



The staging of the first ENUM trial in New Zealand

Consultation Report

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2005



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1 Report recommendations and questions

1.1 Introduction

This report includes a wide range of recommendations and discussion questions in relation to implementing an ENUM trial in New Zealand. These are summarised below with section references for further information on each topic. Comments are invited.

1.2 Consultation process

1.2.1 This report seeks feedback on high level recommendations for holding an ENUM trial in New Zealand and on a range of related policy and technical issues. The report will be circulated for consultation among the following groups:

- Technical and policy specialists in the Internet industry;
- Technical and policy specialists in the telecommunications industry;
- Government officials; and
- Interested consumers.

1.2.2 Feedback can be provided in a range of ways as follows:

- Email: enum-tf@internetnz.net.nz
- Post: ENUM Taskforce, c/- InternetNZ, PO Box 11-881, Wellington
- Fax: +64 4 495 2115

1.2.3 The ENUM Taskforce would appreciate receiving all written responses on or before 5pm, Friday 21 July, 2005.

1.3 Format of the submission

1.3.1 The submitter may choose to make general comments or to address each recommendation and question in turn. If submitters choose to discuss the questions and recommendations they should reference their remarks to relevant section or paragraph number.

1.3.2 The following section summarises the recommendations and questions of the report.



1.4 ENUM Trial Recommendations

1.4.1 **Trial objectives, 5.2.** The following set of objectives should be adopted to guide the implementation of an ENUM trial in New Zealand:

- a. *Architecture:* To establish and evaluate the processes, interfaces and protocols required for interactions between ENUM functions: Tier 1, Tier 2, Registrar, Application Service Provider, etc;
- b. *Provisioning:* To determine technical and operational requirements to provisioning ENUM records at Tier 1 Registry and assess DNS requirements/ implications in the provision of ENUM services. This is likely to include:
 - Validation - Testing zone architectures using +64 telephone numbers mapped into the e164.arpa domain (to ensure integrity of the E164 numbering scheme);
 - Privacy - Testing the Query/Response mechanism of the ENUM DNS protocol using +64 numbers in e164.arpa and test NAPTR records in various domains;
 - Security - Evaluating potential DNS security mechanisms, including identifying security issues (eg. subscriber data, NAPTR-resource records, DoS attacks), along with possible solutions.
- c. *Applications:* To test applications based on the use of ENUM capabilities from both technical and user perspectives: for example, tests of call setup and completion for test user agents/service providers of ENUM-enabled services;
- d. *Inter-working:* To consider and implement (where appropriate) inter-working capabilities with other ENUM trials, such as Australia;
- e. *Awareness:* To inform the public about ENUM;
- f. *Business case:* To enable evaluation of the economic benefits and costs of implementing ENUM;
- g. *Functionality:* To test the use of UCI's as defined by ETSI;
- h. *Implementation:* To establish a governance structure to guide a smooth commercial implementation and ongoing operation of ENUM.



- 1.4.2 **Trial framework, 5.4.** The ENUM trial should:
- Implement User ENUM with voluntary participation through the opt-in principle, whereby users can choose to both register and de-register for an ENUM number;
 - Place control of the ENUM assignment for each telephone number in the hands of the user; and
 - Test UCI in parallel, using PUAs to manage user privacy as specified by the ETSI.
- 1.4.3 **Trial governance, 6.2.** Establish two governance bodies to oversee ENUM trial: the ENUM Operations Board for day to day management and the ENUM Industry Steering Group for progressing development and transition to commercialisation. Membership would consist of key stakeholders (including InternetNZ and TCF) and the same independent chair.
- 1.4.4 **Number range, 6.4.** The trial should include both the existing number range as well a new number range. At the end of Trial all ENUM records can be transferred and reregistered with a Tier 2 Registrar under commercial Terms and Conditions.
- 1.4.5 **Appeal authority, 6.5.** That an Authentication & Appeal Authority for ENUM be established.
- 1.4.6 **Delegation of .4.6.e164.arpa, 6.6.** That delegation of .4.6.e164.arpa be delegated to InternetNZ.
- 1.4.7 **Trial Tier 1 Registry, 6.7.** In relation to the ENUM trial Tier 1 Registry:
- a. Develop a functional specification for the ENUM Trial Tier 1 Registry;
 - b. Appoint a single Tier 1 Registry for the trial (through an agreed process) to hold the ENUM records for each .4.6.e164.arpa domain name record, including information of the registrant, and PSTN number routing information.
- 1.4.8 **Trial Tier 2 Registrars, 6.8.** Develop requirements for accreditation of Tier 2 ENUM Registrars considering the following services:
- a. Registering new ENUM subscribers, authenticate their identity and issue ENUM numbers;
 - b. Interfacing with the Tier 1 Registry Operator to establish a pointer in the Registry to the Tier 2 nameserver holding the subscriber's NAPTR record;
 - c. Interfacing with a Tier 2 nameserver operator to provision a subscriber's NAPTR record.
- 1.4.9 **Security and privacy, 6.9.** In order to manage read access to NAPTR records while maintaining ENUM service functionality, develop the following:
- a. A code of practice for user privacy and data security will be developed;
 - b. Minimum standards for DNS will be developed and implemented;
 - c. The use of WHOIS and testing of DNSSEC should be considered.



- d. Tools to maintain DNS zone files, including access controls to ensure that applications only change resource records they are permitted to update.

1.4.10 **Commercial Business model, 7.3.** Establish a work stream on the ENUM business model for commercialisation that addresses funding and contractual arrangements for the non-competitive (but contestable) aspects of ENUM – the governance structure, Tier 1 Registry, and possible Authorisation Commissioner.

1.4.11 **Trial participation and application availability, 7.3.** Arrange public demonstrations of ENUM to inform the business community, students, government and ICANN.

1.4.12 **Number portability, 7.5.** While the purpose of ENUM is not to provide number portability, deployment of ENUM should be consistent with national regulations for number portability.

1.4.13 **Interconnectivity, 7.6.** Inter-connectivity with other jurisdictions should be considered through information sharing and system comparison for DNS compatibility.

1.5 ENUM Trial Questions

1.5.1 **Trial participation and funding, 5.5.** Is there sufficient interest by service providers to support a self-funded ENUM trial in New Zealand? Would they participate in an ENUM trial, and, if so, in what capacity?

1.5.2 **Registry selection, 5.5.** Should the Tier 1 Registry contract be tendered prior to the start of the trial, and if so, on what basis?

1.5.3 **Commercialisation models, 6.3.** Is a market governance model that involves a competitive contract for service provision of the Tier 1 Registry the best way to manage full commercialisation of ENUM in New Zealand?

1.5.4 **Validation, 6.5.** What form of user authorisation process should be used? Should an Authentication & Appeal Authority for ENUM registrations be established?

1.5.5 **Delegation, 0.** Who should receive delegation of 4.6.e164.arpa for the period of the ENUM trial in New Zealand?

1.5.6 **System security and user privacy, 6.9:**

- a. Should the New Zealand ENUM trial test the EPP that satisfies GRRP RFC3375 on the communication protocol between registry and registrar?
- b. Should a directory service such as WHOIS be provided?



1.5.7 ENUM governance, 7.2. In a commercial context, with consideration of the need for independence and cost effectiveness, should ENUM governance constitute a single governance body (5-7 members) or two tiers of governance made up of an oversight body with independent membership (3-5 members) and a larger industry stakeholder group (7-9 members)? When should the ENUM governance board be established?



2 Introduction

2.1 Background

2.1.1 ENUM is the communications protocol that translates telephone numbers on the public switched telephone network (PSTN) into a format that can be used by the Internet. While the prospect of using the Internet for telephone calls is attractive, there are a number of issues that need to be resolved to make it work efficiently.

2.1.2 The International Telecommunications Union (ITU) has approved interim procedures so that national trials can take place. ENUM trials have been undertaken in many countries to test various implementation plans and processes. Progress has been made in resolving some of the technical and policy issues, however, Austria and Poland are the only countries that have fully deployed ENUM at this time.

2.1.3 In New Zealand the Internet is self-managed with no specific government legislation. The Internet Society of New Zealand Inc, InternetNZ, is a not-for-profit society that seeks to foster coordinated and cooperative development of the Internet in New Zealand. InternetNZ is responsible for managing the .nz Domain Name Space (DNS) for New Zealand (Domain names are used to locate servers and access services on the Internet).¹ This is achieved through:

- Maintenance of a single shared registry system (SRS) for management of .nz domain name registrations;² and
- Operation of the DNS.

2.1.4 InternetNZ considers that undertaking a trial in New Zealand would be useful at this time given the significant opportunity to learn from and build on trials conducted elsewhere. The InternetNZ Council has formed the ENUM Task Force for the purposes of advancing the implementation of ENUM in NZ.

2.1.5 Before commencing a trial, the purpose, objective and outcomes need to be clearly defined and understood. On 13 April 2005, InternetNZ hosted a workshop to discuss the development of an ENUM trial in New Zealand. The feedback from that workshop and subsequent discussions with participants has been incorporated into this document.

2.2 Purpose of this report

2.2.1 This report has been prepared for InternetNZ to facilitate broad consultation on the objectives, approach and necessary conditions for the first ENUM trial to be held in New Zealand.

¹ More information on InternetNZ and its activities may be found on <http://www.Internetnz.net.nz/>.

² The .nz registry is run by New Zealand Domain Name Registry Limited, trading as .nz Registry Services (NZRS), which is a limited liability company wholly owned by the Internet Society.



2.2.2 The proposed framework is based on objectives and lessons from ENUM trials implemented in other jurisdictions.

2.2.3 The goal is to achieve the widest possible support for an ENUM Trial in New Zealand. This reports aims to do three things:

1. To provide understanding on ENUM and the lessons learnt in trials of ENUM in other countries;
2. To propose a framework for an ENUM trial in New Zealand; and
3. To elicit feedback on the key issues around the potential implementation of ENUM in New Zealand, including the objectives and structure of an ENUM trial.



3 An explanation of ENUM

3.1 What is ENUM?

- 3.1.1 ENUM is a new technology that allows telephone numbers to be mapped to corresponding internet numbers. Technology that uses the Internet to carry voice signals has been developing during the last few years. However, the real challenge in mapping the telephone network to the Internet lies in the call signalling used by PSTN networks.
- 3.1.2 Telephone networks are circuit switched; each telephone handset has a unique number, or "address", that is located within a telephone network so that the network can route to the relative location of every telephone address at all times. So +64 4 495 2118 refers to a particular telephone handset at the office of InternetNZ. This is referred to as "E164" address space.³ Access to information on a PSTN/ISDN is often restricted to the operating carriage service provider.
- 3.1.3 The Internet is a packet switched network that uses Uniform Resource Identifiers (URI) for addressing such as henry.ford@modelT.com. The Internet uses the DNS to map a dynamic domain name to a static IP address. The DNS is a highly distributed database containing information that is globally accessible to any device or network connected to the Internet. Appropriate domain name holders can modify DNS entries.
- 3.1.4 For Internet-connected telephones to make and receive calls, each Internet device needs to have a telephone address in addition to its Internet address.⁴ This will enable a circuit address (a telephone number) to be matched to a network address (URI).
- 3.1.5 ENUM is an IETF proposed standard (RFC3761) that was finalised in April/May 2004.⁵ It defines a process for representing an E164 telephone number as an Internet address using the e164.arpa domain in DNS.
- 3.1.6 ENUM allows an end user to type a telephone number into an Internet connected device (such as a Web browser) in order to access a listing of Internet resources (URI) for that number which could include addresses for voice, text messaging, faxes, pagers, instant messaging, data modems, e-mail

³ E164 is the document number assigned by the International Telecommunications Union to the International Public Telecommunication Numbering Plan. A fully qualified E164 number is designated by a country code, an area or city code, and a phone number. ENUM does not change this Numbering Plan or telephony numbering or its administration.

⁴ Voice traffic is carried on the Internet by IP packets which include the IP address of the Internet telephone device. So each Internet telephone needs to maintain both an Internet address and a matching telephone address.

⁵ Available online: <http://www.ietf.org/rfc/rfc3761.txt>



or Web sites. The available services associated with each E164 number are identified using the URI's held in the Domain Name System.

3.1.7 ENUM is:

- a. Currently utilising a specific public part of DNS (e164.arpa) for storing E164 numbers. The IAB is responsible for the e164.arpa domain and has outsourced technical operations to RIPE NCC.⁶ This domain is divided into sub-domains based on country code delegations;
- b. Dynamic, to allow for IP devices that are numbered dynamically using DHCP, or that are mobile and move to IP networks managed by different service providers;
- c. Able to seamlessly redirect the different forms of telephone services associated with the same E164 address to the appropriate IP address and Internet device; and
- d. "Protocol agnostic" because it does not specify the applications that a particular E164 address is associated with, but rather discovers the resources linked with it. For example, it can work with either H.323 or SIP.

3.1.8 Two important standards related to ENUM implementation are currently being progressed by the IETF. These are:

- EPP (Extensible Provisioning Protocol) for provisioning ENUM NS/NAPTR⁷ data between ENUM registries and registrars;
- CRISP (Cross Registry Information Sharing Protocol) for referring ENUM NS registrant data.

3.2 How does ENUM work?

3.2.1 Two key issues for ENUM implementation are: How do network elements (such as gateways and SIP servers) gain access to Internet services if only an E164 telephone number is available? How can users define preferences for specific services and servers to respond to incoming communications requests? The goal is to enable each IP device to find out if an E164 telephone

⁶ RIPE NCC is an independent, not-for-profit membership organisation that supports the infrastructure of the Internet through technical co-ordination in its service region which covers Europe, the Middle East, Central Asia and African countries north of the equator. <http://www.ripe.net/>

⁷ NAPTR records allow a multitude of information to be associated with a single domain name. NAPTR fields contain a number of components including the following:

- An *Order* field to specify the order in which multiple NAPTR records must be processed
- A *Preference* field to determine the processing order when multiple NAPTR records have the same order value
- A *Service* field to specify the resolution protocol and service
- *Flags* to modify the actions of further DNS lookups
- A *regular expression* to allow the query client to rephrase the original request in aDNS format
- A *Replacement* field to define the next DNS query object



address is reachable end-to-end via IP, determine the preferred IP-application and then establish which IP address should be used to complete the transaction.

3.2.2 The ENUM infrastructure utilises a centrally managed DNS to support distributed mapping of E164 addresses to IP addresses through a telephony gateway.⁸ For example, a phone call to an ENUM number is sent to a telephony gateway. ENUM converts this telephone number into a URI and sends a query to the DNS to locate the ENUM record containing the URI for the destination Internet telephone. The gateway then sends a second query to DNS to retrieve the IP address associated with the URI of the Internet telephone. Once this is received, the call is routed over the Internet to the destination telephone.

3.2.3 ENUM services and protocols could include the following:

Service protocol	Service field	URI Scheme (EX)
SIP	E2U+sip	sip:info@sip.co.nz
H.323	E2U+h323	h323:info@h323.co.nz
InternetFAX	E2U+ifax	mailto:fax@fax.co.nz
Telephone	E2U+tel	tel:+6435297257;svc=voice
FAX	E2U+fax:tel	tel:+6435297257;svc=fax
Email	E2U+email:mailto	mailto:info@co.nz
WEB	E2U+web:http	http://.nz/

3.2.4 ENUM can be used to manage multiple telephone services by first mapping each E164 number onto a collection of service-specific URIs.⁹ So for each request, the gateway receives a complete set of URIs for each E164 address. The gateway selects the most appropriate URI and then uses the DNS to translate the domain name part of this URI to an IP address. With the full URI specification, the gateway can open an IP session with the selected service port. Users can create their own profile to direct their communications traffic to different devices based on variables such as time of day and caller location.

⁸ ENUM functions by translating a telephone number into an Internet address using the following steps:

1. The phone number is translated into a fully qualified E164 number by adding the city (or area) and country code. Example: 555-1234 dialled in Washington, DC becomes +1-202-555-1234, where the "1" represents the North American country code. The "+" indicates that the number is a fully qualified E164 number.
2. All characters are removed except for the digits. Example: 12025551234
3. The order of the digits is reversed because DNS names are structured from right to left. Example: 43215552021
4. Dots are placed between each digit to separate the number into administrative domains. Example: 4.3.2.1.5.5.5.2.0.2.1
5. The domain "e164.arpa" is appended to the end. Example: 4.3.2.1.5.5.5.2.0.2.1.e164.arpa
Source: ENUM.org. Online: <http://www.enum.org/information/faq.cfm>. Accessed 23 March 2005.

⁹ NAPTR records are a relatively new DNS facility that allow a multitude of information to be associated with a single domain name.

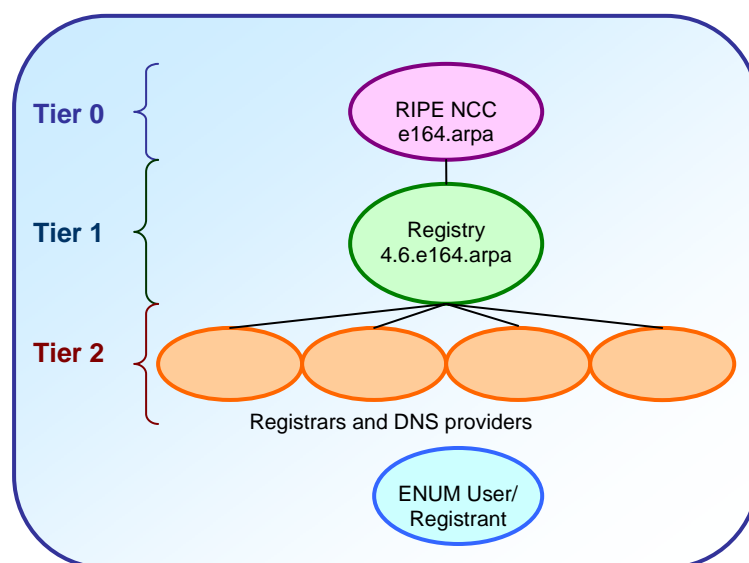
3.2.5 The most widely discussed applications of ENUM are to enhance VoIP (Voice over Internet Protocol) and VPIM (Voice Protocol for Internet Mail).

3.2.6 Ensuring user privacy is critical to the successful implementation of ENUM. Because ENUM uses the DNS, the address information placed there becomes inherently vulnerable due to weaknesses in DNS security. However, in the same way that firewalls are used to protect entities using the Internet, the ENUM protocol uses opt-in support of proxies, or user agents, to protect users.

3.3 Models of ENUM

3.3.1 The model of ENUM developed at ITU-T is based on a Tiered Architecture due to the layered structure of DNS. The tiers are described here and shown in the diagram below.

- Tier 0: Top level DNS e164.arpa. This is managed by ITU-T and operated by RIPE NCC;
- Tier 1: E164 country code ENUM DNS layer or .4.6.e164.arpa (in NZ). Management and operation are handled at a national level;
- Tier 2: Terminal (NAPTR resource records) ENUM DNS layer: .7.5.2.7.9.2.5.3.4.6.e164.arpa. Management and operation are handled nationally.



3.3.2 This tiered structure can be modified by either:

- Adding an extra layer within Tier 1 whereby the country code layer of .4.6.e164.arpa is split into number blocks; or
- Tier 1 delegates each number within .4.6.e164.arpa to Tier 2. This facilitates number portability and is suitable for user ENUM.



