned by ComReg. Examples are the numbers for fixed telephony and mobile telephony. There are number holders with individually assigned numbers, such as the holders of service numbers; 1800 and 1850 numbers. The Irish numbering is described in further detail in the documents “National Numbering Conventions” (ComReg 04/35), “Irish Telephony Numbering Scheme Status Report December 2003” (ComReg 03/143R) and “Geographic Telecommunications Numbering Areas” (ComReg 03/147) .

5.1.7 Other possible roles

To ensure the correct use of telephone numbers within ENUM, a number of checks must be carried out relating to the registration, modification and deletion of details in ENUM. This is called “validation” and needs to be defined as a process, which can then be worked into a technology, based solution. In truth, it is unclear how validation will actually be worked out. It must be noted that no other pilot appears to have addressed this topic in sufficient detail.

All of the roles referred to above will be involved in validation, for example the registry, the registrars and the number holders. There may also be some new roles depending on the process to be used (for example an ASP (Application Service Provider) role is shown in the figure above, whereby some entity operates a server that allows ENUM users to interact with the ENUM system to transparently automate ENUM lookups in the course of messaging).

5.2 SECURITY AND PRIVACY (WITH AN EMPHASIS ON AUTHENTIFICATION PROCESS)

There are two aspects to authenticating a registrant:

- To confirm the registrant is who he/she is (Identification).
- To confirm the telephone number that the registrant wants to register is the registrant's telephone number or that is authorized to register this telephone number on the behalf of another party (Validation).

The Forum agreed that the Authentication Process should occur between the registrant and the registrar. There will not be a separate Authentication agency or body at the Tier 1 level that oversees authentication.

5.2.1 Criteria for Authentication

The Forum identified mandatory and optional criteria for authentication:

- Mandatory criteria
  - Meet data protection requirements
  - Avoid the need to compel Telephone Service Providers to participate
  - Verify the applicant is authorised by the legitimate number-holder (or account holder) to register the number in question
- Optional Criteria
  - Not necessitate physical presence for the registrar and/or the registrant
  - Be reasonably simple, fast and relatively 'cheap'
  - Verify the identity of the registrant

5.2.2 Criteria for Authentication

The following authentication options were suggested for the functional ENUM trial

A. REGISTRAR IS ALSO THE TSP WHO MANAGES THE REGISTRANTS NUMBER ACCOUNT

Option 1 Authentication procedures can be completed internally with an identification and verification check against the Registrant and their account with the TSP.

B. REGISTRAR IS NOT THE TSP WHO MANAGES THE REGISTRANTS ACCOUNT

The following options can be considered here:

Option 2: The Registrant provides authentication in person (ID, account bills) to the Registrar.

Option 3: The Registrant approaches their TSP, obtains an electronic confirmation that they are the account holder and presents this to the Registrar at the start of the ENUM registration process.

Option 4: The Registrant approaches the Registrar with the relevant ID. The Registrar approaches the TSP for verification that the Registrant is indeed the number-holder concerned. The TSP provides a response within an agreed service level and for a fee.

Option 5: The Registrant approaches a Third Party Verification company (TPV) who carries out the verification checks with the TSP on behalf of the Registrant and the Registrar.

Option 6: The Registrant informs their TSP that they wish to avail of ENUM services with Registrar X. Registrar X approaches the TSP with this same information, and authentication information is provided to Registrar X.

Option 7: The Registrant provides an undertaking that they are the person/number holder involved and the Registrar accepts this for authentication.

Option 8: If a mobile number is used then validation can be via an SMS to the number with correct agreed response back from the Registrant (and identification is assumed if the Registrant has that level of control over the mobile).

The following table represents the analysis on whether each of the authentication option satisfies the authentication criteria:

		Options							
	Selection Criteria	1	2	3	4	5	6	7	8
Mandatory	Will be able to meet data protection requirements	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	Avoid the need to compel TSPs to participate in ENUM themselves	Yes	Yes	Yes	No	Yes	No		Yes
	Verify the applicant is authorised by the legitimate number-holder (or account holder) to register the number in question	Yes	Yes	Yes		Yes			
Optional	Not necessitate a physical presence for the Registrar	High	Low	High		High			High
	Be reasonably simple, fast and 'cheap'	High	Low	Med		Med			High
	Verify the identity of the Registrant	High	High	High		High			Low

Table 1: Analysis of the authentication options against the authentication criteria

The Irish Forum members agreed that all these authentication options were acceptable. Nevertheless, for the purpose of the Irish trial, it was agreed that the trial players would be in charge of selecting the option that suits them the best.

5.3 ENUM BLOCK NUMBER ALLOCATION – A POSSIBLE ALTERNATIVE TO VALIDATION ISSUES?

It is clear that the validation and authentication process is key for the success of ENUM. On the one hand, ENUM users must be ensured that all the security principles are applied when they (and consequently other users) register. On the other hand, all the efforts have to be made so this process is "constraint free" from a user point of view.

The allocation of ENUM specific numbers could be an alternative to costly and time-consuming validation process. It consists in assigning an ENUM number during the ENUM registration (a phone book entry is required). A cancellation of the ENUM domain will relinquish the number. It is an easy and cheap process as long as a block number range is allocated for this purpose. Nevertheless it is necessary to ensure that the number allocation is managed in a consistent and efficient way. In its consultation on Numbering for VoIP (document ComReg 04/72) ComReg addressed the question of specific number allocations for ENUM purposes but the responses received rejected this option.

Another way to ease the validation process is to use the SMS service for mobile number holder. An SMS sent during the registration process enable to validate the number. Authentication of the user in this approach is ensured to a reasonable degree by knowledge of the PIN number needed to activate the relevant mobile handset (i.e. authentication against the SIM).

5.4 THE ENUM BUSINESS CASE

The innovation cycle within networks and communications will surely facilitate and drive a greater unification of communications. It is probable that the Next Generation Networks (NGN) will facilitate this unification of communications:

- So far, the main telecommunication carriers providing services on the PSTN have protected themselves from smaller players via huge up-front costs linked with the traditional switch technology.
- Even if the convergence between the PSTN (based on circuit switching) and the Packet Switched World is inevitable it is unlikely that operators will opt for a wholesale replacement because of the multibillion euros investments they made to purchase the traditional infrastructure and associated central offices.
- For the same reasons, the NGN offers flexibility in programming, service offering and low costs. It opens the way for smaller players on the market (no need for huge infrastructure) that will focus on providing adaptable, scalable and easily manageable services at low costs.