3.4 Types of ENUM

- 3.4.1 There are two approaches to implementing ENUM that differ in their definition of the Tier 1 Registry: Operator ENUM or user ENUM (discussed below). The styles of operation are completely different.
- 3.4.2 While most countries have trialled a user ENUM system, a number of private companies have been developing operator ENUM services, and the CC1 ENUM LLC (US ENUM Forum) is considering its trial within 1.e164.arpa. A summary comparing the pros and cons of each approach can be viewed in the Japanese ENUM Study Group Report, 23 May 2003.
- 3.4.3 Under the 'operator ENUM' approach (also called private, carrier or infrastructure ENUM), service operators with assigned E164 numbers (eg. Carriers, ISPs), set an ENUM record to implement the service identified by the telephone numbers.
- 3.4.4 Operator ENUM may be used by VoIP service providers as a mechanism for toll bypassing when interconnecting VoIP calls; the use of ENUM would be completely transparent to an end-user. Using ENUM, both VoIP operators register the associated ENUM domain names for their E164 numbers, along with a NAPTR record containing the URI mapped to the E164 number. When a call is placed to another operator's network, the originating operator can query the ENUM registry to find the URI mapped to the E164 number and route the call direct over the Internet. The ENUM DNS is internal to the operators and NAPTR resource records can be hidden from users.
- 3.4.5 The 'User ENUM' approach (also called public ENUM) allows users (E164 number holders) to register applications to an ENUM record for their number, which is called 'opting-in'. In this context, ENUM is both a prerequisite and driver for a variety of new IP based services. However, verification that the User is the appropriate number holder becomes critical and independent number verification authority is required.



4 Lessons from ENUM trials

- 4.1.1 This section discusses the lessons learnt in ENUM trials so far which incorporate technical, user privacy, structure and governance issues.
- 4.1.2 The hope and expectation is that a trial in New Zealand can learn from and build on trials already taken elsewhere in the world. Descriptions of trials in other jurisdictions are included as Appendix 3 and a summary table is provided on the next pages.

4.2 Technical, Security and Privacy Issues

- 4.2.1 The architectural, technical, operational, and end user aspects of provisioning ENUM services can be successfully implemented (Austria, Japan, UK, Sweden, Poland).
- 4.2.2 One of the objectives of trials overseas has been to test the interoperability between different implementations of ENUM, messaging and directory applications and Universal access.
- 4.2.3 Applications that have been investigated include VoIP, Video, SIP/ENUM, prioritising of devices, intercommunication of applications.
- 4.2.4 Populating DNS with large volumes of telephone numbers has presented challenges in some countries, particularly in provisioning and data management (China). DNS queries increase when ENUM is deployed and users tend to be sensitive about service quality.
- 4.2.5 ENUM trials emphasised the need for minimum standards for DNS. Secure DNS is needed to protect DNS data and verify its integrity. The development of DNSSEC has progressed (under the IETF) and testing may soon be an option. The UK trial report noted that further work is required in a number of related areas such as: key management; data signing policies; roles and responsibilities; and impact on Registry and Registrar operations.
- 4.2.6 Tools are needed to maintain DNS zone files (containing NAPTR records) including access controls to ensure that an application or tool only changes the resource records that it is permitted to update (UK).
- 4.2.7 The ENUM trial registries have used their own communication protocol between registry and registrar. However, the IETF PROVREG WG has published the general-purpose communication protocol between registry and registrar (General Registry Registrar Protocol RFC3375). Testing of the EPP that satisfies GRRP requirements is still required.



Country	Governing body	Trial objectives	Framework	Status
Austria	Austrian domain name regulator - RTR	Technical test Business case evaluation	User ENUM. Promoted by regulatory authorities, TSPs and ISPs.	Operational
Poland	NASK, the Polish national registry	Technical	User ENUM based on telephone networks acting as registrars for their customers. Uses EPP adaptation.	Operational
Netherlands	The DGTP (Directorate-General for Telecommunications and Post - a department of the Ministry of Economic Affairs) has applied for delegation of the Dutch ENUM zone but is open to alternative ways of managing ENUM.	Technical test Business case evaluation	User ENUM. Single registry charged at cost for services; referenced how a phone number is expressed to an IP address but no access to NAPTR records. Registrars undertook authorisation checks.	Trial ran from May to December 2003. Positive results.
France	Joint working group of DiGITIP, a directorate of the Ministry of Finance, and ART, the French telecommunications regulatory authority	Technical test with focus on compatibility with number portability, competition and privacy	User ENUM with opt-in.	Positive results, now considering non-technical issues.
Sweden	Recommendations are for public governance (including appointment of Tier 1 Registry) with supervision by National Post and Telecom Agency (PTS)	Technical with focus on processes and procedures Business case evaluation	User ENUM. The PTS delegated Tier 1 Registry role to the NIC-SE. But TSP in charge of Tier-1 validation. Tier-2 run between a traditional TSP and some IP-telephone operators.	Trial ran from June 2002 – June 2004. Implementation has been recommended.
Korea	NIDA (National Internet Development Agency of Korea), a non-profit organisation. Note that Government funded trial USD\$300,000	Technical test Promoting ENUM to public	User ENUM with Web-based Registration Geographical and Mobile Numbers	Commercial ENUM service planned for 2005.
UK	DTI oversight of industry self-regulation. Recommended two-tier governance model with a policy board of key service providers overseen by supervisory board with reps from DTI and Oftel (regulators). Trial was self funded by industry.	Technical test Policy issues Business case	User ENUM with Multiple Tier 1 Registries; Separate Authentication Agency (BT); 2 Registrars, 3 Nameservers, 9 Application Service Providers	In the process of moving to commercial ENUM; is considering governance and pricing issues.



Country	Governing body	Trial objectives	Framework	Status
Ireland	Commission for Communications Regulation (ComReg). Recommended to assign technical operations to a Tier 1 registry operator on a licensed basis.	Technical test Process and procedures Business case Interfunctionality with another Tier 1 Registry (Austria)	User ENUM with a single tier-1 registry; registrar and NameServer Provider roles combined; Tier 2 responsible for authenticating users (staff of University College of Dublin and MCI - providers of the trial nameservers).	ComReg has decided to designate a new non-geographic number range, based on access code 076, for VoIP-based services- expected to be available in 2005.
China	Ministry of Information Industry (MII) of China	Technical test	User ENUM; single registry by CNNIC; Integrated Trial Platform with VoIP experience platform, SIP UAs and IP/GSTN gateway.	Plans to run a commercial trial with improved security and privacy. This will lead to development of ENUM technical specification.
Finland	Finnish Communications Regulatory Authority (FICORA)	Test of different ENUM models Process and procedures for commercialisation	User ENUM; single registry run by FICORA; NAPTR records administered at Tier 2 or Tier 3 levels.	Implementation recommended on the basis that it will facilitate technological development of electronic communications and other IT applications.
Germany	DENIC, Germany's domain registry (not-for-profit)	Technical test with focus on registration and validation including costing	User ENUM; single registry; Registrars were DENIC members.	Trial is ongoing.
Japan	JPRS (private, for-profit company) is endorsed by the Japanese Government as the .jp registry and overseen by the Japan Network Information Centre (JPNIC) and the Japanese Government.	Technical test Process and procedures for registration and validation and cost recovery	Each ETJP member can apply their preferred numbers as their trial E164 numbers. Trial applications included ENUM enabled SIP Proxy, VoIP Router, InternetFAX.	The Trial is due to finish on September 2005. Special number block for ENUM and/or IP Telephony are under investigation.
Australia	Australian Communications Authority	Test of interfaces, applications and services; Regulatory and consumer issues, privacy and security	User ENUM, single registry under comp. contract, ENUM specific E164 number range, evaluation with and without the use of personal user agents	Trial due to start June 2005.
USA and Canada	The <i>Country Code 1 ENUM LLC</i> was formed by a group of companies to implement public ENUM in NANP under 1.e164.arpa. Has Memo of understanding with CIRA (Canadian Internet Registration Authority, the not-for-profit corporation mandated by Canadian Govt to operate .ca Internet domain) to act as Trial ENUM Tier 1A registry.	Development of requirements for commercial specification and implementation	Operator ENUM, single common ENUM DNS domain, 1.e164.arpa Tier 1 functionality split into: Tier 1A - to hold geographic and non-geographic NPAs; Tier 1B will serve different CC1 (NANP) member states.	Plan to hold a US ENUM trial after delegation. Timeline: RFP for Tier 1A to be issued in June 2005, contract awarded by Oct 2005, and registry operational by Jan 2006.



- 4.2.8 Further work is required on practical implementation of user authentication mechanisms (UK, Japan, Korea, Ireland). Experiences so far show that user/number identification and validation can be performed quite simply (such as with an identity card or copy of a phone bill). However, these procedures still lack the desired degree of automation and reliability.
- 4.2.9 The need for privacy protection has been considered in most ENUM trials given that DNS security remains a concern (UK, France). Trials have adopted the concept that users are the owners of their own data. This has been implemented through the opt-in principle (for users and their proxies).
- 4.2.10 Adopting the opt-in approach conceptually, however, is much simpler than guaranteeing it technically. The key dilemma is that NAPTR records must be public to ensure complete ENUM functionality; the assignment of access rights and restrictions to read authorisation reduces functionality. All trials have worked on the dilemma of how to manage read access to NAPTR records and still provide ENUM service functionality.
- 4.2.11 Many country trials are using proxies to manage user privacy protection. The UK trial assessment by DTI indicated that ENUM proxies (or ‘personal user agents’) are necessary to ensure privacy protection. The Australian trial plans to evaluate ENUM with and without the use of proxies as part of testing for user protection.

4.3 ENUM structure issues

- 4.3.1 For practical reasons nearly all ENUM field trials have used the tier 0 domain e164.arpa. While this is supported by the IETF and ITU, it does not imply any official commitment regarding the future operation of ENUM¹⁰.
- 4.3.2 Practical solutions are available to ensure an open, fair and competitive market in ENUM service provision. Trials have concluded that ENUM:
- Preserves competition between ISPs and is consistent with a free market;
 - Has potential to facilitate creation of an international VoIP hub.

Questions remain around remuneration of ENUM participants and cost recovery. It is important to ensure that the regulatory environment is sufficient to handle ENUM.

- 4.3.3 The trial structure does not have to imply a structure for the future commercial implementation of ENUM. An ENUM trial can be undertaken while certain commercial aspects are still being resolved by separating out the requirements

¹⁰ ‘A Comparison of ENUM field trials: Objectives, Main Issues and an assessment of Challenges ahead.’ Dieter Elixmann, WIK GmbH, Rhoendorfer Str. 68, 53604 Bad Honnef, Germany, Annette Hillebrand, Ralf G.Schäfer,

Available online: http://userpage.fu-berlin.de/~jmueller/its/conf/berlin04/Papers/Elixmann_paper.pdf

that are essential for an ENUM trial from the set of requirements needed for full commercial operation.

4.3.4 National arrangements for the management of domain names and e164 numbers will influence decisions on the preferred administrative model for ENUM. In turn the administrative model influences selection of the functional entities needed for an ENUM trial. The key functional entities are:

- **Tier 0 Registry** – RIPE NCC
- **Tier 1 Registry** - points to the correct ENUM Tier 2 Nameserver Provider in DNS.
- **Tier 2:**
 - **DNS (Nameserver) Provider** - holds the NAPTR records that contain information for specific communication services.
 - **Registrar** - inputs the Subscriber's E164 number into the Tier 1 Registry; Must be appointed or recognised by the Tier 1 Registry; May have access to the Tier 2 nameserver to load, amend and delete NAPTR records.
- **User/Registrant** (holder of E164 number).

4.3.5 Some trials have incorporated additional functional roles such as:

- **Authentication/Validation Agency** – to provide independent verification of User/registrator id. This agency can be affiliated to the Tier 1 Registry, though it is usually independent.
- **Application Service Provider (ASP)** – to provide end user functionality based on the ENUM platform and data inserted within the ENUM zone file;¹¹ May act as a reseller of Registrar services or be the Users' incumbent ISP or TSP.
- **Subscriber** - has access to ENUM Tier 2 nameserver to load, amend and delete NAPTR records.

4.3.6 Business Models trialled for ENUM tend to favour the 'thin' registry approach where the Tier 2 Registrars or DNS (nameserver) providers hold registrant, service and application information.

4.3.7 Specifying multiple Tier 1 Registry providers introduces additional complexity and creates undesirable operational problems (UK).

4.3.8 Two approaches can be taken at the Tier 2 level: either the Registrar and DNS (Name Server) Provider are separate institutions, or they are combined to form an 'ENUM Service Provider'. A single Tier 2 service provider reduces complexity, but at the expense of reducing competition.

¹¹ This can include simple everyday Internet service addresses such as a static email address or Web page location, conventional telephony services such as a switchboard number or fax machine or "next generation" services such as VoIP, LDAP directory services or PKI keys that may need to modify DNS records for the ENUM zone in real time.



4.4 Governance and Administrative issues

- 4.4.1 Most trials have been promoted by an organisation whose members represent DNS registries, government, telecom carriers, ISPs, vendors, etc. In some cases ENUM is promoted mainly by the ccTLD registry (eg. Denmark and Korea), while in others ENUM is promoted by the government and the ccTLD holder is a member of the trial (eg. China, Sweden).
- 4.4.2 Trial objectives have varied widely across countries, with a shift over time from technological features to economic and political features. The different objectives sought can be classified into three groups:
- Testing technological/functional aspects such as systems, processes and interfaces.
 - Analysing commercial aspects such as demand, business models, financing, and applications.
 - Evaluating political aspects such as competition policy and regulation.
- 4.4.3 Most of the ENUM field trials have been self-financed by participants. Trials in South Korea and Taiwan received financial support from the Government.
- 4.4.4 Trial processes have usually involved a consultation period followed by organisation of working parties to develop a technical specification. Trial periods have ranged from six months to two years, often requiring extensions to the e164.arpa delegation. Following trials, most countries have undertaken an assessment and started working towards resolving outstanding issues prior to full implementation.
- 4.4.5 Trial participation is likely to be limited if there is low visibility of ENUM-based applications and services for users to try (UK, Korea). An information programme to attract users or other trial participants could create the demand needed to support the emergence of ENUM-capable services and applications. To attract business users, some of the trials widened their scope to provide ENUM in private branch exchanges.
- 4.4.6 A governance body is required to oversee a national ENUM system and take responsibility for policy matters such as accreditation, disputes and complaints procedure, and scrutiny of the Tier 1 Registry (UK, CC1 ENUM LLC).
- 4.4.7 Further work is required on the economic costs and benefits of ENUM and ENUM related services. However, there are encouraging signs that demand for VoIP and SIP solutions alone could make a compelling case for ENUM implementation (UK, Ireland).

4.5 Summary: Next steps for ENUM

- 4.5.1 The first steps in testing ENUM have already been taken. The key lessons for New Zealand from previous trials are that:



- The testing of ENUM technology has been successful; and
- Business case evaluations recommend ENUM implementation.

4.5.2 This suggests that an ENUM Trial in New Zealand can concentrate on defining a workable specification for commercial implementation. This is the approach taken in the two latest trials scheduled for 2005 - CC1 ENUM LLC and Australia. The focus of these trials is not on testing the technology, but on defining the technical specifications for implementation and resolving issues around privacy and security.

4.5.3 The outstanding ENUM issues yet to be adequately resolved include:

- a. Governance model (to oversee the ENUM system and take responsibility for policy matters such as accreditation, disputes and complaints procedure, and scrutiny of the Tier 1 Registry)
- b. Cost recovery model
- c. User authentication
- d. DNS security and user privacy - how to manage read access to NAPTR records and still provide ENUM service functionality
- e. Testing of the IETF communication protocol between registry and registrar (GRRP) using Extensible Provisioning Protocol
- f. Non-geographic numbers



5 Proposed Framework for a NZ ENUM Trial

5.1 Introduction

- 5.1.1 This section describes a framework for a New Zealand ENUM trial which incorporates both objectives and an approach to trial implementation. The format introduces both recommendations and questions on policy and technical issues. Feedback is sought on all recommendations and questions presented here.
- 5.1.2 The first decision is that of whether or not to trial ENUM in New Zealand. Perhaps the key question here is: Can New Zealand afford not to implement ENUM? As a small and isolated nation, communications technology plays a critical role in New Zealand's global competitiveness. Our key trading partners are moving to test and deploy this technology now. What form of competitive edge will ENUM enhanced communications provide to businesses; or to individuals? Are there alternatives to ENUM?
- 5.1.3 Given that trials in other jurisdictions have already proven the technical viability of ENUM, it is reasonable to assume that a positive decision to trial in New Zealand is likely to be based on the intention of moving directly to full deployment. In this case it would be important that ENUM be trialled and implemented in the most efficient manner possible.
- 5.1.4 ENUM is part of Next Generation Network (NGN) technology. Recent work in Europe has shown that implementation of ENUM is likely to be enhanced with a Universal Communications Identifier (UCI).¹² The UCI points to an ENUM record to provide users with a stable and internationally transferable look-up pointer. Users would generally have a single UCI, but may have several ENUM numbers (eg mobile, fixed line). The UCI provides each person with a single number that defines their identity, and which stays within their control as they change locations, jobs, or service providers. While a lot of work has been undertaken in relation to UCI, it has yet to be tested. A NZ ENUM test that incorporated UCI would create interest on an international scale.
- 5.1.5 On the premise that ENUM *will* be implemented in New Zealand, trial objectives can focus more specifically on reaching defined outcomes, rather than providing a general opportunity for learning. The objectives proposed here have been developed with this in mind.

¹² PUA and UCI have been well specified by The European Telecommunications Standards Institute. The user requirements and benefits of UCI have been investigated in European studies, including extensive consultation with organisations and experts in the fields of the requirements of disability, aging and young children.



5.2 Proposed Objectives

5.2.1 The overarching purpose of an ENUM trial should be to develop an agreed functional specification for ENUM in New Zealand. This will require identifying all technical and policy issues that need to be addressed prior to full commercial implementation of ENUM within New Zealand.

5.2.2 The following set of objectives is proposed:

- a. **Architecture:** To establish and evaluate the processes, interfaces and protocols required for interactions between ENUM functions: Tier 1, Tier 2, Registrar, Application Service Provider, etc;
- b. **Provisioning:** To determine technical and operational requirements to provisioning ENUM records at Tier 1 Registry and assess DNS requirements/implications in the provision of ENUM services. This is likely to include:
 - Validation - Testing zone architectures using +64 telephone numbers mapped into the e164.arpa domain (to ensure integrity of the E164 numbering scheme);
 - Privacy - Testing the Query/Response mechanism of the ENUM DNS protocol using +64 numbers in e164.arpa and test NAPTR records in various domains;
 - Security - Evaluating potential DNS security mechanisms, including identifying security issues (eg. subscriber data, NAPTR-resource records, DoS attacks), along with possible solutions.
- c. **Applications:** To test applications based on the use of ENUM capabilities from both technical and user perspectives; For example, tests of call setup and completion for test user agents/service providers of ENUM-enabled services;
- d. **Inter-working:** To facilitate interconnectivity with other jurisdictions (where appropriate);
- e. **Awareness:** To inform the public about ENUM;
- f. **Business case:** To enable evaluation of the economic benefits and costs of implementing ENUM;
- g. **Functionality:** Parallel with ENUM, to test the use of UCI's as defined by ETSI;
- h. **Implementation:** Nothing in the trial should be incompatible with facilitating a smooth commercialisation process.

Recommendation:

That this set of objectives (a through h above) be adopted to guide the implementation of an ENUM trial in New Zealand, encompassing goals for: system architecture, provisioning, applications, inter-working, awareness, business case and implementation.



5.3 Security and privacy issues

- 5.3.1 An important feature in establishing a trusted communication database for ENUM users is to guarantee security, availability and integrity at all times as well as data protection and privacy for users. DNS security and user privacy policy are critical aspects. Every trial user must be offered an opt-in ENUM security service that is able to restrict access to ENUM DNS records.
- 5.3.2 One of the options for managing user privacy is through ENUM proxies or personal user agents (PUA). A PUA is software that acts as a proxy for a user, by allowing them to apply business rules to the forms of communications to be used for outbound and inbound calls such as what information is disclosed and to who. The UK trial assessment by DTI considered that ENUM proxies are necessary to ensure privacy protection. The Australian trial plans to evaluate ENUM with and without the use of proxies as part of testing for user protection.
- 5.3.3 The UCI allows a user's PUA to be identified by pointing to an ENUM record. In practice, when a user applies for a UCI, an ENUM number that matches the numeric component of the UCI would also be allocated. PUA and ENUM are the infrastructural components required to deliver UCI. ENUM provides the mechanism to store and access the UCI on the Internet, while PUA provides a way for users to control who is able to contact them and how.
- 5.3.4 Both the DNS proxy (Australia) and the UCI Personal User Agent (PUA) (specified by ETSI) provide an opt-in ENUM security service that restricts access to ENUM DNS records. Users who do not opt-in can use ENUM as a direct DNS service.
- 5.3.5 In May the European Commission considered a proposal to “Develop an ETSI Guide (EG) detailing the technical requirements for how UCI capabilities can be met with ETSI TISPAN Next Generation Network specifications.”¹³ This proposed work would concentrate on highlighting the ways that services such as ENUM and SIP can be exploited through the use of UCI. It would also show how existing standards and guidelines, including the IETF rfc2916 "E.164 number and DNS", can be modified to enable the UCI to be achieved.
- 5.3.6 Given the broad potential for UCI, it is recommended that UCI and personal user agents be trialled in parallel with the ENUM Registry Trial. To ensure integration with any future European implementation, the UCI should be as specified by ETSI. In relation to this, work on specific recommendations has already been undertaken by Catalyst IT on behalf of the InternetNZ ENUM Task Force.¹⁴

¹³ ETSI TECHNICAL PROPOSAL Incorporating Universal Communications Identifier (UCI) support into the specification of Next Generation Networks (NGN). Status: Draft, Version: 1.0.0 - Date: 13 April 2005

¹⁴ “Feasibility Study of Personal User Agent and Universal Communications Identifier Technologies”, report prepared for InternetNZ ENUM Task Force by CatalystIT Limited, 5 April 2005.



Detail on implementation of PUA functionality in relation to ENUM is available in the CatalystIT report.

5.4 Proposed ENUM Trial Framework

- 5.4.1 It is proposed that a New Zealand ENUM trial implement User ENUM with voluntary participation through the opt-in principle, whereby users can choose to both register and de-register for an ENUM number. The ENUM assignment for each number would be under the control of the user.
- 5.4.2 User ENUM is more complicated to implement than infrastructure ENUM, but because of its broader scope, it is the driver for new IP based services. Any person with an E164 telephone number can register applications to an ENUM record for that number. This means that participation in the ENUM trial would be open to all E164 number holders in New Zealand.
- 5.4.3 The proposed ENUM trial structure would test both ENUM and UCI in parallel and has the following features:
- a. Stakeholder body to oversee governance and administration;
 - b. Working groups to resolve technical and policy related issues;
 - c. Single Tier 1 registry with delegation for New Zealand ENUMs ie .4.6.e164.arpa;
 - d. An Authentication Authority (AA) to verify user identities, interoperate with telephone companies, maintain a directory of UCIs and have delegation for the dedicated domain for ENUM number ranges, eg 8.7.8.4.6.e164.arpa;
 - e. A Shared Registry System (SRS) which contains ENUMs and UCIs;
 - f. Multiple Tier 2 providers: Registrars and Nameservers, and providers of PUAs;
 - g. Registrants: E164 number holders can choose whether to populate their ENUM record with multiple communications devices, or a UCI PUA;
 - h. PSTN Providers: incumbent telephony (PSTN) operators; and
 - i. PUAs.

Each of these features is discussed in greater detail in section 6 which deals with project planning issues.

- 5.4.4 The User ENUM model would involve the user paying a fee to register an ENUM domain name with an ENUM Registrar. The registrant then decides to populate their ENUM record with either:
- Multiple points of contact (eg. email addresses, telephone numbers, SIP address for IP telephony, http address for a web page). These points of contact are stored as NAPTR records at the location of the ENUM domain name. Users of ENUM can then use the E164 number associated with the registrant's ENUM domain name to contact the registrant. The registrant can alter how they are contacted by changing the contents of their NAPTR records via their Registrar.



- A UCI PUA. In this case, the multiple points of contact are stored in the Registrars' PUA server.
- 5.4.5 The use of UCI requires Tier 1 Registry functionality that includes ENUM+NAME and certificates. Registrars would be able to choose to offer either or both of ENUM and PUA registrations. Registrars' PUA servers would need to communicate with other registrar's PUA servers.
- 5.4.6 Registrants using PUA would have the calls to their normal telephone number intermediated by their PUA. They would be able to place calls between any combination of VoIP and PSTN. People calling ENUM registrants could have their calls bridged seamlessly from PSTN to VoIP if required.
- 5.4.7 The ETSI Specialist Task Force, which was recommended to the European Commission, would be available to liaise and provide knowledge support throughout the Trial.

Recommendation:

The ENUM trial should:

1. Implement User ENUM with voluntary participation through the opt-in principle, whereby users can choose to both register and de-register for an ENUM number.
2. Place control of the ENUM delegation for each number in the hands of the user.
3. Test UCI in parallel, using PUAs to manage user privacy as specified by the ETSI.

5.5 Trial success criteria

- 5.5.1 A set of criteria is needed to determine whether the ENUM trial is successful. This should include both activity and performance parameters as follows:
- A minimum number of users registered for the trial (eg. 100);
 - A minimum number of communications initiated during the trial (eg. 1000);
 - A minimum number of unique communications completed within a certain timeframe (eg. 30 in one week);
 - A performance parameter for communications attempts (eg. 98% completed successfully);
 - A performance parameter for system uptime for the Tier 1 Registry and across registrars (eg. 95% uptime)

5.6 ENUM Business Model and Trial funding



- 5.6.1 The proposed ENUM business model includes registrants, registrars and a single Tier 1 registry operator as follows:
- a. When registering for ENUM, registrants obtain a unique Directory entry, and a key or licence;
 - b. The Registry service provider receives a fee for holding the data, publishing the public data and distributing infrastructure files;
 - c. As only accredited registrars can directly access the registry, the Registrar is able to charge a service fee to registrants;
 - d. Members of the public can access certain registry information and can pay a subscription or access fee for this arrangement.
- 5.6.2 The main infrastructural costs to the trial involve providing the Tier 1 Registry along with Tier 2 Nameservers and Registration facilities.
- 5.6.3 At the Tier 2 level, the functions of registrar and DNS (Nameserver) Provider are competitive services. For this reason, any accredited registrar or DNS Provider should be free to set charges for its services as it considers appropriate. It should be expected that these charges be set at a level projected to enable cost recovery for the provision of ENUM services over time.
- 5.6.4 At Tier 1 level however, with a single Registry, the function is a monopolistic service for which there is always potential for abuse. There are two issues to be considered:
- How to fund a Tier 1 registry for the purpose of the trial?
 - How to provide the Registry service on a commercial basis?
- 5.6.5 Most of the ENUM field trials have been self-financed by participants to some degree. During an ENUM trial the main costs relate to the time of the people who will underpin the trial. In most countries these costs have been met by private businesses or public organisations who committed staff to work on the trial. Trials in Austria, the Netherlands, France, Sweden, the UK, Ireland, China, Finland and Australia received support from regulatory agencies. Trials in South Korea and Taiwan received financial support from the Government.
- 5.6.6 It is important to recognise that while nothing prevents a different registry being employed for commercialisation, the incumbent registry will have a definite advantage. For this reason, and to facilitate a smooth transition to commercialisation, other jurisdictions have let the Trial Tier 1 Registry contract through a competitive tender.
- 5.6.7 In Australia the Tier 1 Registry Operator is expected to establish and maintain a minimum base service for 1 year. They will operate the trial at no cost to the ACA but are able to charge trial participants for the provision of registry services. AusRegistry International Pty Ltd has been selected as the Registry Service Provider for the trial.



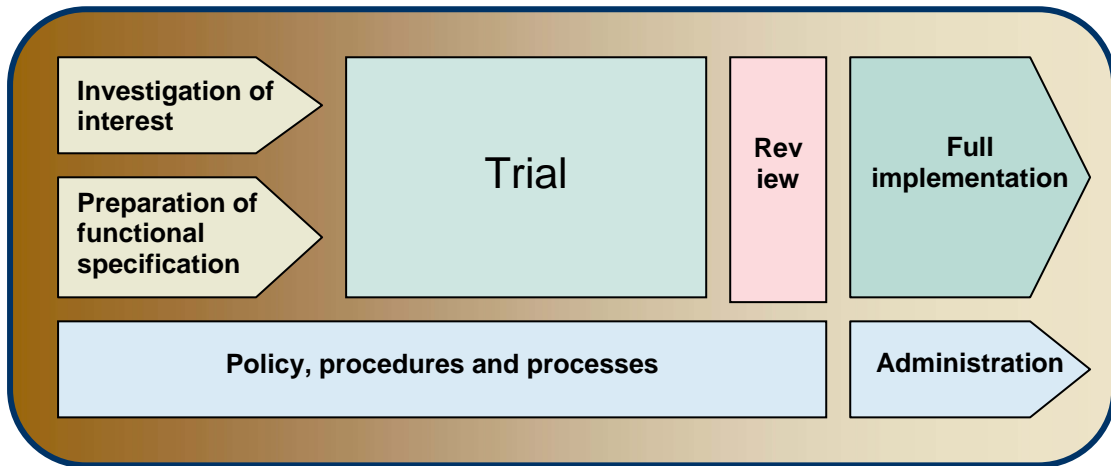
- 5.6.8 An alternative proposal is to establish a shelf ENUM Trial Company that would be controlled by the trial governance board. Administrative support would be required. At the end of the trial, shares in the shelf company could be sold to the commercial registry company that would take over the ENUM registry. This could involve a “Call and Put” option for shares and debt agreed with the commercial company, at a neutral price, and with transfer of IP knowledge.
- 5.6.9 The operation of the Austrian ENUM Domain has been delegated to enum.at until the end of 2007 under a policy framework defined by the regulator (RTR-GmbH) for ENUM in Austria. Cost recovery for the Tier 1 registry's operations (enum.at) is through monthly fees for Registrars (approx. 0.25 - 0.5 Euro/Month/Domain).

Questions:

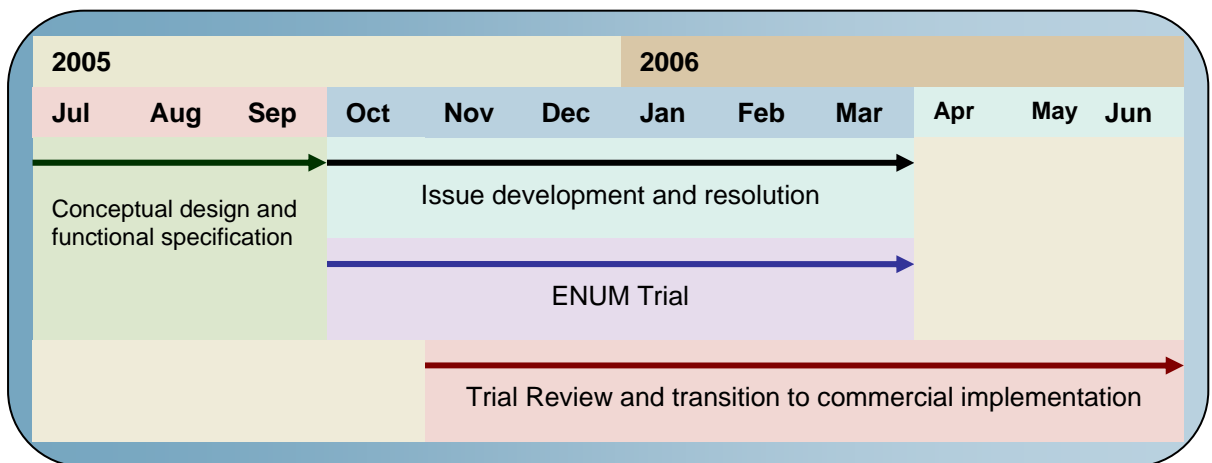
- Is there sufficient interest by service providers to support a self-funded ENUM trial in New Zealand? Would you or your organisation participate in an ENUM trial, and in what capacity?
- Should the Tier 1 Registry contract be tendered prior to the start of the trial, and if so, on what basis?

5.7 ENUM Trial Organisation

- 5.7.1 The proposed approach to the ENUM trial involves decoupling policy and technological goals to allow for concurrent progress of both, and a more efficient timeline.
- 5.7.2 The ENUM trial would consist of five phases as follows:
- a. Preparation of conceptual design and functional specification
 - b. Implementation and operation
 - c. Resolution of outstanding issues
 - d. Review of Trial
 - e. Transition to full implementation



5.7.3 A timeframe for each trial phases would need to be established. To facilitate progress, phases ii. and iii. could be undertaken concurrently. The proposed timeline is shown below.



5.7.4 Responsibilities for progressing each phase of the trial could be allocated as shown in the table below. This proposes two separate bodies for overseeing trial operations and ENUM development. Establishing a governance framework for the trial is discussed in the next section.

	Phase	Method	Outcomes	Responsibility
1	Trial Preparation and conceptual design	Work groups	Draft functional model of trial organisation, technical specifications and processes	Steering Group
2	Trial implementation and operation	Testing and reporting back	Activity and system performance results	Operations Board
3	Resolution of issues	Work groups	Workable solutions and recommendations	Steering Group



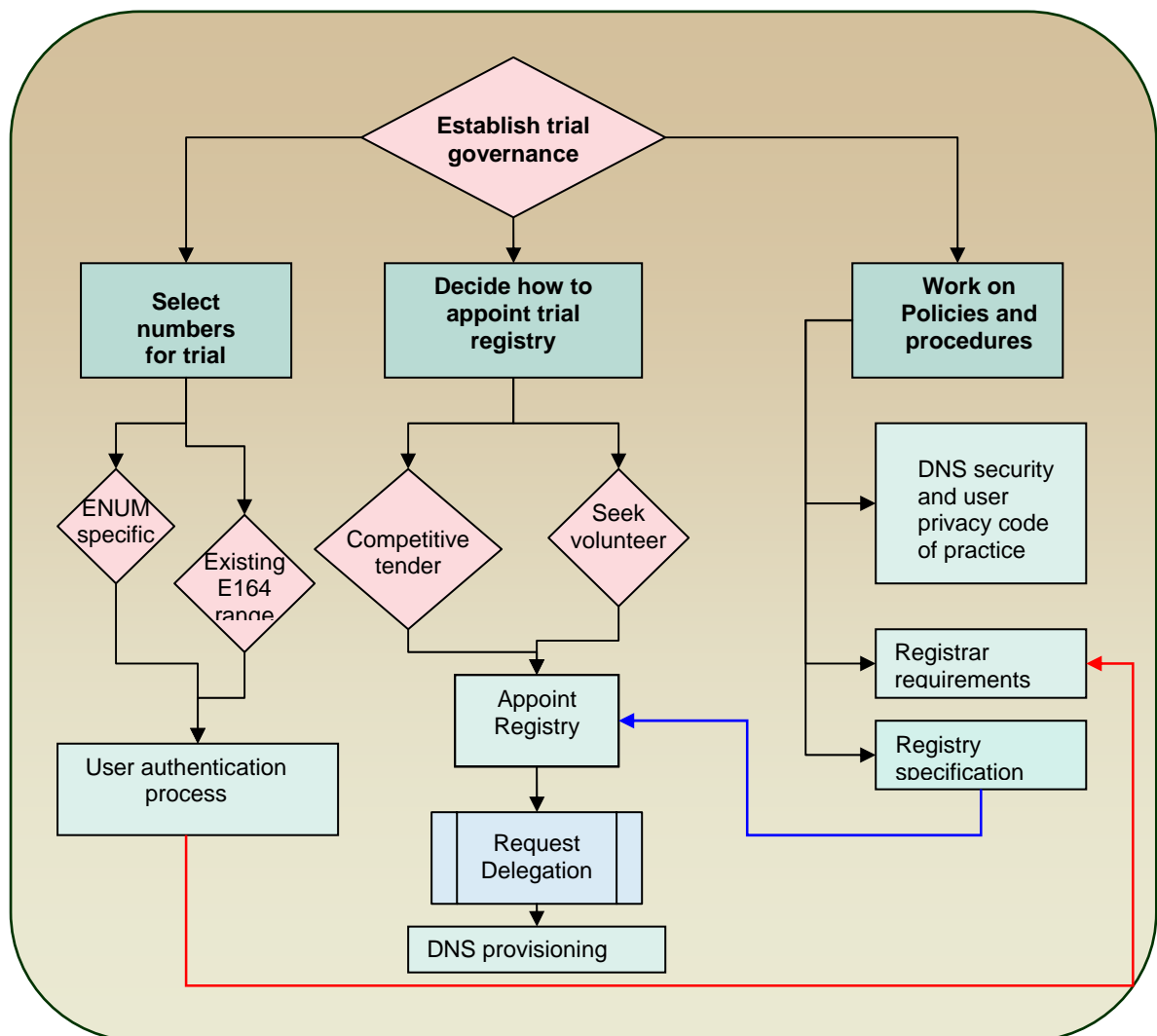
4	Trial Review	Steering Group	<ul style="list-style-type: none">• Analysis of whether objectives have been achieved• Identification of any further work required• Decision to implement	Steering Group
5	Transition to full implementation		Commercial implementation of ENUM	ENUM Governance Board

6 Trial project planning

6.1.1 A number of critical factors related to ENUM structure, organisation and operational policy must be addressed prior to the staging of a New Zealand ENUM trial. The critical factors for trial start are:

- a. Trial governance framework;
- b. Approach to service provision;
- c. Selection of numbers for the trial;
- d. Appointment of a Tier 1 registry for the trial;
- e. Delegation of 4.6.e164.arpa;
- f. Process for accreditation of Registrars;
- g. Provisioning of DNS;
- h. User authentication procedure;
- i. DNS security and user privacy policy.

The important linkages and dependencies between these factors are shown in the flow chart below.