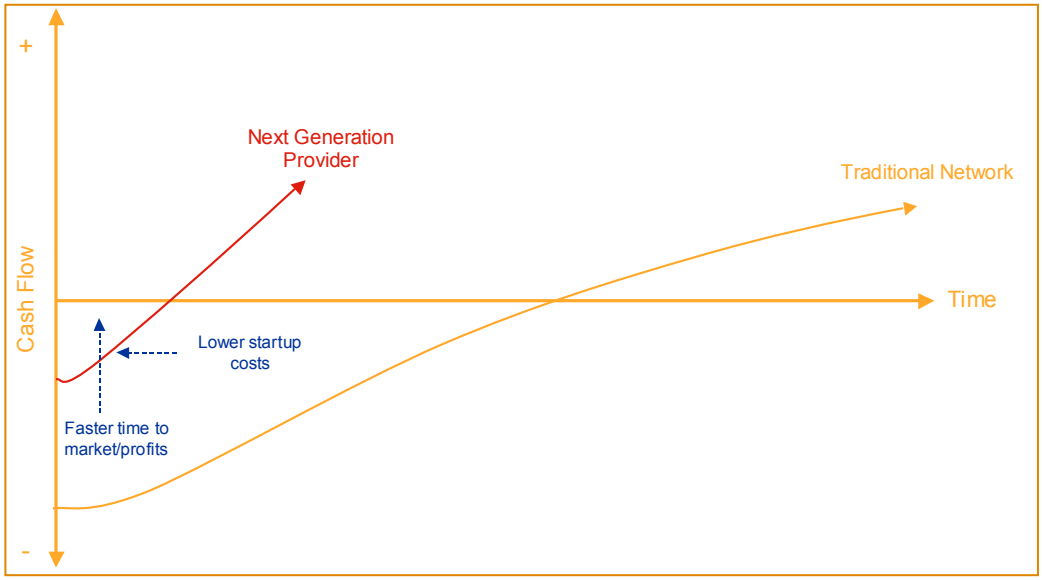


Figure 5: the NGN economic model versus the traditional network model

ENUM represents a good example of a Next Generation Network service: This concept of unification, increased user choice and user mobility will drive simplification of communications from an end-user perspective. Most end-users, at the individual or corporate level, want fewer numbers and email addresses. It is very likely that it will follow the Internet model (or next generation model) rather than the traditional telephony model because it does not require any expensive infrastructure. It is then very likely that, on a first stage, the first ENUM providers will be "small" players such as e.g. Internet Service Provider. Again, because the convergence between the PSTN and the Packet Switched is considered inevitable, the major telco companies should be part of the game after an "observation period".

First broad use of ENUM will likely be to facilitate the transition away from PSTN towards the Internet as the primary carrier of voice communications. ENUM may initially see

widespread adoption with large and medium sized corporations and institutions seeking to reduce telephone costs by using VoIP for voice calls. Corporations could implement ENUM entirely behind the scenes and route some phone calls over the Internet instead of the normal telephone network. VoIP communications can be much less expensive than placing a normal telephone call. If both parties already have a high-speed Internet connection and the proper VoIP equipment, they can today talk to each other over the Internet without incurring any additional telephone charges for the call.

Allowing a single number to provide access to voice, fax, mobile and other channels of communication could enable an "opt in" enhancement of Customer Relationship Management solutions at a corporate level. This would naturally reflect on elements such as a multiple channel approach to communications.

Another use of ENUM may take place within a traditional telephone company's network. Increasingly the leading long distance companies in the Unites States are converting over to carry voice calls using VoIP. These companies may use the ENUM specification to create their own wholly internal version of the DNS, and then use ENUM to assist in routing telephone calls with their own networks.

The mobility question and the ability to separate data from applications allows for significant development of new innovations for corporate competitiveness.

In a longer term, individuals will be able to install Internet-to-telephone equipment in their homes, and in conjunction with VoIP and ENUM-based technology may to able to reduce their usage of traditional telephone services. The more of an individuals friends, family and colleagues who use similar Internet based voice services, the more potential that an individual can save money or avail of services from companies using CRM solutions that use ENUM as a multi-channel instrument.

ENUM may also be used as a convenient way to access new Internet services from mobile telephones and other devices that lack a full keyboard. Users may be able to simply dial a telephone number that is translated using ENUM into the desired Internet address.

In addition ENUM enables users to specify their preferences for receiving incoming communications, and gives greater user control over communications. For example, a user can specify a preference for voice mail messages over live calls during certain times of day, or may indicate a destination for call forwarding.

5.5 DATA SECURITY

In order for ENUM to be a success, registrants must be comfortable that the Irish ENUM operations will not jeopardise their personal data beyond the natural risk of having them published on an Internet DNS server.

Three risk areas can be identified in relation to data security:

- Open disclosure of the registrant's NAPTR records in the public DNS
- ENUM registration and initial provisioning
- Disclosure of registrant personal information to third parties

ENUM providers are required to take reasonable steps to protect security of the information they use during these operations.

In order not to emphasise the data security risk beyond realistic issues linked with the Internet world, it is necessary to inform the applicant on the ENUM operations and give him/her the choice to provide the level of information he/she estimates as relevant:

- Information[15]: "*ENUM providers should be required to provide customers with clear and conspicuous of the information practices, including what information they collect, how they collect it, how they use it, how they provide choice, access and security to the consumers, whether they disclose the information collected to other entities, and whether other entities are collecting information through them.*"
- Choice: "*ENUM Providers should be required to offer consumers choices as to how their personal identifying information is used beyond the use for which the information was provided (e.g. to complete a transaction). Such choice would encompass both internal secondary uses (such as marketing back to consumers) and external secondary uses (such as disclosing data to other entities). In the absence of explicit consent of the Registrant, the ENUM Provider should neither disclose information to other parties nor use of purposes other than effecting and maintaining the ENUM Registration.*"

Consequently, ENUM providers (Registrar, Tier 1, Tier 2 Name Server Provider) have to be able to give access to all ENUM customers to their personal NAPTR and other personal information e.g. billing information.

[15] Extract from ENUM Policies and Process (Reference Document)

5.6 HOW TO GET FROM TRIAL STAGE TO COMMERCIALISATION STAGE?

At the time of writing, there is an ENUM Engineering Trial underway in Ireland. This trial is described in detail later in this report. The question that has arisen in most environments where ENUM trials have occurred is to determine when to move to a commercialisation stage.

There are no pre-determined roadmaps to ascertain how this should be achieved but the deliberations of the forum outline a mechanism whereby the guiding principles of ENUM can be adhered to (please see section 1.6, page 14). The principles argue for a commercialisation process that enables trust in the ENUM process, allows for equal access, ensures that costs are to a minimum to create demand and whereby regulation is relevatively "light" compared to traditional telephony systems. This is in essence a balance between the internet and telephone numbers regulation. However the critical principle guiding the development of ENUM should be that of the Free Market. The business and economic case for ENUM remains unclear and as a technological innovation it will require time to be positioned in the market prior to understanding market consequences.