6.2 ENUM Trial Governance

- 6.2.1 To implement an ENUM trial in NZ, some form of governance is required that has the mandate to move the process forward by: deciding the range of policy issues; identifying appropriate expertise to find solutions to problems; allocating responsibilities for trial implementation; and considering legal issues. Clearly stakeholder involvement is critical to this task.
- 6.2.2 A governance framework defines the nature of membership, chair, voting rights, provision of administrative support, and accountability through reporting requirements.
- 6.2.3 InternetNZ has so far taken the lead in promoting ENUM discussions. They have also proposed the formation of a joint New Zealand ENUM Steering Group (NZESG), initially to the NAD who referred the proposal to the TCF. This would be an interim stakeholder advisory group to steer the trial. Following a meeting with the TCF, there is an expectation that some form of cross industry (telecommunications/internet) and consumer group will be formed to oversee the progress of ENUM.
- 6.2.4 The key governance tasks involve two distinct aspects: day to day trial oversight and commercial development. Given that trial participation and involvement may largely be voluntarily funded, separating the responsibility for these tasks as follows would provide a more practical trial implementation:
- Operational responsibility could be given to the ENUM Operations Board (EOB); and
 - Developmental responsibility could be given to the ENUM Industry Steering Group (EISG).
- 6.2.5 The EOB would hold the operational mandate for the ENUM Trial and would consist of 3 persons as follows:
- 1 Executive Chair (Chair of EISG);
 - 1 TCF nominee; and
 - 1 InternetNZ nominee.
- 6.2.6 The EOB would establish the rules, means and methods of running the ENUM Trial on a day to day basis. It would require the ability to:
- a. Enter contracts necessary to implement and operate the Trial including the Tier 1 Registry;
 - b. Control the terms and conditions of participation by Tier 2 registrars;
 - c. Suspend and resume Trial registrations and operations.
- 6.2.7 The EOB would be independent, but to facilitate ENUM development it would report to the EISG on a monthly basis on trial progress and implementation issues.



A copy of this report would be made available to the public (and specifically to the TCF and InternetNZ).

6.2.8 The key role of the EISG would be to develop and endorse a proposal for commercialisation of ENUM in New Zealand.

6.2.9 It is important that all key stakeholders be represented on the steering group, and that the role of chair is held by an independent party to facilitate fair resolution of issues. Membership of the EISG would consist of:

- 1 Chair (Chair of EOB)
 - 3 TCF representatives
 - 3 InternetNZ representatives
 - 1 Government observer
 - 1 Consumer observer
- } 7 voting members
- } 2 non-voting members

6.2.10 The EISG would be tasked with:

- a. Development of policies and procedures for dealing with issues including:
 - Ongoing governance arrangements;
 - Detailed requirements for Tier 1 Registry service provision;
 - Competition between providers of ENUM services and Terms and Conditions for the transfer of customer data between providers; and
 - Policies for authentication and validation: bulk up-load of information from existing databases, data privacy, universal access, security, and cost recovery.
- b. Resolving any formative issues and reporting back to the EOB with endorsements or suggested changes to proposals for re-testing as part of the trial;
- c. Developing and endorsing a proposal for commercialisation of ENUM in New Zealand;
- d. Transition to implementation

6.2.11 It is likely that the EISG will require the use of working groups to resolve issues relating to architecture, provisioning, security, applications, and interoperability. The EISG would be required to report back to the EOB, TCF, and InternetNZ, with a copy made available to the public.

Recommendation:

Establish two governance bodies to oversee ENUM trial: the ENUM Operations Board and the ENUM Industry Steering Group. Membership would consist of key stakeholders (including InternetNZ and TCF) and the same independent chair.



6.3 Approach to service provision - Market based or cooperative

- 6.3.1 An important decision is whether to contract out the key functions related to ENUM market operations, in particular the Tier 1 registry, or to provide services to the market directly through a centralised market-owned organisation. This issue is described in two models of governance known as the “make” or co-operative model, and the “buy” or market governance model.
- 6.3.2 Under a standard co-operative model, an ENUM co-operative business would be owned and operated for the benefit of its members, and is therefore likely to be structured as a not-for-profit business. The weakness of a co-operative model is that the mandate of the ENUM co-operative would be to act on behalf of its members, but those members are likely to have diverse preferences. This would create an incentive to develop, over time, in a way that individual members have limited ability to control.¹⁵
- 6.3.3 The market governance model separates ownership and control of service provision so that members can govern the provision of services without carrying the full risks of ownership. Under this approach, ENUM market operations would be viewed as a commercial activity in their own right which are best provided contestably and with accountability directly to the market.
- 6.3.4 The market governance model is likely to produce greater ongoing gains to the industry relative to a cooperative model because:
- Registry services are relatively easy to define and specify in a contract, and can reasonably be expected to be subject to competitive pressure under a properly designed contestable process;¹⁶ and
 - The skills required for registry service provision are not so specialised or specific to the industry that there would not be a number of people/organizations capable of bidding to carry out these services.
- 6.3.5 When there is uncertainty as to which model is likely to produce greater gains over time, the costs from switching models should be considered. In general, the costs involved in moving from an arms length contractual model to a cooperative model are lower than the other way around.
- 6.3.6 The .nz registry is run by New Zealand Domain Name Registry Limited, trading as .nz Registry Services (NZRS), which is a limited liability company wholly owned by the Internet Society. Under the .nz Shared Registry System, there is a competitive environment for registrations with a number of registrars on the market. Authorised registrars both register and manage .nz domain names directly with the registry. There is no direct communication between NZRS and registrants.

¹⁵ This is often referred to as an agency problem because the principle shareholders that make up the co-operative have difficulty controlling the agent acting on their behalf.

¹⁶ Where it is difficult to define all elements of service provision in advance and the buyer would bear considerable risk from the exercise of discretion by the service provider, the buyer might gain from a greater ability to ‘command and control’.

- 6.3.7 The Domain Name Commissioner (DNC) is responsible for day to day oversight of the .nz domain name registration and management system. This includes the authorisation of registrars, and the transfer of management of specific domain names from Domainz to the authorised registrars as they connect to the SRS. A full list of authorised registrars is maintained on the DNC website.¹⁷ The DNC is also responsible for ongoing development and monitoring of the competitive registrar market and the environment for registration and management of .nz domain names.
- 6.3.8 Applying a market governance approach to ENUM in New Zealand would be consistent with the approach taken for managing the .nz registry.

Question:

Is a market governance model that involves a competitive contract for service provision of the Tier 1 Registry the best way to manage full commercialisation of ENUM in New Zealand?

Recommendation: Offer a competitive contract for commercial service provision of the Tier 1 Registry.

6.4 ENUM Number range

- 6.4.1 Rights-of-use to use domain names become an issue when implementing both the User ENUM model and when geographic and non-geographic numbers are used for ENUM. The options for ENUM numbers are to use E164 numbers that have already been issued to users, or to use an ENUM specific¹⁸ number range, or both.
- 6.4.2 For ENUM to be truly useful, public Trial users must be able to dial and reach existing e164 numbers and vice versa.
- 6.4.3 The Numbering Plan stipulates that geographic and digital mobile numbers may only be issued to customers in association with a carriage service. This means that before registering a geographic or digital mobile number as an ENUM domain name, a customer must already be issued the E164 number in association with an existing carriage service (fixed line service or digital mobile service). The customer's right to use the ENUM domain name is conditional on maintaining the right to use the associated E164 number.
- 6.4.4 The Australian trial will use ENUM specific E164 numbers that are independent of any carriage service and not conditioned on the PSTN. At the conclusion of the trial the numbers will be withdrawn in accordance with the requirements of the numbering plan. In Austria the numbers used for the trial included: geographical numbers, numbers for private networks (+43 5xxxx), mobile numbers (+43 6xx), location-independent fixed network numbers (+43 720),

¹⁷ <http://www.dnc.org.nz/>.

¹⁸ ENUM specific or ENUM only numbers are E164 numbers that are independent of any carriage service and can only be used for ENUM.



numbers for converged services (ENUM enabled) (+43 780) and free-phone numbers (+43 800). With the move to commercialisation, a new number range +43 780 has been created particularly for use in connection with VoIP.

- 6.4.5 When an ENUM specific number range is used, the problem of proving an existing right to use a particular E164 number is avoided, because the user receives the right to use the E164 number at the same time that the domain name is created. The user's right to this E164 number must be conditional on maintaining the associated domain name: if the domain name is deleted, the user loses the rights to the E164 number. So if an ENUM user decided to de-register, the E164 number could be allocated to a new registrant.
- 6.4.6 The downside to using an ENUM specific number range is that a new E164 number must be issued to every ENUM registrant. However, this may circumvent problems where two or more people are using the same E164 fixed line service and the account holder decides to register for ENUM.
- 6.4.7 As re-use of an existing telephone number will not be appropriate for all registrants, a new number range under the +64 country code may be necessary for new ENUMs. A dedicated number range could be provided by a single provider, and offer simple PSTN redirection to a 'real' number.
- 6.4.8 Personal number service (PNS) codes already exist in the number plan. These enable the user to have a unique number that is independent of any network or location. However, there would need to be some change in the deed for ISP's to be in a position to allocate numbers: for the moment only TSP's are included.
- 6.4.9 It is important that the trial include both the existing number range as well a new number range. At the end of the Trial all ENUM records can be transferred and reregistered with a Tier 2 Registrar under commercial Terms and Conditions.

Recommendation:

The trial should include both the existing number range as well a new number range. At the end of the Trial all ENUM records can be transferred and reregistered with a Tier 2 Registrar under commercial Terms and Conditions.

6.5 User authorisation procedure

- 6.5.1 The responsibility for user authentication should lie with Tier 2 Registrars. Registrars should be made to face sanctions should they exceed a contracted accuracy threshold.
- 6.5.2 The 'User ENUM' approach based on existing E164 numbers allows users to register applications to an ENUM record for their own E164 number. In this case verification of the identity of the user, and validation that the user is authorised to register the telephone number for ENUM, becomes critical. Most trials of user



ENUM have concluded that some form of independent number authorisation is required.

- 6.5.3 Two approaches have been trialled to authorise the use of a number and provide synchronisation between the ENUM e164.arpa domain and E.164 numbers across the life cycle of a number:
- A physical or electronic token is held by the customer such as a bill, or a PIN, or a signed public key certificate;
 - Identity matching of a pre-established customer identity against either the number-issuer or a central authority record.
- 6.5.4 The ENUM trial in the UK showed that simple procedures for user/number identification and validation (such as with an identity card or copy of a phone bill) lacked automation and reliability. A number of difficult situations arose including DDI blocks allocated to an organisation, premium-rate numbers, pay-as-you-go mobile phones, ex-directory numbers, freephone and non-geographic local and national numbers.
- 6.5.5 The two solutions identified for number authorisation in the UK were: 1). A lightweight form of authentication, such as a first-come, first-served, basis for registrations with a simple appeals mechanism to prevent speculative ENUM registrations; or 2). By reference to either the number issuer or a neutral third-party that is kept up-to-date by number issuers. This could require development of an on-line authentication system in cooperation with a telephone company.
- 6.5.6 Telephony companies may be encouraged to support the authentication process to the extent that they provide Tier 2 Registrar services; If registrars face suspension for annual registration error rates above a preset level, this will motivate them to provide an effective authentication process.
- 6.5.7 In Austria a revalidation is performed by the registrar at regular intervals (e.g. every 6 months), in order to make sure that the call number of the relevant domain is still assigned to the user.
- 6.5.8 An Authentication Authority (such as a Commissioner) could be established to provide authoritative decisions on ENUM applications based on a Code of Practice. Registrars could seek Authentication confirmation from the AA Commissioner (for a fee) in order to remove their liability for making an incorrect Domain entry being. The AA Commissioner role would be outsourced to an independent person and funded from wholesale registration fees. The Commissioner would be appointed by the ENUM governance board.
- 6.5.9 In addition, an Appeals Authority could be made available to hear UCI applications rejected by the AA Commissioner.

Questions:

What form of user authorisation process should be used in a New Zealand trial of ENUM?

Recommendation:

That an Authentication & Appeal Authority for ENUM registrations be established.

6.6 Delegation of ENUM domain 4.6.e164.arpa

- 6.6.1 An immediate governance issue is the need to obtain the 4.6.e164.arpa delegation from the ITU for the trial. Note that delegation is associated with governance responsibility which is a separate function from day to day operations. For example, InternetNZ has delegation of .nz while day to day registry operations are the function of NZRS.
- 6.6.2 Interim arrangements for national ENUM trials are formal; delegation requires the consent of the government and national administration, but it could be issued to a private company, NGO, regulatory authority or ENUM taskforce. The risk to the government is minimal as the delegation is issued for a limited period only and they can change the delegation at any time.
- 6.6.3 The question is, who should receive the delegation? In most countries delegation has gone to a regulatory authority or the E164 country code manager. The UK trial took the approach of seeking Tier 1 Registry volunteers, and then asking them to work together during the trial; the presence of competing interests makes this solution impractical in a commercial environment. In Ireland, the delegation was issued to ComReg (the regulator) while the Tier 1 Registry service was provided by a private company, Affilias. In Australia, AusRegistry, the contract holder for the Tier 1 Registry, has received the delegation for 1.6.e164.arpa.
- 6.6.4 Despite the potential option to re-assign the delegation, it would be administratively simpler to establish a permanent manager for the delegation - from the outset. From an economic efficiency perspective, delegation should minimise the transaction costs associated with decision making and facilitate smooth transition to commercialisation. The holder of the delegation must have the incentives and capacity to manage 4.6.e164.arpa, possess credibility and be accountable for the delegation.
- 6.6.5 The Ministry of Economic Development has expressed satisfaction with the handling of the .nz delegation by InternetNZ. Given their experience and independence, the simplest approach would be to assign delegation for 4.6.e164.arpa to InternetNZ.

Recommendation:

Assign delegation of 4.6.e164.arpa for the ENUM trial to InternetNZ.

6.7 Tier 1 Registry Requirements

- 6.7.1 A key component in the implementation and delivery of ENUM is the establishment and management of the Tier 1 e164.arpa registry. For New Zealand this would be the .4.6.e164.arpa Registry.
- 6.7.2 The trial could use either a single or multiple Tier 1 Registry Operators. The UK ENUM trial is the only one to test multiple Tier 1 Registry operators. The result was additional complexity and undesirable operational problems. The UKEG has recommended a single ENUM Tier 1 registry, but with separate, competing nameservers and ENUM registrars that may be run separately or by the same organisation.
- 6.7.3 It is recommended that there be a single Tier 1 Registry for two main reasons: First, it would be difficult to justify more than one Tier 1 Registry Operator in a New Zealand context given the size of the market; and, second, making a single entity responsible for maintaining and running the master registry of numbers provides simplicity which should enhance accuracy.
- 6.7.4 The most widely known and used Internet Registry is the DNS. Users register their computer name-to-address translation information through a reseller and registrar. The registry determines and distributes the Zone-File on a periodic basis for infrastructure support. Basic information is published in WHOIS databases for public viewing.
- 6.7.5 Under a thin registry approach, the Tier 2 Registrars or DNS (nameserver) providers would hold registrant, service and application information. The Tier 1 Registry would hold the ENUM record for each .4.6.e164.arpa domain name record including information of the registrant and PSTN number routing information.
- 6.7.6 The Tier 1 Registry would need to make agreements with Tier 2 Registrars about methods of exchanging information, provisioning, privacy of personal information and reporting on trial outcomes. This could be done through the accreditation process.
- 6.7.7 The set of specific responsibilities for the Tier 1 Registry Operator must be defined. These may include:
- a. Creating a zonefile for the 1.6.e164.arpa domain and operating a set of Tier 1 nameservers to supply DNS information



- b. Providing a directory service, such as the WHOIS service used for domain names that provides publicly readable information about a particular ENUM record.
 - c. Implementing an interface to allow Tier 2 Registrars to remotely connect to and interact with the Tier 1 Registry.
 - d. Authenticating Registrars and interfacing with them in order to perform registration related operations (eg. establishing a pointer to a nameserver holding a customer NAPTR record, transfer of ENUM domain between Registrars, deleting cancelled ENUM domains).
- 6.7.8 A set of minimum service standards needs to be defined to specify required system performance levels for the Tier 1 Registry.
- 6.7.9 The Tier 1 Registry contract should be developed to manage the potential for abuse of this monopolistic position. Note that assigning a Tier 1 Registry for the ENUM Trial does not need to imply a full implementation contract with this provider.

Recommendations:

1. Develop a functional specification for the ENUM Trial Tier 1 Registry;
2. Appoint a single Tier 1 Registry for the trial to hold the ENUM records for each .4.6.e164.arpa domain name record including information of the registrant and PSTN number routing information.

6.8 Tier 2 Provider Requirements

- 6.8.1 Tier 2 ENUM industry structure should consist of multiple Registrars and Nameserver Providers. Tier 2 Registrars would need to:
- Provide systems capable of making and receiving PSTN calls
 - Bridge PSTN -> VoIP and VoIP -> PSTN calls
 - Operate PUA registries
 - Support SIP and PSTN
- 6.8.2 For the purpose of the trial no restriction should be placed on whether Registrar services are offered individually or jointly. However, the outcome in terms of market structure should be examined to see whether sufficient competition exists.
- 6.8.3 Tier 2 Registrars will be a competitively offered service. The industry focus should therefore be placed on performance and accuracy requirements that Registrars must agree to as part of the accreditation procedure.
- 6.8.4 Registrars need to be accredited by the Tier 1 Registry. The responsibilities for Registrars would include:
- a. Registering new ENUM subscribers;

- b. Authenticating the identity of ENUM subscribers and validating their authority
- c. Interfacing with the Tier 1 Registry Operator to establish a pointer in the Registry to the Tier 2 nameserver holding the subscriber's NAPTR record;
- d. Interfacing with a Tier 2 nameserver operator to provision a subscriber's NAPTR record;
- e. Managing PUAs; and
- f. Issuing ENUM numbers to new ENUM subscribers.

6.8.5 The registration process would involve the following:

- User applies to a Registrar to participate in the ENUM trial.
- Registrar validates user in the case of existing e164 numbers; and applies to Tier 1 registry (holds UCI numbers).
- Registry approves application and supplies UCI (e.g. +64 878 xxxx xxxx).
- Registrar: creates domain, directs that special UCI number to a new or existing DDI, creates an account for the user and provides those details to the user.
- User configures ENUM or PUA entry by specifying the NAPTR records (including their order) in the ENUM. Within a PUA, users manage their contact settings including time-based and per-caller rules.

Recommendation:

Develop requirements for accreditation of Tier 2 ENUM Registrars considering the following services:

1. Registering new ENUM subscribers, authenticate their identity and issue ENUM numbers;
2. Interfacing with the Tier 1 Registry Operator to establish a pointer in the Registry to the Tier 2 nameserver holding the subscriber's NAPTR record;
3. Interfacing with a Tier 2 nameserver operator to provision a subscriber's NAPTR record.

6.9 Security and Privacy controls

6.9.1 The Irish ENUM trial classified the data security risk areas as follows:

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

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

6.9.2 The opt-in approach implies that when a user registers for ENUM, they are agreeing to place their contact data into web-based NAPTR records. The risk is



that all of the communications services associated with an individual's telephone number may be accessed by a third party.

- 6.9.3 For the Australian trial, participants will be able to decide whether to have their contact information publicly available and can choose to remove their name from their ENUM listing.
- 6.9.4 To ensure user privacy, the trial will also need to manage read access to NAPTR records (through, for example, the assignment of access rights and restrictions to read authorisation) while maintaining ENUM service functionality. In this respect:
- A code of practice for user privacy and data security (specifically relating to the handling of registrant personal information) must be developed;
 - Minimum standards for DNS need to be developed and implemented;
 - The use of WHOIS and testing of DNSSEC should be considered.
 - Tools are needed to maintain DNS zone files (containing NAPTR records) including access controls to ensure that applications only change resource records they are permitted to update.
- 6.9.5 A code of practice for how Registrars deal with registrant personal information is critical to ensure good practice and protection of user privacy. While such a code must be based on privacy laws, it should also provide a practical framework for dealing with user data and should cover all relevant aspects including WHOIS, UCI/PUA and proxy requirements, transfer rights, authentication and trust.¹⁹ This policy should be agreed to by each user as part of the registration process and by each registrar in the accreditation process.
- 6.9.6 In most trials, ENUM registries have used their own communication protocol between registry and registrar. However, the IETF PROVREG WG has published the general-purpose communication protocol between registry and registrar (General Registry Registrar Protocol RFC3375). Testing of the EPP that satisfies GRRP requirements is still required.
- 6.9.7 A number of ENUM trials have used a directory service such as WHOIS that translates telephone numbers in domain name form back to the identity of the persons or organisation using them. This service will not be used in the UK because of privacy considerations. The question is one of how much information to provide and to whom.

¹⁹ For example: This data may not be used for any other purpose other than for which it is provided, which is to facilitate one to one ENUM based communications between the registrant and a third party; This data may not be released to any third party other than with the express agreement of the registrant.



Recommendations and questions

In order to manage read access to NAPTR records while maintaining ENUM service functionality:

- A code of practice for user privacy and data security will be developed;
- Minimum standards for DNS will be developed and implemented;
- The use of WHOIS and testing of DNSSEC should be considered.
- Tools are needed to maintain DNS zone files, including access controls to ensure that applications only change resource records they are permitted to update.

Should the New Zealand ENUM trial test the EPP that satisfies GRRP RFC3375 on the communication protocol between registry and registrar?

Should a directory service such as WHOIS be provided?



7 Supporting Issues

7.1 Introduction

7.1.1 There are a number of issues which, although important, can be considered secondary in terms of trial implementation. Consideration of these matters, however, will enhance both the ENUM trial design and trial implementation. If necessary, further consultation may be undertaken on particular aspects. These include the following:

- ENUM Governance model;
- Trial participation and availability of applications for testing;
- Number portability;
- International interconnectivity.

7.1.2 This section discusses these issues and presents questions for consideration.

7.2 ENUM Governance model

7.2.1 An ENUM governance body will have primary oversight for: the ENUM system, ensuring that the codes of conduct (such as data privacy management) remain relevant to the needs of ENUM users and service providers, and the appointment process and performance of the Tier 1 Registry Provider(s).

7.2.2 To establish a governance body, a number of decisions must be made including:

- a. Determining the overarching objectives of the market for ENUM;
- b. Determining how the governing body will be structured and the roles and responsibilities of decision makers;
- c. Deciding whether the governing body will consist of independent or partisan membership or a combination of both.

7.2.3 The New Zealand government has delegated responsibility for telecommunications and Internet related activity to the private sector. Management of .nz Internet domains lies in the hands of the New Zealand Internet community (through the Internet Society of New Zealand), while the management of PSTN numbering is the hands of the telecommunications industry (through the Numbering Administration Deed, NAD).

7.2.4 The main advantages of self-governance are flexibility in developing ENUM arrangements, and the ability of market participants to assume responsibility for their own actions. Self-governance should allow for better and more timely decision making through the expertise of stakeholders, and greater incentives for competitiveness as industry participants seek to innovate and identify least cost solutions.

- 7.2.5 Self-governance models are common in mature commodity markets such as stock exchanges and security exchanges. As far as ENUM implementation, the only countries using self-governance models are the USA, UK, Japan, Korea and Germany. In the Netherlands, the DGTP has indicated openness to alternative governance options.
- 7.2.6 The challenge in self-governance is managing compliance with codes of conduct. In the absence of statutory empowerment (i.e. becoming a statutory mandated body), an ENUM governing body can establish a constitution but only on a contractual basis. When industry participants become part of an ENUM market, they bind themselves to its constitution. If the constitution refers to a set of rules or code of conduct, the members can be bound into compliance with these.²⁰
- 7.2.7 A range of decision criteria can help to define an appropriate governance structure. The governance arrangements need to:
- Provide the governing body with the **capacity** to make decisions and enforce them
 - Ensure **effectiveness** in decision-making and enforcement
 - Establish **accountability** through a clear accountability framework
 - Provide **credibility** to all stakeholders
 - Provide **transparency and clarity**.
 - Ensure that **decision making** is co-located with information and incentives. Decisions should be made by those parties with the best incentives to get the decision right and those possessing the best information relative to both the decision and market guiding principles
 - Minimise the **transaction costs** associated with decision making and enforcement.
- 7.2.8 Determining who should perform the different tasks of governance can be decided on the basis of comparative advantage in carrying out three basic tasks: specifying requirements, monitoring and measuring compliance with what has been specified, and ensuring compliance.
- 7.2.9 A market must have the capacity to evolve to continue to meet the changing needs of its stakeholders and to take advantage of new technologies as they become available. Self-governance by an industry stakeholder advisory group is necessary to minimise transaction costs, provide capacity and effectiveness in decision making, and to align information and incentives in decision making. However, a stakeholder group, by its nature, lacks credibility through its lack of independence. While an attempt can be made to establish transparent and clear processes, inherent conflicts of interest will undermine its effectiveness. Moreover, if service providers are members, the advisory group may be in the situation of needing to enforce compliance on itself. For this reason independent membership is needed to build accountability and credibility into the governance framework.

²⁰ Note that a contract can only be enforced between the contracting parties and is not usually automatically binding on third parties.



7.2.10 Options for providing independence in governance include:

- a. Structure the membership of a single governance body (5-7 members) to incorporate stakeholders, independent membership (i.e. one-third of members) and an independent Chair.
- b. Allocate responsibilities between two tiers of governance: an oversight body with independent membership (3-5 members) and a larger industry stakeholder group (7-9 members).

7.2.11 With regard to the second option, an overarching ENUM governance body would have ultimate jurisdiction to:

- Oversee the market rules;
- Service provision appointment and licensing conditions (such as for market membership, appointments to the governance body and compliance with codes of conduct).

The larger stakeholder group would be an advisory body responsible for managing issues surrounding day to day ENUM operations and would report to the ENUM governance body. Moreover, this group could be separated into different committees such as for registration and software/application development.

7.2.12 A secondary independent body provides a more robust governance framework, but at a greater cost due to the need to employ additional independent expertise, and increased administration costs from supporting two boards.

7.2.13 In terms of functional capacity, the governance body will need to be established as a legal entity such as a company. This will enable it to have direct contractual relations with the Tier 1 Registry provider and the Tier 2 Registrars based on Code of Practice guidelines.

Questions:

1. In a commercial context, with consideration of the need for independence and cost effectiveness, should ENUM governance constitute a single governance body (5-7 members) or two tiers of governance made up of an oversight body with independent membership (3-5 members) and a larger industry stakeholder group (7-9 members)?
2. When should the commercial ENUM governance body(s) be established?

7.3 The business model

7.3.1 In order to achieve a seamless transition to commercialisation, a work stream on the ENUM business model (cost and price issues) for commercialisation will be required. This should specifically address funding and contractual arrangements



for the non-competitive aspects of ENUM – the governance structure, Tier 1 Registry, and possible Authorisation Commissioner.

- 7.3.2 The Tier 1 Registry contract should be appointed to a private company that is not providing any other ENUM related telecommunication or registration service. This company would receive the delegation for 4.6.e164.arpa. The Tier 1 Registry service should include objectives similar to those for the SRS: “to derive a return on capital, adequate to ensure a (re)investment in “failsafe” technology, ownership and management platforms that will exceed or meet the service requirements of the current SRS DNS registration system in New Zealand.”
- 7.3.3 Cost recovery for governance: the commissioner and the ENUM registry can occur separately with each agency collecting its own fees, or be combined to reduce transaction costs. A combined billing approach can be implemented to set the charges for industry participants (such as registrars) in accordance with actual volume of use in terms of registry or commissioner services.
- 7.3.4 The cost of governance could be funded by an agreed levy on the ENUM wholesale fee (e.g. \$1 pa). This levy could also be set to provide funds for general ENUM application development.
- 7.3.5 The general cost of the Authorisation Commissioner could also be met through a levy, combined with part charges for individual usage.
- 7.3.6 Under a market based approach, pricing pressure can be brought to bear on Registry service provision through a contestable contracting process. A fixed term contract that must be re-won can then place an ongoing competitive pressure on the service provider. The contract price can be based on a two-part system that allows for a base level of service and performance combined with a charge per-record.

Recommendation:

Establish a work stream on the ENUM business model for commercialisation that addresses funding and contractual arrangements for the non-competitive (but contestable) aspects of ENUM – the governance structure, Tier 1 Registry, and possible Authorisation Commissioner.

7.4 Trial participation and application availability

- 7.4.1 ENUM presents a range of commercial incentives for participants in both internet and telecommunications markets such as:
- Registry providers – ENUM creates demand for larger and improved registry systems with better data management, higher registration rates and faster propagation of updates;



- DNS providers - An increased volume of NAPTR records creates a need for more DNS capability and opportunities for DNS hosting (DNS data to store and serve at Tier 1 and Tier 2 NAPTR);
- Software and Application developers: DNS software and ENUM capable applications are needed to exploit NAPTR record richness, including compatible PUA services;
- Registrar service providers - email and Web hosting companies and telcos may nominate an ENUM registrar to act on behalf of all or some of their subscribers. There is scope to package value added services through the registrar process such as web hosting and email support;
- Internet service providers – Opportunities exist for convergence/systems integration between TSPs and network operators, offering ENUM registration and personal user agent services;
- Telcos - Higher percentage of call completion, added value services that better meet consumer expectations, facilitation of transition to NGN, and the ability to offer new services (ENUM registrars) without requiring new public identities.

7.4.2 The greatest benefits of ENUM should accrue to users of the technology through:

- Providing identity control – registrants have greater control over how they wish to be contacted, based on the time of day and caller location, and access to identity security services;
- Streamlining incoming communications - Reduction in the number of user identities, registrants use one number to receive fixed and mobile phone calls, e-mail and instant messages, even if they access these services through different service providers;
- Enhanced accessibility - Internet users can communicate with a registrant via a range of services when they only know the registrant's telephone number or only have access to a telephone keypad;
- Enables individuals to attach short term Telecommunications Identities during Contracts; and
- Consolidation which will lead to price reductions over time such as reduced costs for VoIP.

7.4.3 However, the potential of ENUM to achieve benefits for users is limited by the availability of applications for testing during the trial.

7.4.4 Trials in some countries have shown that participation may be limited without availability of ENUM-based applications and services. In the UK trial participation was poor mainly due to low visibility of ENUM-based applications and services for users to try. This created a catch-22 situation whereby ENUM-capable services and applications were slow to emerge because the low number of registrations suggested demand would be low. The Korean trial experience



showed a need to have both infrastructure and services in place before commercial organisations become interested in involvement.

- 7.4.5 Availability of ENUM applications for the trial is important to allow testing of the interoperability between different applications. The questions is: How do we avoid the chicken and egg situation where users wait for ENUM applications to become available before they decide to trial ENUM services, while developers wait for user demand to increase before they develop new ENUM applications?
- 7.4.6 User participation is critical for the trial to be a success. New Zealanders are well known internationally for being early uptakers of new technology, but they must be aware of it and have access to it. An information programme to attract users will help to create the demand needed to support the emergence of ENUM-capable services and applications.
- 7.4.7 To facilitate user participation in the trial, it is important to both:
- Disseminate information on ENUM and how users can opt-in to the trial; and
 - Demonstrate how ENUM works.
- 7.4.8 On a commercial basis, the trial can be self-promoted by InternetNZ, Tier 2 registrars and software developers who can implement PUAs both for ENUM and current telco number services. Trial registration fees could be offset when Registrars transfer to commercial terms and conditions.
- 7.4.9 Public demonstrations could be organised in conjunction with:
- Regional organisations such as Chambers of Commerce and Rotary, to inform the business community;
 - Universities to promote ENUM to students;
 - The Ministry of Economic Development to promote the use of ENUM across government;
 - The ICANN meeting to be held in Wellington, March 2006 to promote ENUM to integrators and ASPs.

Recommendation:

Arrange public demonstrations of ENUM to inform the business community, students, government and ICANN.

7.5 Number portability

- 7.5.1 Number portability enables customers to keep their existing telephone number when changing their local or mobile access and calling supplier.
- 7.5.2 The purpose of ENUM is not to provide number portability. However, it does provide a potential solution to the issue because of the ability to link a range of communication addresses to one ENUM number.



- 7.5.3 In New Zealand, both local and cellular telephone number portability are regulated under the Telecommunications Act 2001. To be used as a vehicle for number portability, ENUM would need to be deployed in a way that is consistent with national requirements for number portability.
- 7.5.4 The NZ Commerce Commission is currently considering two applications on the implementation of number portability submitted by the Telecommunications industry that deal with: first, the functions and standards necessary to provide number portability; and, second, allocating the cost of delivering a number portability service between the access seekers and access providers. Telephone service providers will be required to comply with the final decision of the Commission on industry processes and procedures regardless of the underlying technology used for service delivery.
- 7.5.5 Number portability of geographic numbers in New Zealand may be implemented later this year. The Telecommunications Carriers Forum has set a deadline of April 2007 to implement a mobile number portability solution, but they are trying to bring this date forward.

Recommendation:

While recognising that the purpose of ENUM is not to provide number portability, deployment of ENUM should be consistent with regulations for number portability.

7.6 Inter-connectivity

- 7.6.1 A useful issue to consider from the outset is how a New Zealand ENUM would plug into ENUM in other countries.
- 7.6.2 The Irish ENUM decided to test all DNS architecture through testing the interfunctionalities between different Tier 1 registries. A partnership with Austria was facilitated for this purpose.
- 7.6.3 A strategic decision for New Zealand is whether to seek some form of cooperation with other countries trialling ENUM. The option for physical interconnectivity is likely to be limited to the trials due to be in progress during late 2005 which include China, Japan and Australia.
- 7.6.4 An alternative and simpler option is to test for interconnectivity through information sharing relating to software, policy, process and security threats, and system comparison for DNS compatibility and WHOIS type features.

Recommendation:

Inter-connectivity with other jurisdictions should be considered through information sharing and system comparison for DNS compatibility.



8 Appendix 1: Definitions

ACA	Australian Communications Authority
API	Application Programming Interface
ASP	Application Service Provider
ccTLD	Country-coded Top Level Domains
CRISP	Cross Registry Information Sharing Protocol
DHCP	Dynamic Host Configuration Protocol
DNC	Domain Name Commissioner, http://www.dnc.org.nz/
DNS	Domain Name System
DNSSEC	DNS Security Extensions
E164(05/97)	The international public telecommunication numbering plan http://www.itu.int/rec/recommendation .
ENUM	electronic numbering system
EPP	Extensible Provisioning Protocol
ETSI	European Telecommunications Standards Institute. An independent, not-for profit organisation that is officially responsible for standardisation of Information and Communication Technologies (ICT) within Europe. http://www.etsi.org/
GRRP	General Registry Registrar Protocol
IAB	Internet Architecture Board. Has oversight of the IETF. http://www.iab.net/
IETF	Internet Engineering Task Force. http://www.ietf.org/
IP	Internet Protocol
ISP	Internet Service Provider
ITAC	International Telecommunications Advisory Council http://www.state.gov/e/eb/adcom/c668.htm
ITU	International Telecommunications Union. http://www.itu.int/
NAD	Numbering Administration Deed
NAPTR	Naming Authority Pointer. This is a relatively new DNS facility that allows a whole set of information to be associated with a single domain name.
NIDA	http://www.nic.or.kr/center/english.htm
NZRS	.nz Registry Services. Trading name of InternetNZ.



PROVREG	Provisioning Registry Protocol
PSTN	Public Switching Telecommunications Network
PUA	Personal user agent
RIPE NCC	Réseaux IP Européens Network Coordination Centre, located in the Netherlands. Responsible for technical management of e164.arpa. http://www.ripe.net/
SIP	Session Initiation Protocol. This is used to initiate, modify and terminate interactive communications sessions between users. With ENUM, SIP can be used to initiate attempts to multiple locations to find the user receiving the call.
SRS	Shared Registry System
TSB	Telecommunications Standardisation Bureau
TSP	Telecommunication Service Provider
VoIP	Voice over Internet Protocol
VPIM	Voice Protocol for Internet Mail
UCI	Universal Communications Identifier
URI	Universal Resource Identifier



9 Appendix 2: International Telecommunications Union

9.1 Purpose of the International Telecommunications Union (ITU)

9.1.1 The ITU was established to be an impartial, international organisation that coordinates the efforts of governments and the private sector in the operation of telecommunication networks and services, and in advancing the development of communications technology.

9.2 Telecommunications Standardisation Sector

9.2.1 The Telecommunications Standardisation Sector (ITU-T) of ITU produces standards on technical, operating and tariff issues. These standards are non-binding, but are widely used because they guarantee interconnectivity and interoperability of networks and enable telecommunication services to be provided worldwide. ITU-T study group 2 is responsible for service definition, numbering and routing issues including ENUM.

9.2.2 ENUM defines a method for entering E164 country codes into the Internet Domain Name System. To facilitate ENUM trials, ITU-T study group 2 has approved interim administrative procedures for delegating the national ENUM domains from Tier 0 (e164.arpa managed by RIPE NCC) to Tier 1 (a national Registry, eg. .4.6.e164.arpa).²¹ Member States must specifically opt-in for their E164 country code resources to be placed in DNS. All delegations are approved by the Telecommunications Standardisation Bureau (TSB).²²

9.2.3 The ITU-T has also developed *Recommendation E164 Supplement 3 (05/04)* which is available at <http://www.itu.int/rec/recommendation>. This Supplement “provides background, tutorial and guidance information on a broad range of operational and administrative issues associated with the inclusion of E164 numbers into DNS.”

9.2.4 Work by ITU-T continues on the following issues:

- Draft Recommendation E.A-ENUM is being prepared by Study Group 2 for approval around May 2005. This deals with the process and procedures for delegation of E164 country codes;
- Cooperation with IAB and IETF to make a final choice for the top level domain registry (currently e164.arpa), and requirements for registry operations; and
- Interim administration.

²¹ Recommendation E164 Supplement 3 (05/04).

²² These procedures were approved on 24 February 2005 by ITU-T Study Group 2. Online: <http://www.itu.int/ITU-T/inr/enum/procedures.html>. Accessed 25 March 2005.



- 9.2.5 Note that the IETF Network working group has been developing a protocol for Extensible Provisioning Protocol (EPP). The EPP is a mechanism for the provisioning and management of E164 numbers stored in a shared central repository. Information exchanged via this mapping can be extracted from the repository and used to publish DNS resource records as described in ENUM.



10 Appendix 3: ENUM Trial summaries

10.1 Introduction

10.1.1 This appendix provides brief summaries of ENUM trials undertaken or planned as of May 2005. The trials are ordered according to date of trial implementation.