In that regard, it is believed that the means to move from Trial Stage to Commercialisation stage is to use a seamless process without delay. This process implies the following:

- ComReg should retain ownership of ENUM as a representative of the Irish Communications industry and on behalf of the Department of Communications, Marine and Natural Resources. In practice, ComReg should retain the delegation and licence it to a Tier 1 operator for a fixed period of time (5 years). ComReg would also be required to conduct annual reviews and take an oversight role.

- An open competition, run by ComReg, should be used to ascertain who should run the Tier 1 operation in Ireland. As this will be a licence for a fixed period of time, this competition should deal with the start-up and wind-up situation, including escrow of records. It would be envisaged that a set of criteria would be established to determine who the operator should be and that such criteria would revolve around:

    - Technical capability
    - International capability
    - Local capability
    - Ability and commitment to "grow" and develop the market
    - Ability and commitment to work with all stakeholders in the market

  It would be recommended that a "Restricted Procedure" be used to manage this procedure. This would allow for ComReg to determine relevant market interest whilst ensuring a complete solution for ENUM in Ireland.

- It would be envisaged that the Tier 1 operator would have a Policy Advisory Board. This Policy Board should build on the Policies and Procedures that have been developed as part of this report and modify them / create new versions as the need arises. The Policy Advisory Board should be representative of all the Irish Communications industry including Tier 2 operators.

- The Tier 1 operation should provide regular quarterly reports to ComReg outlining relevant ENUM usage and growth.

5.7 THE ECONOMIC APPRAISAL OF ENUM

Given the nature of the different transactions with customers and the associated investment, it is very unlikely that ENUM by itself will be a moneymaker. ENUM being an enabler of the convergence of NGNs, it will generate cash indirectly via the applications it will enable and players in the ENUM field are likely to be those adding ENUM capabilities to gain extra value from their other existing operations, rather than stand-alone ENUM operators.

VoIP user connection is deemed the main 'killer'[16] application for the time being but there is no doubt that other key applications will arise through the natural innovation cycle. In this context, VoIP is seen as a strong driver for ENUM uptake whereas uptake of ENUM also greatly facilitates growth of VoIP – a virtuous circle. Nevertheless all these applications will be highly dependent on the Internet bandwidth available to the users.

Therefore, it is necessary to make sure that Ireland reaches a minimum level of broadband availability for both companies and individuals to secure the success of any commercialisation.

The diagram below shows that the best of VoIP and broadband access is yet to come. If a commercialisation of ENUM is without any doubt feasible, it is important to make sure it is launched at a proper time.

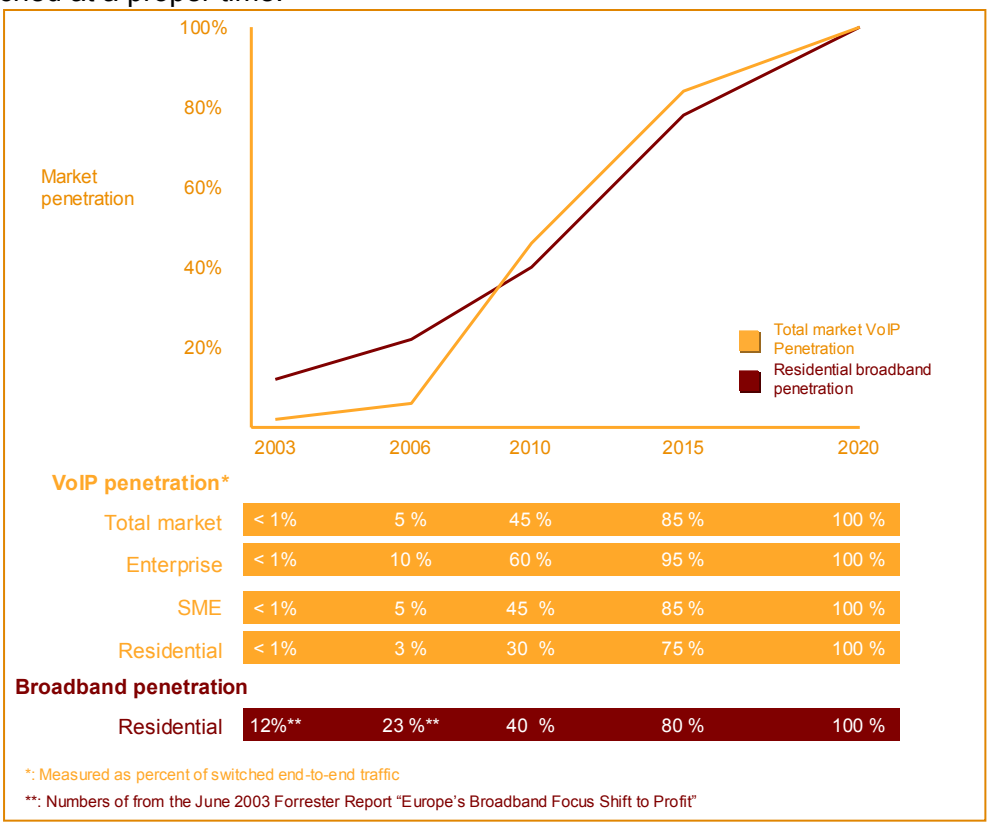


Figure 6: The Complete Migration to VoIP will take 15 to 17 years in Europe

[16] Various other applications are already suggested but with less impact (e.g. telephone number as email address; redirection from one telephone number to another (e.g. fixed to mobile); telephone number to web page access).

6. THE IRISH ENUM TRIAL

This chapter presents the Irish ENUM trial proposed by the Forum and due to run between June and September 2004 (Phases 1 & 2) and between October and March 2005 (Phase 3).

The following actors are involved:

- Tier 1 Registry: Afilias
- Tier 2 Name Server Provider: UCD and MCI

The main results: a technical and organisational platform available for tests with UCD and MCI customers

The next steps: tests with UCD/MCI customers between October 2004 and March 2005 and a commercialisation scheduled from March 2005.

6.1 SCOPE OF THE TRIAL

6.1.1 Objectives of the trial

The trial should enable ComReg and the Forums member to:

- Agree a functional model for ENUM in Ireland
- Test and evaluate ENUM processes including authentication/validation, registration, data entry and look-up etc
- Establish the simplest procedures that meet legal obligations in Ireland as well as participant's needs, including data protection and privacy obligations in particular;
- Test the usefulness of ENUM as a facilitator for packet-based services of interest to participants, typically including VoIP/SIP/H.323, advanced messaging services and so on, as well as support evaluation of the inter-working of these with PSTN/ISDN
- Support the use of other services (e.g. fax, mobile communications, mailboxes, web, video conference as required by participants)

The forum did not want to repeat work whose results were available from trials carried out elsewhere (though it built on these and/or incorporate their results in its summary of lessons learnt).

6.1.2 Organisation and roles for the Irish trial

Ireland has one Tier 1 Registry for the purposes of the Irish ENUM Trial. Afilias will be in charge of the Tier 1 Registry Role.

Regarding the Tier 2 functions, it has been decided that, for the purposes of the trial, there would be two Name Server Providers namely University College of Dublin and MCI. UCD and MCI will act as registrars as well. For the trial purpose, the registrar role includes the provision of the Accreditation/Authentication activities.

2 types of registrant population were taken into account within the trial:

- UCD staff and students
- MCI staff

The following authenticating policy was used regarding the UCD staff and students:

Type of customer	Authentication method
UCD Staff using their DDI number for registration	Check consistency of numbers in the UCD registry
UCD Staff using their UCD Vodafone mobile Numbers for registration	Check consistency of numbers in the UCD mobile phone registry
UCD Staff using private mobile number for registration	A SMS will be sent to the registrant asking to confirm the password that was given to him/her at registration. Authentication is completed when the Tier 2 receives confirmation of the password.
UCD Staff using their private fixed number for registration	The registrant will be given a password when registering. He/She will have to confirm this password when called by the Tier 2 on the private phone number.
UCD Students using their private fixed number for registration	The registrant will be given a password when registering. He/She will have to confirm this password when called by the Tier 2 on the private phone number
UCD Students using their private mobile number for registration	A SMS will be sent to the registrant asking to confirm the password that was given to him/her at registration. Authentication is completed when the Tier 2 receives confirmation of the password

6.2 PLAN

There are three phases to this trial. The first phase involved the procurement of equipment for UCD and the establishment of a Tier 1 registry operation. This also included finalising the organisational and technical set-up of the trial. The second phase consisted of establishing the first set of communications to ensure that the overall environment is operating accordingly. The third phase aims at operating the complete engineering trial platform with UCD and MCI customers will continue until March 2005. The Engineering Trial has now completed Phases 1 & 2 and is currently entering Phase 3 where it will continue until March 2005

The first and second phase of the Irish ENUM trial started in June 2004 and was completed in September 2004.

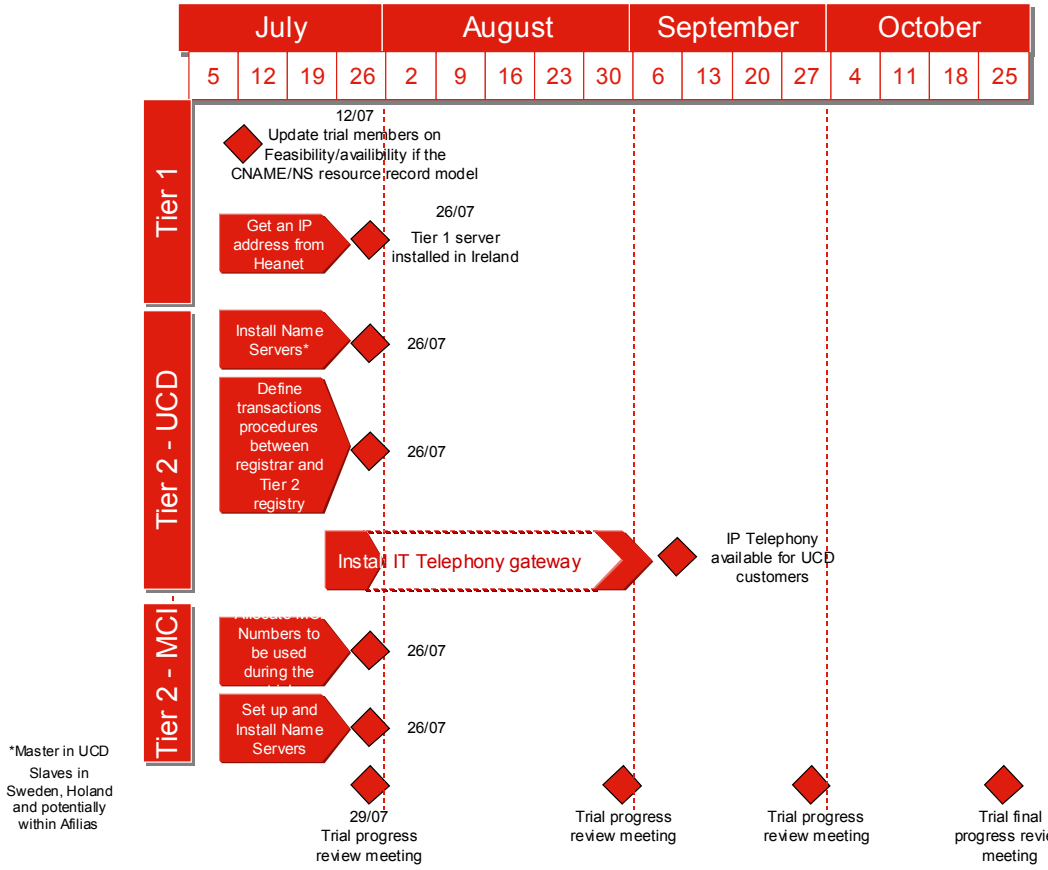


Figure 7: Highlevel project plan for the Irish Trial

The third practical phase is scheduled between October 2004 and March 2005.

6.3 RESULTS

6.3.1 Equipment and Interface

The following equipment was used within the Irish Trial:

A. TIER 1:

The Afilias Tier 1 footprint Registry is hosted on a DELL server hosted with HEANet in Dublin with backup in Canada and in the US.

B. TIER 2:

The UCD Master Tier 2 registry is hosted on a DELL server (Intel 4 Proc 2.8GHs, 80 GB HD, Linux OS) based in UCD.

UCD Slave servers are installed on Autonomica's servers in Sweden and in Holland.