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10.2 ENUM Progress Matrix, May 2005

10.2.1 The chart below records the status of use of the e164.arpa numbering code for ENUM trial purposes. The source of e164.arpa delegations shown here is RIPE NCC (<http://www.ripe.net/ripe/wg/enum/index.html>).

Country	E164	Status	Details
Austria	43	production	User ENUM
Poland	48	production	User ENUM
Romania	40	production	Operator ENUM based on private networks
Trialling			
China	86	trial	Trial to complete in 2005.
Finland	358	trial	Trial due to complete in June 2005.
France	33	trial	Trial completed September 2004.
Germany	49	trial	Underway
Ireland	353	trial	Trial completed March 2005.
Japan	81	trial	Trial due to complete 30 September 2005.
Sweden	46	trial	Trial completed June 2004
VISIONng	87810	trial	
Implementing			
United Kingdom	44		Implementation due 2005 - 2006
Delegated			
Antarctica Mobile	88234	delegated	
Armenia	374	delegated	
Ascension Is.	247	delegated	
Australia	61	delegated	Trial due to start in June 2005.
Brazil	55	delegated	
Czech Republic	420	delegated	
Diego Garcia	246	delegated	
Hungary	36	delegated	
Liechtenstein	423	delegated	
Singapore	65	delegated	
Slovak Republic	421	delegated	
St Helena	290	delegated	
Switzerland	41	delegated	
The Netherlands	31	delegated	
United Arab Emirates	971	delegated	



1 Austria¹

1.1 Introduction

- 1.1.1 In August 2001 the Austrian domain name regulator, RTR GmbH, began looking at the possibilities of ENUM and launched a formal consultation process. A working party established in February 2002 associated the main interested parties.
- 1.1.2 The trial began in November 2002 following publication of a policy framework. Operational deployment of ENUM began in December 2004.
- 1.1.3 The .at domain is managed by enum.at, a wholly owned subsidiary of the Internet Foundation Austria (IPA).
- 1.1.4 As the international dialling code for Austria is +43, the domain for Austrian ENUM trials is .3.4.e164.arpa.

1.2 Trial Framework

- 1.2.1 Membership in the Austrian ENUM trial was open to any “organisation, company or entity having an interest in the activities of the Austrian ENUM trial platform”. The founding members were a mixture of regulatory authorities, TSPs and ISPs.
- 1.2.2 RTR provided the administrative and technical policy framework for the trial.
- 1.2.3 The types of telephone numbers used for the trial included: geographical numbers, numbers for private networks (+43 5xxxx), mobile numbers (+43 6xx), location-independent fixed network numbers (+43 720), numbers for converged services (ENUM enabled) (+43 780) and free-phone numbers (+43 800).

1.3 Trial objectives

- 1.3.1 The general objectives of the ENUM trial were: first, to gain an understanding of the technology and gauge its potential to provide new products and services to consumers; and, second, to assess the economics of implementing ENUM.
- 1.3.2 More specific objectives included:
 - Establishing a basic DNS infrastructure that could hold the NAPTR records of ENUM users;
 - Establishing a user interface capable of adding, deleting and modifying NAPTR records in Tier 2 name servers.
 - Providing ENUM clients to users on the Internet so they can query the database and process NAPTR records.

¹ Richard Stastny, Introduction to ENUM, version 1.0, Austrian ENUM Trial Platform – Principles and Procedures; www.enum.nic.at



- Testing the ENUM service by using clients, and test the ENUM user interface for modifying NAPTR records.

1.4 Current status

- 1.4.1 The commercial phase of ENUM in Austria was launched on 9 December 2004. This was facilitated by an agreement between RTR-GmbH and enum.at for the operation of the Austrian ENUM Domain (3.4.e164.arpa). The operation of the Austrian ENUM Domain is delegated to enum.at until the end of 2007 under the policy framework defined by RTR-GmbH for the use of ENUM in Austria. Cost recovery for the Tier 1 registry's operations is through monthly fees for Registrars (approx. 0.25 - 0.5 Euro/Month/Domain).
- 1.4.2 During registration, the validation process verifies whether the ENUM domain user is identical with the user of the telephone number. A revalidation is performed by the registrar at regular intervals (e.g. every 6 months) in order to confirm that the call number of the relevant domain is still assigned to the user.
- 1.4.3 All domains used during the trial will be automatically revoked and not migrated to the commercial ENUM service. Users who wish to continue using their domains from the trial have to re-register under the new terms and conditions.
- 1.4.4 A new number range +43 780 has been created by RTR GmbH, particularly for use in connection with VoIP and ENUM. Registration of ENUM domains / call numbers within the 780 range started on 17 May 2005. The delegation of the corresponding ENUM domain is a requirement for assigning numbers in the 780 range. No telephone services are required in the 780 number range, but at least one convergent service must be offered.



2 Poland²

2.1 Introduction

- 2.1.1 In Poland ENUM has been driven by NASK, the Polish national registry, and the Office of Telecommunications and Post Regulation (URTIP, www.URTiP.gov.pl).
- 2.1.2 In July 2002, NASK applied and received the delegation for a Polish ENUM trial. The ENUM trial started that month. During the trial NASK undertook consultations with the National Radiocommunications Agency (NRA) and TSPs.
- 2.1.3 The trial ended in May 2004 and full commercial ENUM operation commenced. As the international dialling code for Poland is +48, the domain for Polish ENUM trials is .8.4.e164.arpa.

2.2 Framework

- 2.2.1 Only valid E164 numbers assigned by Office of Telecommunications and Post Regulation (URTIP) can be registered. There is no special ENUM number block.
- 2.2.2 There are no direct registrations in the Polish ENUM system; Rather they take place via telecom operators that are approved by the regulator (TSPs). The operators are not allowed to register numbers administered by other operators.
- 2.2.3 NASK does not verify if the applicant has a right to a number; it is merely responsible for the mapping. The basis for this approach is that if a TSP provides false data it is subject to prosecution under the Telecommunication Act.
- 2.2.4 NASK uses an EPP adaptation for ENUM.

2.3 Trial objectives

- 2.3.1 Little information regarding the ENUM trial objectives is available. The main intention was to check that it worked. There was a commitment to putting the system into production once it was ready.

2.4 Current status

- 2.4.1 As stated in the introduction, the system is now in production. Cost recovery for the Tier 1 registry's operations is through an annual fee per registered number/year (ca. 2 - 5 EUR).

² Andrzej Bartosiewicz, ENUM in Poland, CENTR Technical Workshop, February 2005; Andrzej Bartosiewicz, ENUM project in Poland, ETSI ENUM Workshop; Andrzej Bartosiewicz, ENUM Background; www.nask.pl



3 Netherlands³

3.1 Introduction

- 3.1.1 Following a public forum held in 2000, a working group called the Dutch ENUM Group (NELG) was set up in October 2001 to oversee ENUM progress in the Netherlands. It is chaired by a representative of the Directorate-General for Telecommunications and Post (DGTP), a department of the Ministry of Economic Affairs.
- 3.1.2 Participation in the group was on a voluntary basis and included representatives of Internet user groups, telecom providers, Internet providers, DNS experts of other countries, and the .nl registry.
- 3.1.3 The group reported back in December 2002 on the feasibility of ENUM, concluding that ENUM had a great deal of potential and should be looked at seriously. It proposed that a field trial be set up to “test the model, the assumptions and market interest”.
- 3.1.4 As the international dialling code for the Netherlands is +31, the domain for Dutch ENUM trials is .1.3.e164.arpa.

3.2 Trial Framework

- 3.2.1 When the NELG reported back on ENUM in December 2002, it made a number of recommendations. These were translated into a set of principles, which are paraphrased from the report as follows:
- Any person who is registered for ENUM must have opted in;
 - Anyone who registers must confirm his or her identity;
 - Verification is required that any application is being made on behalf of the registering party;
 - A check must be made that the telephone number registered is actually in use;
 - If access information is inputted into the NAPTR records or modified, a check is required that it is on behalf of the registering party;
 - Anyone who inputs the NAPTR records must have authorisation to use the access information;
 - If anyone inputs NAPTR records without authorisation, registration of the telephone number will be cancelled;
 - If use of a telephone number ends, the number must be removed from ENUM;
 - If a user no longer uses a telephone number, the holder of the number is authorised to have it deleted from ENUM;

³ ENUM in the Netherlands, A report by the Dutch ENUM group (NLEG), December 2002; ENUM trial, Implementation and Results, ENUM Workshop, February 2004; www.enumnederland.nl



- The Government should not manage ENUM and its operational aspects; the market should;
 - The Government should investigate how the management of ENUM should be delegated; and
 - A trial of ENUM should be started if there is sufficient interest.
- 3.2.2 The NLEG identified a framework in which the participants were international organisations (IAB, RIPE, and ITU), registrant, registry, government and number holders.
- 3.2.3 The Dutch Government has very different involvement with regard to the Internet and telephony market. However, it considers the telephony aspect of ENUM to be the most important. Given its present responsibilities in the area – it is responsible for number allocation – it has an important role to play in ENUM. The DGTP has on that basis applied for the delegation of the Dutch ENUM zone. However it is still open to alternative ways of managing ENUM.
- 3.2.4 The trial framework included a single, independent registry which could charge at cost for its services. It was responsible for recording the reference of how a telephone number is expressed to an IP address but did not have access to NAPTR records. Such information was provided by registrars.
- 3.2.5 The registrars are akin to Internet service providers. They were charged with passing on the required information to the registry, carrying out the required information checks and deleting parties that do not obey by the rules.
- 3.2.6 The registrants were required to go through the registrars to establish ENUM links.
- 3.2.7 The December 2002 report formed the basis of a consultation exercise. Market players were invited to submit their views on ENUM and whether they wanted to participate in a field trial.
- 3.2.8 The ENUM trial eventually began in May 2003, lasting until December 2003.

3.3 Trial objectives

- 3.3.1 The overriding principles of the trial were to test the effectiveness and feasibility of ENUM, and to gauge market interest. Put in practical terms, this meant assessing whether the model under consideration was valid and whether sufficient services would be offered through ENUM to make the project viable.
- 3.3.2 It was considered essential to meet the recommended principles (outlined above), particularly the setting out of the rights and responsibilities of parties.
- 3.3.3 Factors that would indicate the likely market success of ENUM were as follows:
- The level of interest in the registrar role;



- The number of registrants registered in the trial period;
- The level of usage made of ENUM;
- The one-off and recurring costs of ENUM; and
- The number of commercial services being developed.

3.4 Current status

3.4.1 The trial began in May 2003, lasting eight months until December 2003.

3.4.2 The main conclusions were:

- All testers were enthusiastic about ENUM;
- ENUM was easy to integrate in the current telecommunications environment;
- New services were offered; and
- A valid business model with recurring revenues was possible.



4 France⁴

4.1 Introduction

- 4.1.1 In May 2001 DiGITIP, a directorate of the Ministry of Finance, and ART, the French telecommunications regulatory authority, formed a working party to look at ENUM.
- 4.1.2 In February 2002 the working group suggested that a trial should take place and called for proposals. In May the Numerobis proposal was accepted, with the trial scheduled to begin in February 2003, lasting until September 2004.
- 4.1.3 A report detailing the results of the trial was presented in October 2004. Indications are that the trial was a success.
- 4.1.4 As the international dialling code for France is +33, the domain for French ENUM trials is .3.3.e164.arpa.

4.2 Trial Framework

- 4.2.1 The key participants in the French ENUM trial were:
 - RNRT, the National Telecommunication Research Network – a government funded research group;
 - AFNIC, the French Internet domain names registry;
 - INT, a higher learning institute;
 - France Telecom, Orange, and SFR: all telecommunications companies and Internet service providers.
- 4.2.2 The trial was carried out in four stages, some of which ran concurrently.
- 4.2.3 The first stage consisted of assessing the future potential applications of ENUM. A number of possible services were identified, for example messaging services and telephone conversations. This analysis was complemented by a more general list of requirements for the technology for each tier. This stage took five months.
- 4.2.4 The second stage involved looking at different DNS servers, and in particular, assessing the inquiry times and possible load factors. This stage ran for 12 months.
- 4.2.5 The third stage (concurrent with the second stage) involved looking at DNSSEC protocol to see if its extensions could be deployed on DNS architecture.

⁴ Communication finale sur le projet RNRT Numérobis, 26 octobre 2004; Rapport de synthèse projet RNRT Numérobis, Expérimentation française sur la mise en oeuvre du USER ENUM, octobre 2004; Sophie Coste-Martinez, ENUM Trial in France, February 2004; www.numerobis.fr



4.2.6 The fourth stage was ENUM experimentation itself which ran concurrently with other testing.

4.2.7 Finally, there was an assessment period that took two months at the conclusion of the trial.

4.3 Trial objectives

4.3.1 The objectives of the working group were to:

- Ensure compatibility with the national numbering system at the Tier 2 level;
- Ensure competition between ISPs;
- Ensure that ENUM was an ‘opt-in’ facility;
- Avoid commercialisation of ENUM domain names;
- Ensure that number portability was compatible with ENUM.

4.3.2 The Tier 2 objectives were to:

- Ensure that the delegation model followed the attribution model of E164 numbers;
- Ensure that number portability was maintained.

4.3.3 Respect for privacy was an overriding principle of the trial.

4.4 Current status

4.4.1 Numerobis concluded that the results were very encouraging. However, it thought that DNSSEC had not had sufficient time to prove itself. Positive results included:

- ENUM did not add much traffic to the existing infrastructure; the response time for ENUM connections was adequate with present technology.
- DNS structure allows a flexible division of technical responsibilities given the demands of the administration working group.
- There are no technical barriers to a successful implementation of ENUM.
- Working scenarios were satisfactory on an experimental level.

4.4.2 In summary, the ENUM trial has resulted in:

- An account of the state of ENUM technology, DNS, and other solutions;
- A number of functional and technical choices being made available;
- An architecture proposal that was compatible with existing telecommunication rules and regulations;
- Supplementary questions that the appropriate juridical and regulatory authorities may now consider; and
- A multi-level experimental model.



5 Sweden⁵

5.1 Introduction

- 5.1.1 In Sweden the National Post and Telecom Agency (PTS) is overseeing the ENUM implementation process.⁶
- 5.1.2 The Government requested in 2001 that PTS begin to investigate the introduction of ENUM to Sweden. The work began in 2002, with three working groups set up to prepare for trials. The working groups reported back between September and November of 2002. The trials began shortly afterwards.
- 5.1.3 The ENUM trial was planned to last from December 2002 until June 2003, but it was subsequently extended, until June 2004.
- 5.1.4 As the international dialling code for Sweden is +46, the domain for Swedish ENUM trials is .6.4.e164.arpa.

5.2 Framework

- 5.2.1 The three working groups that were set up to prepare for trials were as follows:
- ENUM-1 (Applications) was tasked with investigating which applications based on ENUM should be part of the trial;
 - ENUM-2 (ENUM domain names and customer process) was tasked with studying the registration and customer process for ENUM subscribers; analysing the remuneration principles between market participants; and evaluating who should act as the ENUM registrar or nameserver provider;
 - ENUM-4 (Infrastructure and ITU TSB delegation) had the responsibility of looking at the requirements of a common infrastructure for ENUM on a country code level and developing guidelines regarding the delegation of the .6.4e164.arpa domain.
- 5.2.2 Originally a working group – ENUM-3 – was to look at personal integrity issues. Instead this issue was examined via submissions from interested parties.

⁵ Joakim Strålmarm, A Regulator Perspective on ENUM, RIPE 47 Meeting, January 2004; ENUM4, Description of DNS infrastructure for the Swedish ENUM trial, November 2002; ENUM – Slutrapport, Summary, December 2004, PTS; Staffan Hagnell, The Swedish ENUM trial, experience and remaining questions, February 2004, NIC-SE; ENUM1 and ENUM2, the promise of ENUM, applications and consequences, November 2002; ENUM Test framework for ENUM trials in Sweden, June 2002; www.enum.autonomica.se

⁶ IIS-Stiftelsen (<http://www.iis.se/meta/english.shtml>), the Internet Infrastructure foundation, is a private foundation responsible for the management of the .se domain. The day to day administration of the .se domain is managed by IIS's subsidiary NIC-SE.



- 5.2.3 NIC-SE, the Network Information Centre Sweden, ran the Tier-1 registry during the trial. The PTS delegated this role to the NIC-SE.
- 5.2.4 The Tier-2 registrar of nameservers and database was run in conjunction between a traditional TSP and some IP-telephone operators.
- 5.2.5 The registered TSP was in charge of the Tier-1 validation.
- 5.2.6 The trial used both Geographic E.164 numbers and non-geographic E.164 numbers (e.g. mobile numbers).

5.3 Trial objectives

- 5.3.1 There were two main objectives of the Swedish ENUM trials: to provide guidance to PTS and to allow the Swedish telecommunications sector an opportunity to gain experience in the use of ENUM.
- 5.3.2 The overriding goal is to investigate the utility of ENUM-based applications in the Swedish telecommunications market in order to make a recommendation on the use of ENUM in Sweden.
- 5.3.3 The first objective – “Provide PTS with guidance on the applicability and usefulness of the ENUM based applications for end-users and other players in the Swedish telecom and Internet market” – was broken down into a requirement to handle the following problems:
 - Developing solutions for the administrative and technical roles and responsibilities for ENUM;
 - Developing a framework for handling end-user data in the customer process;
 - Resolving the question of remuneration between entities involved in ENUM; and
 - Answering questions concerning protection of privacy and processing of personal data and competition aspects of ENUM.
- 5.3.4 The second objective – to “Give the Swedish telecommunications market an opportunity to gain experience in the use of ENUM” – is broken down as follows:
 - **SIP/PSTN basic call:** test the interoperability between different implementations of ENUM and investigate the performance impact of the domain name system (DNS) on call routing;
 - **Non-telephony applications:** investigate the interaction between different applications with respect to DNS and test interoperability of messaging and directory applications;
 - **ENUM subscriber identification:** find a solution to the problem of subscriber identification for the trial period and for permanent operation with an emphasis on ENUM registers;



- **Notification:** Find a mechanism for TIER-1 notification upon subscriber cancellation;
- **E164 ENUM Life Cycle:** Describe the ENUM life cycle of a subscriber/e164 domain and create mechanisms needed for permanent operation. Identify any entities beyond the TSP, TIER-1 and ENUM registrars;
- **Message passing:** Implement a framework for message passing between ENUM entities;
- **TSP opt-in:** Investigate the implications of TSPs not participating in ENUM;
- **Registrar requirement:** Document all requirements placed on ENUM registrars by TSPs and TIER-1;
- **Cost recovery and financing:** Document possible business models and monetary streams;
- **TIER-1 zone operations:** Document operational procedures for the TIER-1 zone including the use of slave servers and internal delegation;
- **DNS Sec:** Investigate the implications of using DNS Sec in the 6.4.e164.arpa domain. Document operational requirements placed on all affected ENUM entities; and
- **CNAME vs NS:** Investigate the relative merits of using CNAME or NS as the mechanism for TIER-1 to TIER-2 reference.