C. SIP COMMUNICATION

IP Telephony:

- IP Phones:
  - Cisco IP Phone 7940G
- PBX Gateway:
  - Single-Port 30 Enhanced Channel E1 Voice/Fax Network Module
  - 16 to 48MB Flash Factory Upgrade for the Cisco 2600XM
  - 32 to 128MB DRAM factory upgrade for Cisco 261x/2xXM
  - Cisco 2600 Series IOS IP PLUS
  - 10/100 Ethernet Router w/ Cisco IOS IP

Media Gateway:

The SIP Router software used during the trial is SIP Express Router for IPTel.org (open source)

The SIP Router is installed on a DELL computer (Intel 4 Proc 2.8GHs, 80 GB HD, Linux OS)

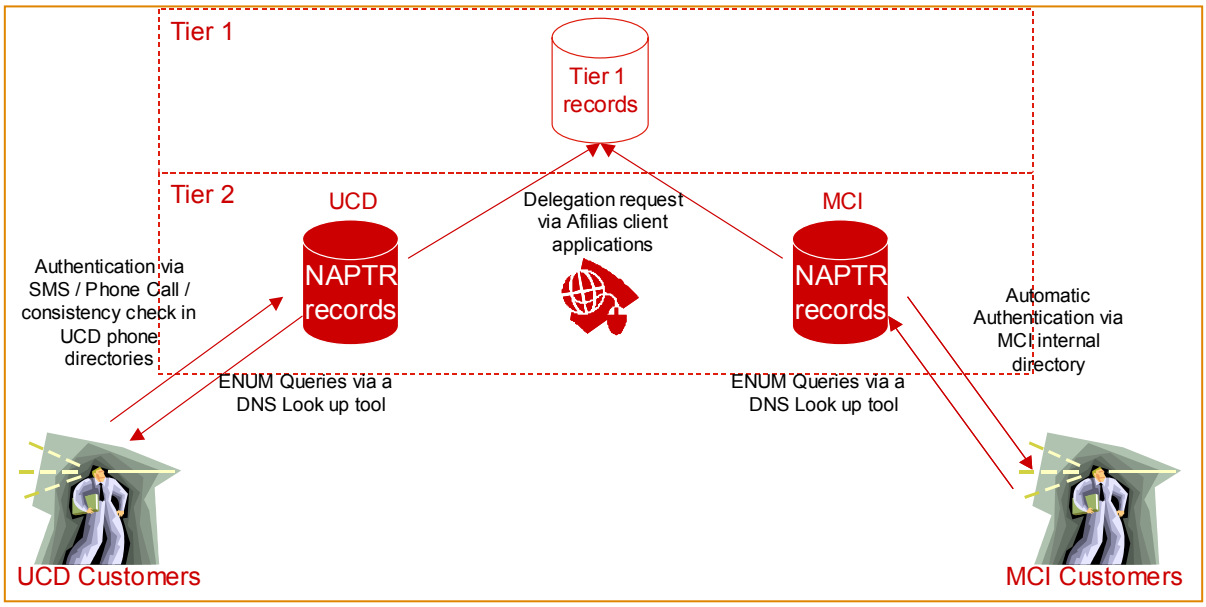
D. INTERFACE BETWEEN THE TRIAL PLAYERS

The Tier 1 Registry offered a web interface and an API to the Tier 2 registries that enable them to proceed to the ENUM registration of a/ a NAPTR record or b/ NS records (delegation) and complete automatically upon the creation of the associated Tier 1 Record in the Tier 1 Registry.

For the trial purpose, the NAPTR records are created manually on both UCD and MCI registries.

Registration of customers is performed manually.

The following figure illustrates the different interfaces between the trial players.



6.3.2 Type of records used within the Tier 1 Registry to ease the Tier 2 delegation operations: NS/CNAME/DNAME

A. QUICK PRESENTATION OF THE THREE TYPES OF RECORD:

This section describes alternative methods for effecting the delegation between Tier-1 and Tier-2 ENUM registries, and identifies the corresponding different approaches necessary for provisioning the Tier-2 name service. Two methods for delegation are described: the first of these uses NS resource records at Tier 1 and requires a distinct DNS zone for each E.164 number registered in ENUM; the second uses CNAME and/or DNAME records at Tier 1 and allows all E.164 numbers served by a single Tier-2 registry to be held in a single DNS zone. The second method appears to lead to significant simplification of administration and provisioning at Tier 2 and to result in a smaller zone file at Tier 1.

In order to associate Internet-based resources with a given telephone number, appropriate resource records must be entered in the DNS for the corresponding domain name. Some of these records are used to provide linkage from the parent DNS zone. The others specify the resources, which the user wishes to have associated with the telephone number in question. The terms Tier 1 and Tier 2 respectively are used to distinguish these two categories. The distinction is useful because Tier 1 provides a central infrastructure within which a competitive market among divers Tier-2 registries is expected to emerge. Although the separation of the ENUM DNS into two tiers provides the opportunity for a competitive market, this is achieved at the cost of more complex provisioning procedures, as two registries must typically be involved, at Tiers 1 and 2 respectively.

The provisioning activity necessary for registering a telephone number in the ENUM DNS hierarchy and associating some Internet-base resources therefore involves the following steps.

1. The appropriate Tier-2 zone is set up on the Tier-2 name servers.

2. Application-specific resource records are placed in the Tier-2 zone.

3. The Tier-2 zone is activated on the Tier-2 name servers.

4. Delegation records are inserted in the Tier-1 zone, allowing the Tier-2 name servers to be identified.

5. The updated Tier-1 zone is activated on the Tier-1 name servers.

Delegation from Tier 1 to Tier 2 may be implemented using either of two strategies, described in the following sections. The two strategies involve significantly different overhead in the provisioning process. The following assumptions, consistent with actual practice in administering and operating name servers, apply to the description of each of the two strategies. Delegation is normally required at the level of individual telephone numbers except where a range of contiguous numbers is held by a single customer. This is to give customers the freedom to migrate as desired from one Tier-2 registry to another. Only authoritative name servers are considered. At least two distinct name servers are required to support any given zone, for resilience. One of the servers supporting a given zone is the master server, from which the other (slave) servers obtain new copies of the zone data as appropriate to maintain synchronization. A given name server can support a reasonably large number of zones. Each name server uses a local configuration file to identify, which zones are to be supported. Data for each zone is held on any name server in a distinct file or database (zone file) on local disk storage, identified to the name server software by the local configuration file.

i. Delegation using NS Records

The traditional strategy for implementing delegation is to use name server (NS) resource records in the parent zone to indicate directly the domain names of the authoritative name servers for the delegated zone. There must be as many such records as there are distinct (official) name servers supporting the delegated zone.

Using this delegation strategy for ENUM involves the following provisioning activities for each new telephone number registered.

1. A zone file for the given telephone number (or, possibly, number block) is created on the master Tier-2 name server.

2. The required (application-specific) resource records are placed in the Tier-2 zone file.

3. A configuration entry for the new zone is added to the local configuration file on the master Tier-2 name server.

4. The master Tier-2 name server is loaded with the new configuration.

5. A configuration entry for the new zone is added to the local configuration file on each slave Tier-2 name server.

6. Each slave Tier-2 name server is loaded with the new configuration.

7. Two or more (NS) delegation records are inserted in the Tier-1 zone, allowing the Tier-2 name servers to be identified.