5.4 Current status

- 5.4.1 After a successful trial, which lasted until June 2003, the trial was extended for a further 12 months.
- 5.4.2 The PTS reported to the Government in December of 2004. It concluded that a permanent introduction of ENUM would facilitate technological development in electronic communications for the eventual benefit of end-users. It recommended that:
- The Government act to ensure ENUM be permanently introduced to Sweden;
 - Some group be given the responsibility for the code domain .6.4.e164.arpa, its preference being that the Government administer it via the Ministry of Industry, Employment and Communications;
 - The Government be responsible for the organisational framework of ENUM, with PTS having a supervisory role;
 - The Government appoint a registry for the technical responsibility of .6.4.e164.arpa with safeguards in place to ensure this position is not abused;
 - No new legislation is needed as current competition regulations are sufficient to regulate ENUM; and
 - Self-regulation by the telecommunications sector will safeguard personal integrity.



6 South Korea

6.1 Introduction

- 6.1.1 ENUM activities in Korea are managed by NIDA (National Internet Development Agency of Korea), a non-profit organisation. NIDA was founded in 1999 with the aim of building a stable Internet address management system. It is mandated to encourage Internet use by developing and providing various Internet-related services.
- 6.1.2 The Korea Network Information Centre (KRNIC) is the sub-organisation of NIDA responsible for allocation and assignment of domestic IP addresses and registration of .kr domains.
- 6.1.3 An ENUM Trial test was undertaken by NIDA between March and June 2003. Subsequently an ENUM Trial was held from 13 October 2003 to 9 January 2004 to determine the requirements for ENUM implementation. An extended commercial trial service was undertaken in 2004 and South Korea is now preparing to offer a commercial ENUM service in 2005.
- 6.1.4 The Korean ENUM Service Council was established in September 2003 with membership including MIC (Government), KRNIC; Dacom, Hanaro, KT (Wired Telco.); KTF, LGT, SKT (Mobile Telco.); Saerom, Yahoo KR, KThitel (TSB. Exceptional Telcos). The goals of the Council are to deal with Joint Promotion, Privacy Guidelines, Delegation of the National Code, Tier 1 Registry Selection, System and Service, Extension and Standardisation Works. Future work is planned on the Profit Model Setup and Commercial Service.
- 6.1.5 Work is being undertaken on national ENUM standardisation issues in two areas:
- The URI Standardisation Forum was established in 2001 and its ENUM Trial Working Group started in 2003. It will consider the next step of ENUM Trial Service and affiliations with major Telecommunications companies in Korea.
 - The TTA TC02 (Telecommunication Network Technical Committee) established the ENUM Task Force Team in 2002 to follow up international ENUM standardisation activities and standardisation for the national application of ENUM. It is currently developing specifications for ENUM implementation based on the trial results in Korea.

6.2 Trial Framework

- 6.2.1 The Korean ENUM Trial System was composed of the following elements:
- ENUM API: A client program required in accessing ENUM. This was Based on Windows (98/ME/2000/XP), IE Tool Bar and IE Built-in ENUM number direct fill-in, Service array and connection
 - The Telephony System is IP-PSTN Connection Telephony Service Based on SIP Technology



- DNS: ENUM Tier 1 / 2, Dynamic Update from Registration System
- Web-based Registration
- Both Telephone Number and Mobile Number can be used for ENUM Numbers (due to the high proportion of mobile phone subscribers).⁷

6.2.2 The ENUM pilot test was held in 2003. This involved users downloading an ENUM program from www.enum.or.kr, and inserting a phone number (mobile or fixed) registered on the ENUM home page in the program. The contact information including e-mail address, phone number and home page of the relevant number was displayed and the user could select one of these for use.

6.3 Trial Objectives

6.3.1 The Korean ENUM Trial objectives were to examine the technical availability of ENUM through VoIP, IE application, and NAPTR DNS techniques and to inform the public on ENUM.

6.3.2 The budget of approximately USD\$300,000 was funded by the Korean Government (MIC).

6.3.3 ENUM Trial Usage Statistics were recorded during the trial period from Oct 13th 2003 to Jan 9th 2004 (87 days):

- ENUM Registration: 1,495
- ENUM Telephony Service Use: 14,697
- PC to PC (IP Phone): 5,117
- PC to Mobile: 8,022
- PC to PSTN: 1,558
- Total ENUM Web Visitors: 181,734 (Oct: 37,861, Nov: 70,625, Dec: 73,248)

6.3.4 A survey of ENUM Service Users showed demand for an Extended Trial and System Modification. The Korean experience showed a need to have the infrastructure and services in place before commercial organisations become interested in involvement.

6.4 Current status

6.4.1 The Korean Council is currently considering the following questions in relation to ENUM development:

- a. What is the business model for ENUM? Many Telecommunications Service Providers in Korea are wondering why other countries are continuing to work on ENUM implementation.

⁷ South Korea has significantly more mobile phone users than wire subscribers; There are 23,000,000 (41%) wire telephone subscribers compared with 33,000,000 (59%) mobile phone subscribers.



- b. What is ENUM's affect on Telecommunication Policy? What is the relationship between ENUM and VoIP? The MIC (Government) is wondering whether ENUM is above the VoIP or under it.
 - c. Why does ENUM attract users? Is it as attractive to users as a domain name?
- 6.4.2 South Korea is preparing to offer a commercial ENUM service in 2005. Next steps involve resolving both policy and technical issues.
- 6.4.3 Policy issues include: ASP requirements for Tiers 1 and 2, regulations for ENUM Service, authentication and authorisation requirements, and business model development.
- 6.4.4 Technical issues to be resolved include: System Interoperation, System Extension, Verification/Authentication, Fax, H.323 VoIP, and Telephone embedded ENUM.



7 United Kingdom

7.1 Introduction

- 7.1.1 Discussion on the implementation of ENUM in the UK began in 2001 between: the UK ENUM Group (UKEG) an ad-hoc industry body, the department of Trade and Industry (DTI), and the telco regulator (Ofcom). DTI provides oversight in the interests of ensuring openness and neutrality in ENUM arrangements and consumer protection; Its preference is for a self-regulating model.⁸
- 7.1.2 The UKEG produced a report recommending an approach to implementing ENUM. On the basis of this DTI held an industry seminar on ENUM in 2002. The ENUM Trial Group (UKETG) was subsequently established in September 2002 to test implementation aspects of ENUM in the UK.⁹
- 7.1.3 The work of UKETG was broken down into specific components of an ENUM system and members chose to work on each of these components. In the collaborative approach adopted, members agreed to work on the basis of consensus: lack of sustained reasonable objection.
- 7.1.4 The UK ENUM trial operated from December 2002 until December 2003 and incorporated a number of industry participants. Its purpose was to identify the advantages and disadvantages of the approach to ENUM suggested in the UKEG report.
- 7.1.5 The trial used a complex structure of operation with multiple Tier 1 providers and there were issues concerning uptake. Experience gained in the trial has informed UKEG about various technical and policy matters concerning implementation of a commercial ENUM system in the UK.

7.2 Trial Framework

- 7.2.1 The UKETG Chair had obtained the delegation for 4.4.e164.arpa on behalf of the DTI. The UK ENUM trial experimented with having multiple tier 1 registries. With no central database for telephone numbers in the UK (each Telco has its own) there were three companies in a position to act as the Tier 1 Registry. A meta-registry was provided by the UKETG chair to delegate sections of 4.4.e164.arpa to each of the three operators.
- 7.2.2 The UK trial involved the following functions and parties:

⁸ DTI's ENUM consultation August – November 2004. Presentation by Simon Hicks, DTI, Sept 2004. Available online: http://www.dti.gov.uk/industry_files/other/DTI_ENUM_presentation_sep_04.ppt#3

⁹ UK ENUM Trial Group (UKETG) Status Report on the Trial Implementation of ENUM in the UK. May 2004, Issue 1.1. Available online: <http://www.ukenumgroup.org/pdf/UKETGReportFinal.pdf>. Accessed 28 March 2005.



- 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).

7.2.3 The **Tier 1 Registries** provide the ENUM delegation required to activate an ENUM record. The Registry must be confident that the registration process has been satisfactorily followed prior to enabling the delegation. This can be achieved in a range of ways including accreditation of participating entities and/or checking and sending of security tokens. The registry platform consisted of the following components:

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

7.2.4 The **Tier 2 Registrar** collects all information relevant to the registration of the ENUM and organises the registration. If the Registrar collects a payment from the end user before attempting to validate the registration, this information could be used by the Authentication Agency in identifying the user. In many situations Registrars are likely to also offer DNS services.

7.2.5 The **Authentication agency (AA)** is ultimately responsible for the identification and validation of the Registrant. Each AA could choose to authenticate: only Directory Enquiries (DQ) numbers; certain TSP numbers (to which they are affiliated), or a combination. All AAs were permitted to choose which Registrars to work with and set their own commercial terms.

7.2.6 **DNS Provider** is responsible for providing an infrastructure of name servers to provide a DNS service for the end-user’s ENUM zone or zones.

7.2.7 **Application Service Provider(s) (ASPs)** provide end user functionality based on the ENUM platform and data inserted within the ENUM zone file. ASPs may act as a reseller of Registrar services that are provided by third parties or may be the users’ incumbent ISP or TSP.

7.2.8 The Top Level process for registration procedures and interactions was as follows:

- a. **Information Collection:** The Registrant selects a Registrar and requests them to register a new ENUM domain name. The Registrar collects information to be passed to the AA to validate the user such as the name of the user’s TSP, any relevant customer numbers and or supporting information, and the details of the Registrant’s DNS provider.
- b. **Validation Information Collection:** The AA is responsible for providing a secure interface to the end user via the Registrar where needed to permit the

collection of information that may be commercially sensitive such as TSP account number.

- c. **Identification (Preliminary):** The Registrar attempts to identify the user, preferably using an automated process such as making a charge to a credit or debit card registered by the user at the Telephone number service address.
- d. **Authentication (Identification & Validation):** The Registrar forwards all relevant information to the AA which initiates a request that the AA authenticate the registration attempt. The AA validates the request via either a participating TSP or the secondary process if appropriate. If successful, the AA informs the Registrar to continue with the registration and passes an authentication token. The AA may request additional supporting information from the Registrar at any time. (The UKETG agreed that TSP participation is the preferred mechanism of ENUM authentication because it provides the maximum level of trust in the registration. AAs are compelled to use this interface which means that safeguards are required with regard to the TSP interface to avoid the potential of abuse. A process is required in order to classify a TSP as participating. A TSP may run its own AA and/or Registrar).
- e. **Zone Creation:** The Registrar notifies the chosen DNS provider to create a zone file associated to the new ENUM domain name.
- f. **Registry Submission:** The Registrar passes all required information for registration and zone delegation to the Registry including the relevant AA authentication token.
- g. **Registry Insertion:** The Tier 1 Registry processes the request, creates the zone delegation and returns a notification of the registration and delegation to the Registrar.
- h. **Registrant Notification:** The Registrar informs the Registrant about the results of the ENUM domain name registration.

7.2.9 To meet privacy and security considerations, a token must be devised to ensure secure communications between the Registrant, Registrar, AA and TSP without revealing sensitive data to those parties that do not explicitly require this.

7.3 Trial objectives

7.3.1 The objectives of the UK ENUM trial are as follows:

- a. To produce interim and 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;
- b. To evaluate processes/interfaces/protocols for the interactions between the different parties involved (Tier 1 Registry, ENUM Domain Name System, Provider, ENUM Registrar, Application Service Provider, Number Assignment Entity, Authentication Agency and Telephone Service Provider);
- c. 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;



- d. To test from a technical and user perspective applications based on the use of ENUM capabilities;
- e. To evaluate and refine economic benefits and costs of supporting ENUM;
- f. To consider and implement where appropriate inter-working capabilities with other ENUM trials.

7.3.2 The UKETG also developed a set of guiding principles for ENUM implementation. In brief these are:

- **Trust:** an integral part of the ENUM registration system is Validation and Identification which 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.
- **Equal Access:** to ensure commercial success there must be no artificial barriers to registration in terms of cost, timescale or restrictive business practices.
- **Value:** costs must be set at a reasonable and bearable level to the end user.
- **Regulation:** while some form of oversight is necessary ENUM should not require regulation in the same way as the telephone system. 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.
- **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 stimulate competition, a customer should be free to choose their service supplier.

7.4 Key trial findings¹⁰

7.4.1 The trial broadly succeeded in testing the architectural, technical, operational, and end user aspects of provisioning ENUM services for country code +44. It also revealed practical solutions that could be used in full commercial implementation to ensure an open, fair and competitive market. The trial showed encouraging

¹⁰ UKETG, STATUS REPORT ON THE TRIAL IMPLEMENTATION OF ENUM IN THE UK, MAY 2004, Issue 1.1. Available online: <http://www.ukenumgroup.org/>

signs that demand for VoIP and SIP solutions alone could make a compelling case for ENUM implementation.

- 7.4.2 Issues around managing validation and identification of ENUM registrations were significant. Where ASP's act as an intermediary, they must have privacy policies that allow them to pass on pieces of information needed for a subscriber's ENUM registration, whilst ensuring that they do not misuse this information for other purposes. In addition they must take reasonable care to ensure that only the Registrant can request that data be populated or changed within the ENUM domain they have registered, and also that no indication of the identity of the owner of that domain is passed to others without the explicit consent of the Registrant.
- 7.4.3 An experience within an enterprise that provided an ENUM DNS content population and maintenance web service, found that once users populated their ENUM domains with contacts, they rarely changed them. The ENUM system was seen as a way of publishing an Electronic Business Card with telephone numbers and email addresses listed under a main ENUM-registered telephone number. However, these users did change the relative priorities between entries in order to indicate which contact was most appropriate at the time.
- 7.4.4 Further work is required in relation to the economic costs and benefits of ENUM and ENUM related services as well as practical implementation of authentication mechanisms. Time pressures and resource constraints meant that none of the Registrars implemented Extensible Provisioning Protocol (EPP) during the trial.
- 7.4.5 Multiple Tier 1 Registry providers introduced additional complexity and created undesirable operational problems. The UKEG recommended a single ENUM Tier 1 registry, but with separate, competing nameservers and ENUM registrars that may be run separately or by the same organisation.
- 7.4.6 The use of three Tier 1 Registries added unwanted complexity to the identification task for Registrars:
- Four sets of name servers were required - one for each Registry operator and one for the meta-registry.
 - Registrars had to determine which of the three Registries to send each request.
- Registration problems were overcome during the trial by an "email director" account held by one Registry that passed registration requests to the appropriate Registry based on the telephone number. This approach, however, would not be appropriate for a commercial ENUM service.
- 7.4.7 Tools are needed to maintain DNS zone files (containing NAPTR records) including access controls to ensure that an application or tool only changes the resource records that it is permitted to update, and prevent unwanted NAPTR record manipulation (UK).¹¹

- 7.4.8 Authentication and validation posed significant problems. Trial registrations were verified by manually checking against the BT Directory Enquiries (DQ) database. However, in many cases telephone numbers proved difficult to verify including: DDI blocks allocated to an organisation, premium-rate numbers, pay-as-you-go mobile phones, freephone and non-geographic local and national numbers. Ex-directory numbers also presented a problem. Two potential solutions are: 1). A lightweight form of authentication, perhaps something as straightforward as a first-come, first-served basis for registrations with a simple but quick appeals mechanism to prevent speculative ENUM registrations; or 2). Develop an on-line authentication system in cooperation with a telephone company. This would require a convincing business case.
- 7.4.9 Security of the DNS was a concern given its currently vulnerability to protocol attacks. The IETF is working on a protocol, Secure DNS (DNSSEC), to protect DNS through public-key encryption to digitally sign DNS data and verify those signatures. Once this standard is finally agreed, outstanding issues on how to deploy DNSSEC for ENUM may include: tools for signing DNS data and verifying those signatures, key management, data signing policies and procedures, introducing new keys and withdrawing old ones, and assessing the impact on the Registry, Registrars and DNS providers.
- 7.4.10 Trial participation was poor mainly due to low visibility of ENUM-based applications and services for users to try. This created a catch-22 situation whereby ENUM-capable services and applications were slow to emerge because the low number of registrations suggested demand would be low. A contributing factor was that UKETG did not have an outreach programme to attract users or other trial participants.
- 7.4.11 The trial emphasised the need for an organisation to oversee a national ENUM system. UKETG recommended formation of a self-regulating ENUM Policy Group with representation from all stakeholders and responsibility for policy matters such as accreditation, a disputes and complaints procedure, and scrutiny of the Tier 1 Registry. It was noted that this would incur real costs for consultancy fees, legal expenses etc which may require support from government. Public money could perhaps be recovered at a later date: for instance by some form of revenue sharing from the Tier-1 registry operator for a commercial ENUM service or through accreditation/licensing fees.

7.5 Current status

- 7.5.1 DTI undertook a consultation process on implementing a public ENUM between August and November 2004. The main topics for comment covered the following design aspects.¹²

¹² DTI's ENUM consultation August – November 2004. Presentation by Simon Hicks, DTI, September 2004.



- a. Governance through the 'ENUM Committee' which would consist of two boards: the UK ENUM Policy Board made up of representatives of the key ENUM service providers, and a Supervisory/review Board of 5 members (3 independent organisations and observers from DTI and Oftel).
- b. Appointment of a Tier 1 Registry by the ENUM committee through a competitive tender (using a separate independent panel) for an appointment of 4-6 years to be managed by the ENUM Policy Board.
- c. Appointment of Registrars to Tier 2 that will not include the Tier 1 Registry. Registrars to abide by a code of practice.
- d. Subscriber control and authentication based on the opt-in principle and with procedures for identification and validation of registrants. Validation options that do not involve direct participation by the telephone service provider include the use of the UK's directory enquiry database and the number portability process, checking against bills and call-backs to the number concerned.
- e. Because of privacy considerations, a WHOIS service that would translate telephone numbers in domain name form back to the identity of the persons or organisation using them, will not be provided.

7.5.2 The DTI consultation process was completed by January 2005 and transition to commercial phase has now begun.¹³ Launch of commercial public ENUM in the UK is unlikely before December 2005.

¹³ 'ENUM experience in the UK - a technology looking for an application?' Marco Bernardi, NeuStar, Presentation to Centr GA, February, 2005. Available online: <http://www.centri.org/docs/2005/02/centri-ga25-bernardi-enum.pdf>



8 Ireland

8.1 Introduction

- 8.1.1 The Commission for Communications Regulation (ComReg) regulates the telecommunications sector in Ireland in line with both EU and domestic legislation and manages the National Numbering Scheme. ComReg undertook a public consultation round on ENUM in 2003 and supported creation of the +353 ENUM forum in September 2003. Participants include Government & State Agencies, Telcos/ISPs, Registry Operators, DQ & Layered Providers, ISOC-IE & UCD. There was also overlapping membership between the +353 and UK forums.
- 8.1.2 The approach of the Irish ENUM Forum was to advance the thinking and understanding of ENUM within the Irish communications industry, to develop a clear understanding of a framework for the operation of ENUM and to define an Engineering Trial that would derive some additional learning. The goal was to be able to reach conclusions that would provide guidance to Irish organisations on how to respond to ENUM. Forum planning focused on DP issues, validation, VoIP service focus and implementing an engineering trial that would prove the technical aspects of ENUM.
- 8.1.3 The IE Domain Registry Limited (IEDR), a private, independent, not-for-profit company is responsible for management of the Irish domain .ie. In Ireland the E-Commerce Act of 2000 empowers the relevant Minister to introduce regulations which may "authorise, prohibit or regulate the registration and use of the .ie domain name in the State." However, this power has not yet been exercised.
- 8.1.4 A key issue for Ireland relates to VoIP implementation. Some consider that it may be possible to create a VoIP hub in Ireland for telecommunication in Europe. In Ireland it appears likely that the first ENUM users will be large national/international companies using ENUM in their VoIP roll out to reduce communication costs. In order for Ireland to promote national ICT capabilities they must prove knowledge of ENUM to the large companies market.
- 8.1.5 An ENUM trial was launched in July 2004 and was due to end in March 2005. Phases 1 and 2 involved technical and organisational set-up (July-October 2004) while Phase 3 allowed testing with customers (Oct 2004 to March 2005).
- 8.1.6 The E164 code +353 was delegated for the duration of the trial to ComReg, acting on behalf of the Department of Communications, Marine and Natural Resources.