8. The updated Tier-1 zone is activated on the Tier-1 name servers.

It is worth noting that, for each new number, the configuration file on each name server must be changed, a new zone file must be created and populated, and all servers must be caused to reload their configuration.

ii. Delegation using CNAME records

The second possible delegation strategy is to use canonical name (CNAME) resource records in the parent zone to indicate that the domain name in question is actually an alias for another domain name (the canonical name) located in another part of the DNS hierarchy. This strategy is already widely used in the reverse DNS, which binds domain names, regarded as resources, to IP addresses using a conventional algorithm not unlike that used for ENUM. The need for this strategy [5] arises because IP addresses whose conventional (algorithmic) domain names belong in the same zone are often allocated to different organisations.

Using this strategy, a Tier-2 registry can set up a single zone, in a part of the domain name hierarchy of its choice, to contain the application-specific resource records for all of its customers. This approach involves provisioning activities both on a once-off basis for the Tier-2 registry zone and on a pernumber basis for each new telephone number registered.

The following provisioning activities are required just once to set up the Tier-2 zone.

1. A zone file for the single Tier-2 zone is created on the master Tier-2 name server.

2. A configuration entry for the single Tier-2 zone is added to the local configuration file on the master Tier-2 name server.

3. The master Tier-2 name server is loaded with the new configuration.

4. A configuration entry for the single Tier-2 zone is added to the local configuration file on each slave Tier-2 name server.

5. Each slave Tier-2 name server is loaded with the new configuration.

6. Two or more (NS) delegation records are inserted in the parent zone of the single Tier-2 zone (which is not the Tier-1 zone), allowing the Tier-2 name servers to be identified.

7. The updated parent zone is activated on the parent zone servers.

Subsequently, the following provisioning activities are required for each new telephone number registered.

1. The required (application-specific) resource records are placed in the single Tier-2 zone file.

2. The updated single Tier-2 zone is activated on the Tier-2 name servers.

3. A single (CNAME) delegation record is inserted in the Tier-1 zone, identifying the corresponding canonical name in the single Tier-2 zone.

4. The updated Tier-1 zone is activated on the Tier-1 name servers.

iii. Illustrative example

This example shows how two telephone numbers would be registered according to each of the delegation strategies described above. SIP URL's for the telephone numbers are to be registered as shown below. The numbers and URL's chosen are believed not to be in service.

+353-1-716-0000 sip:cxe@ucd.ie

+353-87-221-0000 sip:nor@ucd.ie

Using NS Records

For the given example, the delegation strategy using NS records requires, for each new telephone number to be registered in ENUM, that at least five files be created or modified and that the name server software is restarted on the master Tier-1 name server and on each Tier-2 name server. If more than two Tier-2 name servers are used, then a further file must be created for each additional name server beyond the second.

Tier-1 zone file

```
$ORIGIN 3.5.3.e164.arpa.
0.0.0.0.6.1.7.1     IN NS enum-ns1.ucd.ie.
                    IN NS enum-ns2.ucd.ie.
0.0.0.0.1.2.2.7.8   IN NS enum-ns1.ucd.ie.
                    IN NS enum-ns2.ucd.ie.
```

Tier-2 master configuration file

```
$ zone "0.0.0.0.6.1.7.1.3.5.3.e164.arpa" {
        type master;
        file "0.0.0.0.6.1.7.1.3.5.3.zone";
        allow-transfers { enum-ns2.ucd.ie; };
};
zone "0.0.0.0.1.2.2.7.8.3.5.3.e164.arpa" {
        type master;
        file "0.0.0.0.1.2.2.7.8.3.5.3.zone";
        allow-transfers { enum-ns2.ucd.ie; };
};
```

Tier-2 slave configuration file

```
zone "0.0.0.0.6.1.7.1.3.5.3.e164.arpa" {
        type slave;
        file "0.0.0.0.6.1.7.1.3.5.3.backup";
        masters { enum-ns1.ucd.ie; };
};
zone "0.0.0.0.1.2.2.7.8.3.5.3.e164.arpa" {
        type slave;
        file "0.0.0.0.1.2.2.7.8.3.5.3.backup";
        masters { enum-ns1.ucd.ie; };
};
```

Tier-2 zone file 0.0.0.0.6.1.7.1.3.5.3.zone

```
$ORIGIN 0.0.0.0.6.1.7.1.3.5.3.e164.arpa.
@               IN SOA (      enum-ns1.ucd.ie.
                              enum-admin.ucd.ie.
                              2003050502
                              3600
                              600
                              604800
                              86400 )
                IN NS enum-ns1.ucd.ie.
                IN NS enum-ns2.ucd.ie.
                IN NAPTR 10 100 "u" "E2U+sip" "!^.*$!sip:cxe@ucd.ie!" .
```

Tier-2 zone file 0.0.0.0.1.2.2.7.8.3.5.3.zone

```
$ORIGIN 0.0.0.0.6.1.7.1.3.5.3.e164.arpa.
@               IN SOA (      enum-ns1.ucd.ie.
                              enum-admin.ucd.ie.
                              2003050502
                              3600
                              600
                              604800
                              86400 )
                IN NS enum-ns1.ucd.ie.
                IN NS enum-ns2.ucd.ie.
IN NAPTR 10 100 "u" "E2U+sip" "!^.*$!sip:cxe@ucd.ie!" .
```

Using CNAME Records

For the given example, the delegation strategy using CNAME records requires that, at least five files be created or modified and that the name server software is restarted on the master Tier-1 name server and on each Tier-2 name server. If more than two Tier-2 name servers are used, then a further file must be created for each additional name server beyond the second.

Tier-2 Master configuration file (once only)

```
zone "3.5.3.e164.ucd.ie" {
        type master;
        file "3.5.3.zone";
        allow-transfers { enum-ns2.ucd.ie; };
};
```

Tier-2 slave configuration file (once only)

```
zone "3.5.3.e164.ucd.ie" {
        type slave;
        file "3.5.3.backup";
        masters { enum-ns1.ucd.ie; };

};
```

Tier-2 parent zone file ucd.ie.zone (once only)

```
$ORIGIN ucd.ie.
3.5.3.e164    IN NS enum-ns1.ucd.ie.
              IN NS enum-ns2.ucd.ie.
```

Tier 1 zone file (per number)

```
$ORIGIN 3.5.3.e164.arpa.
0.0.0.0.6.1.7.1 IN CNAME 0.0.0.0.6.1.7.1.3.5.3.e164.ucd.ie.
0.0.0.0.1.2.2.7.8 IN CNAME 0.0.0.0.1.2.2.7.8.3.5.3.e164.ucd.ie.
```

Single Tier-2 zone file 3.5.3.zone (per number)

```
Tier-2 zone file 3.5.3.zone (per-number)
$ORIGIN 3.5.3.e164.ucd.ie.
0.0.0.0.6.1.7.1 IN NAPTR 10 100 "u" "E2U+sip" "!^.*$!sip:cxe@ucd.ie!" .
0.0.0.0.1.2.2.7.8 IN NAPTR 10 100 "u" "E2U+sip" "!^.*$!sip:nor@ucd.ie!"
```

B. IMPACT ON THE IRISH ENUM TRIAL OPERATIONS

The trial members agreed that there was an opportunity to test these different types of records operationally and compare them from a quality of service point of view and a ENUM services provision point of view.

In order to test these types of record, the Tier 1 provided a web interface and a database that is able to host the three different type of records (NS, CNAME and DNAME).

The next stage of the Irish ENUM trial will enable to draw conclusion on this topic.

6.3.3 Performance Monitoring Indicators

The following indicators will be used to monitor the performance of the Irish ENUM Trial:

Indicator	Definition	Frequency of update	Calculation
Tier 1 DNS service availability %	% of time when the Irish ENUM Trial Tier 1 DNS Service is available to answer querries during its opening hours (24*7*365)	Monthly	Tier 1's monitoring tool. The monitoring tool will provide details (Time, Duration, severity) linked with downtimes (to be used to calculate the overall availability of the Irish ENUM Trial DNS).
Tier 2 DNS service availability %	% of time when the Irish ENUM Trial Tier 2 DNS Service is available to answer querries during its opening hours (24*7*365)	Monthly	Monitoring Tier 2's monitoring tool. The monitoring tool will provide details (Time, Duration, severity) linked with downtimes (to be used to calculate the overall availability of the Irish ENUM Trial DNS).
Tier 1 DNS service – Absence of error in zone	Number of errors in the Tier 1 DNS zone	Monthly	Quality control script
Tier 2 DNS service – Absence of error in zone	Number of errors in the Tier 2 DNS zone	Monthly	Quality control script
Tier 1 DNS service – remote accessibility	Average response time from a remote access	Monthly	Quality control script
Tier 2 DNS service – remote accessibility	Average response time from a remote access	Monthly	Quality control script
Tier 1 Registration service – Availability %	% of time when the Irish ENUM Trial Tier 1 registration service is available to accept transactions	Monthly	Manual
Tier 2 Registration service – Availability %	% of time when the Irish ENUM Trial Tier 2 registration service is available to accept transactions	Monthly	Manual
Average Time to register (Tier 1)	Time between the request for delegation from the Tier 2 and the creation of the associated NS/CNAME/DNAME record available on line	Weekly	dates and times of both request for delegation and NS/CNAME/DNAME records creation are calculated manually or automatically within the Tier 1 application
Average Time to change (Tier 1)	Time between the change request from Tier 2 and the effective change on the associated NS/CNAME/DNAME record	Weekly	dates and times of both change requests and change on the NS/CNAME/DNAME records are calculated manually or automatically within the Tier 1 application
Average Time to cancel (Tier 1)	Time between the deletion request from Tier 2 and the effective deletion of the associated NS/CNAME/DNAME record in the Tier 1 registry	Weekly	Dates and times of both deletion requests and change on the NAPTR are recorded manually
Number of registrations (Tier 1)	Number of records created within the Tier 1 database on a weekly basis	Weekly	Automatic query into the database
Number of changes (Tier 1)	Number of NS/CNAME/DNAME records that are changed within the Tier 1 database	Weekly	Counter hosted within the Tier 1 database. The counter is incremented each time the Tier 1 application proceed to a NS/CNAME/DNAME record change

Indicator	Definition	Frequency of update	Calculation
			(excluding deletion)
Number of cancellations (Tier 1)	Number of ENUM records that are deleted from the Tier 1 database	Weekly	Counter hosted within the Tier 1 application. The counter is incremented each time the Tier 1 application proceed to a NS/CNAME/DNAME deletion
Number of registrations (Tier 2)	Number of ENUM registrations hosted within the Irish ENUM DNS system	Weekly	Tier 2 applications could produce this report at the end of each week
Number of changes (Tier 2)	Number of ENUM records that are changed within the Irish ENUM DNS system	Weekly	Counter updated manually a each registration
Number of cancellations (Tier 2)	Number of ENUM records that are erased from the Irish ENUM DNS system	Weekly	Counter hosted within the Tier 2 application. The counter is incremented each time the Tier 2 application proceed to a NAPTR record deletion

Detailed and up-to-date records of these indicators will be provided in the next phase of the ENUM trial.

6.4 CURRENT STATUS OF THE IRISH TRIAL

The technical and organisational framework that is necessary for the Irish ENUM trial to operate is ready:

- Tier 1, Tier 2 technical platforms including additional records (NS, CNAME, DNAME) and ASP services (VoIP)
- Performance indicators
- Roles and responsibilities

During the next stage of the trial (until March 2005), the trial players will test the overall ENUM platform that is available for customers:

- Registration/Cancellation services
- ENUM service provisioning (DNS Lookup)
- ASP service provisioning: VoIP (and potentially Video Conferencing over IP)

6.5 LEGAL CONSIDERATIONS

This section intends to provide guidance with regard to legal matters requiring consideration by companies who have or, intend to participate in the Irish ENUM Trial, or its subsequent phases, to deliver ENUM related services to end user Registrants. It is intended to be of help and should not be assumed to be providing any form of legal advice on how any of the matters raised in this document may affect (and or may apply to) any particular organisation and or service. Independent legal advice should be sought if the reader needs such advice.

6.5.1 Overview

To date, the Irish ENUM trial progressed well throughout 2004 and will continue until March 2005. The means by which was achieved, was under a framework provided by a Memorandum of Understanding for the Irish ENUM Trial (MoU). This MoU was entered into by all the Trial Players, and had the following key features and functions:

- Definition of the purpose and scope of Trial
- To define high-level architectural, technical, operational objectives and capabilities of the Trial.
- To defines general principles of participation with regard to promotion, competition, barriers of entry.
- To bind participants to principles of, co-operation, openness, fair trade, and general conduct with regard to data privacy, protection and competition.
- That the Trial is not for profit, and participants do not expect any financial benefits or compensation.

As a prerequisite to enable the transition towards a full Production or Commercial Irish ENUM service, there may be a need for change with regard to the existing MoU, for (but not limited to) the following reasons:

- To implement and evaluate production quality platforms and systems.
- To clearly bring to an end, and then move away from Trial
- To implement and evaluate secure, stable, integrated platforms and systems as well as authentication and verification platforms and systems.

How the transition to a Production and / or Commercial ENUM phase should be arranged has yet to be decided. There are, as part of such a migration, requirements for full legally binding contracts and agreements between the various tiers of participation within and upon the Participants. At such time as the Trial includes Registrant participation then, for example, there will be important issues to be considered and decided with regard to fiscal remuneration, price, and other implications.

However at this stage it is undecided what form this transition could take. Various possible options include:

- By amendment to the existing Trial MoU
- By agreeing and subscribing to a new MoU for Commercial service, which covers and includes Production phase terms.
- By new MoU specifically for a Production phase.

Whichever vehicle of transition is adopted specific considerations must be given to encompassing the following:

- Degree of formality - the existing MoU is non-binding and voluntary.
- Existing Trial information, and level of confidentiality of any future documents relating to data collected, technical specifications and production systems.
- Intellectual Property and legal ownership, e.g. copyright, trade secrets, licenses, patent applications.
- Continuing obligations, or surviving terms of Trial MoU
- Conduct under data protection and privacy laws.
- Conduct under competition and antitrust laws.
- Termination of Participation.

In addition to the above, the Irish ENUM Trial, by definition as a medium that facilitates electronic communication is ultimately governed by both Irish and EU legislation.

Perhaps much more importantly, consideration must be given to where any parts of ENUM in Ireland prove less successful, or where misuse of any part of the Registration or other processes may occur.

7. RECOMMENDATIONS

In this report the elements that are necessary to successfully run ENUM are presented. At this point in time, ENUM trials have been implemented in several countries although few have actually moved into a commercialisation stage, with the exception of Austria and Japan.

In this report an ENUM operating model with associated Registration Policies, available services and priorities are presented. Privacy issues concerning DNS information etc are also highlighted. The reality is that true operation of an ENUM environment will see issues such as availability, response time, etc being further discussed and resolved.

The economic case for ENUM is also presented although this is somewhat mitigated by the fact that ENUM Trials show very little take-up and the principal application of ENUM (VoIP) is masked by new technologies such as XDSL and WiFi. Clearly the economic case for ENUM should be felt in the corporate sector as it can replace existing equipment whilst preserving the existing dialling plan. There are regulatory and legislative issues to be resolved in this situation and these are also addressed within this report.

The ENUM engineering trail demonstrates that ENUM works however many potential issues remain to be resolved and it is incumbent upon Ireland to find it's own way in this regard (e.g. authentication practical organisation, end users look-up tools…).

With this in mind the following roadmap for ENUM in Ireland is recommended.

1. The ENUM delegation in Ireland should be managed and controlled by ComReg (acting as Tier 1 Manager as described in ITU-T documentation), representing the Department of Communications, Marine and Natural Resources. ComReg should have a "light touch" supervisory role in administering the ENUM environment as it already regulates telephone numbering today. It is expected that the ENUM delegation (the Tier 1 Manager role) will remain with ComReg but technical operation will be assigned on a license basis to a Tier 1 registry operation.

2. Ireland, as a small country, will have a single Tier 1 Registry operation and this operation should be selected using standard European procurement mechanisms. A condition of the Tier 1 Registry is that it will be guided by a Policy Advisory Board which is representative of all relevant ENUM stakeholders.

3. The Irish ENUM environment should use the registration policies and procedures as outlined in this report as a platform for the creation of an ENUM environment in Ireland. The Policy Advisory Board should be used to modify these policies and procedures when determining the practical and volume implications[17] of issues such as:

    a. Assignment of subscribers to ENUM services that are not bound to PSTN services

    b. Competition between providers of ENUM services and in particular the Terms and Conditions for transfer of customer data from one provider to another

[17] The Forum has taken great care to develop Policies and Procedures that could operate in a conceptual sense. It will be the role of the Tier 1 operation and the Policy Advisory Board to determine how these Policies and Procedures would work in a volume environment.

c. Transfer of data held by incumbent telephone operators to ENUM providers

d. Data privacy policies

e. Authentication and validation policies; The Opt In consumer consent policy is recommended for usage in Ireland and any change to this must be seriously considered

f. Policies concering the bulk up-load of information from existing databases

g. Number portability policy

h. Universal access policy

i. Legal intercept policy

j. Security policy, including escrow

It is also recommended that the Tier 1 Registry should be responsible for maintaining communications and exchange information / best practices with other operators.

4. The existing engineering trial and it's associated measurements should be continued until March 2005. At that point, a review of the trial should be conducted to ascertain if additional learning points have been developed. This report may be updated at that point.

5. Post March 2005, Ireland should move ENUM to a commercialisation phase if sufficient interest is demonstrated in this. This commercialisation phase should be conducted through a procurement procedure as outlined in Recommendation 1 above. It is anticipated that the Commercialisation phase will take 6 months to conclude. The commercialisation phase should take the form of ComReg seeking a Tier 1 operator for ENUM for a period of 5 years, with an bi-annual review of operations and developments. The criteria for selection of the Tier 1 operator should be based on technical capability, ability to develop the market and ability to manage the innovation cycle brought about by ENUM.

APPENDIX A: GLOSSARY

AE:	Authentication Entity
ARPA:	Addressing and Routing Parameter Area
CC:	Country Code (as specified in the ITU-T Recommendation E.164)
ccTLD:	Country Code Top Level Domain
DQ Database:	Direct Query Database
DNS:	Domain Name System
ENUM:	Telephone Number Mapping
IAB:	Internet Architecture Board
IANA:	Internet Assigned Numbers Authority
ICANN :	Internet Corporation for Assigned Names and Numbers
IETF:	Internet Engineering Task Force
IP:	Internet Protocol
ITU-T :	International Telecommunications Union – Telecommunications Standard Sector
ISDN:	Integrated Services Digital Network
ISOC:	Internet Society
NAPTR:	Naming Authority Pointer Resource Records. A DNS resource record that specifies a regular expression-based rewrite rule, which when applied to an existing string, will produce a new domain label or a Uniform Resource Identifier (URI)
NGN:	Next Generation Workshop
NP:	Number Portability
NPA:	Number Plan Administrator
NRA:	National Regulatory Authority
PSTN:	Public Switched Telephone Network
PLMN:	Public Land Mobile Network
QoS:	Quality of Service
RFC:	"Request For Comments" – A pre-Standard stage document, where public comments are invited
RIPE NCC:	Réseaux IP Européens Network Coordination Centre
RR:	DNS Resource Records
SG2:	ITU-T Study Group 2
TLD:	Top Level Domain
TSP:	Telephone Service Provider
URI:	Uniform Resource Identifier – A URL is one type of URI; an email address is another
URL:	Uniform Resource Locator
VoIP:	Voice Over IP