8.2 Trial Framework

- 8.2.1 There were three phases to the Irish ENUM trial:



- Phase 1 involved the procurement of equipment for UCD, establishment of a Tier 1 registry operation, finalising the organisational and technical set-up of the trial.
 - Phase 2 consisted of establishing the first set of communications to ensure that the overall environment is operating accordingly.
 - Phase 3 aimed at operating the complete engineering trial platform with UCD and MCI customers, including further examination of issues such as: practical customer management, validation of the service model, and the relationship between Tier 1 and Tier 2 operations.
- 8.2.2 The first two trial phases were completed by October 2004. The third phase to test with UCD and MCI customers was conducted between October 2004 and March 2005.
- 8.2.3 A special number range was defined for VoIP, but ENUM was not restricted to this range.
- 8.2.4 The reference architecture defined roles for The Tier 1 Registry, the Registrant, the Registrar, the Name Server Provider, the Irish government and the actual number holder.
- 8.2.5 The Tier 1 Registry functions consist of the Tier 1 Manager which has formal delegation of 3.5.3.e164.arpa and the (technical) registry function which contains all pointers to Tier 2 NAPTR records. A single tier-1 registry operator, Afilias, was used for the duration of the trial (The permanent Tier 1 registry operator will be determined before commercialisation).
- 8.2.6 The single ENUM registry in Ireland (3.5.3.e164.arpa level) has two key tasks:
- Recording the reference from the domain name in which a telephone number is expressed to the IP address and the domain name of the Tier 2 server on which the NAPTR records information for that telephone number is stored.
 - Storing the reference in the registry's name-server (via a zone file) and maintaining this record so long as the telephone number is validly held by a subscriber who wishes to participate in ENUM.
- 8.2.7 The Tier 2 Name Server Provider holds the NAPTR records in the format being used by Ireland and is responsible for provisioning the NAPTR records requested by the ENUM registrant. The two Name Server Providers used for the trial were University College of Dublin and MCI. To ensure that the simplest operating model was applied within the trial, registrar and NameServer Provider activities were combined. Consequently Tier 2 was responsible for authenticating (Identification and validation) any party wishing to register to ENUM through them. Two types of registrant population were taken into account: UCD staff and students, and MCI staff.



- 8.2.8 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.
- 8.2.9 The registrant is a person that makes their access information available to others through ENUM, selecting a Registrar to accomplish the registration. For the purpose of the trial, several categories and subcategories of registrants were identified depending on the type of relationship they have with the Tier 2 functions (MCI/UCD).
- 8.2.10 Security and privacy issues were managed largely through the Authentication Process. This both confirms the identity of the registrant and validated that the registrant is authorised to register the telephone number. The Forum agreed that the Authentication Process should occur between the registrant and the registrar. Mandatory criteria for authentication included meeting data protection requirements; avoiding the need to compel Telephone Service Providers to participate; and verifying that the applicant is authorised by the legitimate number-holder (or account holder) to register the number in question.
- 8.2.11 Data security risk areas were classified as follows:
- Open disclosure of the registrant's NAPTR records in the public DNS;
 - ENUM registration and initial provisioning; and
 - 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.

8.3 Trial Objectives

- 8.3.1 Objectives of the phase 1 trial were to enable ComReg and Forum members to:
- a. Agree a functional specification for ENUM in Ireland;
 - b. Test and evaluate ENUM processes including authentication/validation, registration, data entry and look-up etc;
 - c. Establish the simplest procedures that meet legal obligations in Ireland as well as participants needs, particularly data protection and privacy obligations;
 - d. Test the usefulness of ENUM as a facilitator for packet-based services of interest to participants, typically including VoIP/SIP/H.323 and advanced messaging services, as well as support evaluation of the inter-working of these with PSTN/ISDN;
 - e. Determine how ENUM best supports the use of other services (e.g. fax, mobile communications, mailboxes, web. as required by participants).



- 8.3.2 Rather than repeating trials carried out elsewhere, the Forum decided to build on these results by running an international trial that would test the interfunctionalities between different Tier 1 registries and therefore test all DNS architecture. A partnership with Austria was facilitated for this purpose.
- 8.3.3 In order to maintain simplicity a reduced number of processes were tested including:
- The registration process including Authentication activities;
 - The information Change process including Authentication activities;
 - The termination process; and
 - The SIP communication via ENUM that represent an ASP solution enabled by ENUM.

8.4 Current status

- 8.4.1 Phases 1 and 2 of the ENUM engineering trail demonstrated that ENUM works, however there are outstanding issues to be resolved (e.g. authentication practical organisation, end users look-up tools).
- 8.4.2 A report prepared for ComReg in October 2004¹⁴ recommended that:
- The ENUM delegation in Ireland be managed and controlled by ComReg (acting as Tier 1 Manager), with technical operations assigned to a Tier 1 registry operator on a licensed basis.
 - Ireland have a single Tier 1 Registry selected using standard European procurement mechanisms which operates under guidance of a Policy Advisory Group made up of stakeholder representatives
 - Use of ENUM registration policies and procedures as a platform for the creation of an ENUM environment in Ireland. The Policy Advisory Group should modify these policies and procedures when determining the practical and volume implications 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, Terms and Conditions for transfer of customer data between providers
 - c. Transfer of data held by incumbent telephone operators to ENUM providers
 - d. Policies for Authentication and validation (based on Opt-In consumer consent); bulk up-load of information from existing databases; Data privacy, Number portability, Universal access, Legal intercept, Security including escrow.

¹⁴ ComReg 04/105a IRISH ENUM FORUM, Final Report, 20th October 2004, Prepared for ComReg by PA Consulting Group, Dublin.
Available online: <http://www.comreg.ie/fileupload/publications/ComReg04105a.pdf>



- The Tier 1 Registry should be responsible for maintaining communications and the exchange of information / best practices with operators in other countries.
- 8.4.3 With completion of phase 3 of the trial, it will now be determined whether there is sufficient interest to move ENUM to a commercialisation phase. The commercialisation phase is expected to take about 6 months and would require ComReg to seek a Tier 1 Registry operator.
- 8.4.4 The roll out of VoIP providers (within their numbering ranges) in Ireland is expected by the third quarter of 2005. ComReg has issued draft Directions to allow access to the new '076' number range for VoIP services.



9 China

9.1 Introduction

- 9.1.1 The Chinese ENUM trial is led by the government, i.e. the Ministry of Information Industry (MII) of China. In November 2001, MII held a workshop on ENUM and introduced the international progress on ENUM.
- 9.1.2 In March 2002, the initial ENUM trial plan was finished and submitted to the first coordinating meeting of the ENUM trial. Subsequently an ENUM trial leading team and five study groups were established. Participants include CNNIC (The Chinese Internet Network Information Centre, authorised by the Ministry of Information Industry), MII, China Carriers, Institutes and ISPs etc.
- 9.1.3 The ENUM trial leading team is in charge of the overall study program and working plan. It consists of the officials of MII and leaders of the five study groups. The five study groups are investigating: ENUM Application, Provision, Registration, Regulation and Security, and ENUM International Coordination aspects.
- 9.1.4 CNNIC received 6.8.e164.arpa delegation in September 2002.
- 9.1.5 In September 2002 CNNIC set up two name servers for 6.8.e164.arpa. By July 2003, CNNIC had upgraded the ENUM trial system on both registration and resolution, and provided the free SIP registration for testing purposes for users. Performance testing occurred in September 2003 and public testing of ENUM began in December 2003.
- 9.1.6 China is participating in both ITU-T and IETF ENUM, and in ENUM workshops.
- 9.1.7 The context for the Chinese ENUM trial involves the following statistics: at the end of 2003, there are 80 Million Internet users in China, 260 Million mobile phones, and 255 Million fixed phones.

9.2 Trial Framework

- 9.2.1 China utilised an Integrated ENUM Trial Platform with VoIP experience platform, SIP UAs and IP/GSTN gateway.¹⁵
- 9.2.2 The structure of the functional roles was as follows:
- Tier 0: e164.arpa. Note that CNNIC is running one of the six slave servers of e164.arpa for RIPE NCC.

¹⁵ Xiaodong(Sheldon) Lee, CNNIC, Status on ENUM@CNNIC, Presentation to IETF59, Seoul, 03 March 2004. Available online:
<http://www.ietf.org/proceedings/04mar/slides/enum-4/sld12.htm>



- Tier 1: 6.8.E164.arpa; there are two servers for this domain, one primary and one secondary - arpa-ns0.enum.net.cn; arpa-ns1.enum.net.cn
- Tier 2: NAPTR Record storage.

9.2.3 ENUM Registration Platform, <http://WWW.ENUM.CN>, provides registration, modification, deletion, query, etc. The User check-up function involves the System manager checking registration information and confirming through E-mail. Information is updated to “6.8.e164.arpa” zone every 5 seconds. There is an ENUM enabled SIP server for SIP registration.

9.2.4 Telephone numbers in China are managed by province or carrier code. The Registration plan is yet to be finished, but it should cooperate with carriers and telephone number management should be independent with NAPTR records management to prompt NP.

9.2.5 ENUM enabled SIP proxy was open for public registration for testing purposes only, along with the ENUM registration website. Only ENUM users could register an SIP account.

9.3 Trial Objectives

9.3.1 The ENUM trial in China has the following objectives:

- Set up a testbed including the ENUM provisioning and application to demonstrate the core concepts and significance of ENUM ;
- Study the technical framework for ENUM implementation under the country code 86 ;
- Study the policy, regulation and security problem brought by ENUM; and
- Study and analyze the market perspective of ENUM in China.

9.3.2 The trial was confined to technical study and test. No commercial test or implementation was launched during the trial period.

9.3.3 The ENUM registration platform registered over 260 users and 520 ENUMs. Resolution Logs showed trial activity as follows:

- 6923 queries, Dec. 2003
- 4288 queries, Jan. 2004
- 7741 queries, Feb. 2004

9.3.4 Up to February 2004, 205 SIP accounts had been registered and 9029 calls had transacted from SIP users (IP2IP) or through gateway (IP2Phone or Phone2IP).

9.3.5 ENUM Performance Testing used Internet-based ENUM resolution to compare the resolution performance with PSTN. The two key items considered were:

- ENUM reply time & reply percentage. e.g. Remote query with cache, 18719 queries (18610 reply, 99%), average 407 millisecond; Remote query without cache, 18713 queries (17360 reply, 94%), average 2266 millisecond.



- ENUM server pressure: How to support a large number of queries with dynamic update.
- 9.3.6 The most beneficial ENUM service in China to date is SIP registration and to exchange ENUM in the browser address bar.
- 9.3.7 In the ENUM Client for Browser IE client has been used to reach the http link by ENUM number. IE Client captures the local DNS Server's IP address, then asks DNS Server to query the domain name. The size of this client software is only 558k. They are currently supporting IE version 4.0 and above but hope to support other browsers in the near future.
- 9.3.8 For email ENUM clients, Outlook client is used to send the E-mail by ENUM number. It captures the local DNS Server's IP address, then asks DNS Server to query the domain name. The size of this client software is only 569k and they can support office 2000 Outlook and newer versions.
- 9.3.9 In the last year work has continued on:
- Continuing the trial system and getting feedback;
 - Undertaking research on Tier 2 resolution performance and administrative policy suitable for China;
 - Making suggestions to the government to open a business trial system (Number plan for SIP with ENUM resolution);¹⁶
 - Consideration of deploying some open tests with other carriers or ISPs.

9.4 Current status

- 9.4.1 Privacy and safety are being enhanced for special users and environments. ENUM users set different preferences to URIs for query. The Query client creates a query message with key and validation information. The server validates user name, password, and key. The result will be achieved by synthesizing the current situation and configuration.
- 9.4.2 The next steps for ENUM in China involve implementing a commercial trial. Many Carriers have shown interest in the ENUM/SIP trial system. They plan to begin the commercial trial system with a special scope in cooperation with carriers.
- 9.4.3 A series of standards will be developed based on the commercial trial experiences. These will include an overall technical specification for ENUM and activities such as registration, monitoring, operation, accounting and etc, and will be supervised by the Chinese government (MII).

¹⁶ Promotion of ENUM/SIP application is a challenge in China because licenses for Internet phone to end users are not issued. However, many ISPs, carriers, and software vendors show great interest in this.



10 Finland¹⁷

10.1 Introduction

10.1.1 In November 2001 the Finnish Communications Regulatory Authority (FICORA) established a working group to study ENUM technology and to make recommendations for administering ENUM.

10.1.2 A further working group was established in April 2003 to plan and run the trial. At the same time FICORA registered the Finnish domain +358. The domain for Finnish ENUM trials is .8.5.3.e164.arpa.

10.1.3 The working group reported back in November 2003, with the trial scheduled to run from December 2003 until June 2005.

10.2 Framework

10.2.1 The trial was based on a single registry run by FICORA. NAPTR records were administered at Tier 2 or Tier 3 levels.

10.2.2 Trial participants were Internet service providers and other telecommunication companies.

10.3 Trial objectives

10.3.1 The purpose of the trial was for participants to gain experience of different ENUM models.

10.3.2 There was a strong focus on gaining experience in Tier 1 management and ENUM domain validation processes so as to develop recommendations for commercial administration of the domain.

10.4 Current status

10.4.1 The interim conclusion is that ENUM technology does work.

10.4.2 The working group considers that business viability is doubtful at the present time because few ENUM enabled applications are currently available.

10.4.3 Commercial introduction, however, would facilitate technological development of electronic communications and other IT applications. On this basis the working group have recommended that ENUM be introduced in Finland.

¹⁷ ENUM Final Report, FICORA, February 2005; Klaus Nieminen, Finnish ENUM Trial, February 2004; www.ficora.fi



11 Germany¹⁸

11.1 Introduction

11.1.1 DENIC, the not-for-profit domain registry for Germany, is co-ordinating the ENUM trials for Germany. Its membership includes companies and institutions with an interest in Internet services.

11.1.2 In May 2001 the first consideration was given to obtaining delegation of an ENUM domain. One year later the delegation was formally obtained.

11.1.3 In June 2001 a working group was established to prepare for an ENUM trial.

11.1.4 The trial itself began in September 2002 with an agreement between DENIC and the Regulatory Authority for Telecommunications and Posts (RegTP).

11.1.5 As the international dialling code for Germany is +49, the domain for German ENUM trials is .9.4.e164.arpa.

11.2 Trial Framework

11.2.1 The trial itself involves the participation of a large number of Internet service providers, which in Germany is a particularly competitive area. It includes ESPs, manufacturers, telecommunication firms, research institutions, data and privacy protection organisations and user groups.

11.2.2 As of 31 December 2004 there were:

- 420 participants in the trial;
- 49 members having registered ENUM domains;
- 1398 ENUM domains.

11.2.3 The 'registrar model' was established with certain guidelines as follows:

- Only DENIC members were able to use the registration system on behalf of customers;
- The registrar acquires the administrative and technical data and verifies the registrant data;
- Either the registrar or the registrant can provide the name service for an ENUM domain;
- The registrar sends the electronic request to the registry;
- The registry verifies data;
- The registry operates the name service infrastructure and WHOIS service.

¹⁸ DENIC and the Trial of ENUM for .9.4.e164.arpa, February 2005; Petra Blank and Stefan Dieterle, DENIC and the German ENUM Trial, January 2005; www.denic.de



11.3 Trial objectives

- 11.3.1 The initial part of the test phase involved testing the potential of ENUM technology – i.e. testing hardware and software and developing it to the point needed for operation.
- 11.3.2 The main role of DENIC was to develop the registration system such that ISPs could make automated inquiries using the system.
- 11.3.3 It was considered essential to test different methods of validating telephone numbers and appraising them in terms of efficiency, reliability and cost.

11.4 Current status

- 11.4.1 At the present time, the trial is on-going with the following key advantages having been identified:
- Cheap instant telephony;
 - The advantage of one number for many different services;
 - An integrated service for communication;
 - A bridge between networks – conventional equipment can access Internet services;
 - Recipients of incoming calls can determine criteria for ordering and assigning terminal devices.
- 11.4.2 There are frequent meetings (every three months) to talk about the status of the trial and exchange experiences of ENUM.



12 Japan

12.1 Introduction

12.1.1 JPRS was established in December 2000 to be the country code Top level domain registry for .jp (This function was completely delegated to JPRS in April 2002). JPRS is a private, for-profit company that is endorsed by the Japanese Government as the .jp registry. Its registry activities are overseen by the Japan Network Information Centre (JPNIC) and the Japanese Government. There is no regulation for use of ccTLD in Japan.

12.1.2 The Japanese ENUM Study group was established in September 2002 as a private sector initiative with an aim to:

- Understand the ENUM technology;
- Study implementation and operation of an ENUM-based system and related matters;
- Find political/regulatory issues related to ENUM based implementation and operation;
- Find technological issues related to ENUM; and
- Clarify pros and cons in ENUM usage.

The final report of the ENUM study group was published in May 2003. ¹⁹

12.1.3 Japan is interested in ENUM in relation to the IP telephone and the potential for "Operator (or Private) ENUM".

12.1.4 The ENUM trial in Japan (known as ETJP) began on 17 September 2003 and was to run for a period of 12 months.

12.1.5 The E164 code of +81 for Japan has not been delegated for the trial, however, the trial is recognised and supported by the government. The ENUM trial is being performed under 1.8.e164.jp and will use a set of special numbers led by '000' which do not look like the existing phone numbers.

12.1.6 For the trial JPRS acted as Tier 1 registry under 1.8.e164. Trial software and communication devices and services were provided by participants. As of 4 March 2005 there were 46 members in the ETJP trial.

12.1.7 In order to continue the ENUM trial, ETJP has extended it for one year to 30 September 2005.

12.2 Trial framework

12.2.1 The Japanese ENUM Trial has three phases:

¹⁹ Available online: <http://www.nic.ad.jp/en/enum/ENUMReport.pdf>



- Phase 1: Feasibility Test the Infrastructure of ENUM DNS, communication Applications/Terminals, SIP, Mail, Web, etc.
- Phase 2: Feasibility test the communication service (single carrier) provisioning, Communication Security
- Phase 3: Feasibility test of communication service (multiple carriers) Authentication, Social Security

12.2.2 The details of Phase 1 of the trial are as follows:

- a. ETJP Registration system: Each ETJP member can apply their preferred numbers as their trial E164 numbers. Verification is performed by each member's ID and password.
- b. NAPTR Registration Web I/F: ETJP members can set their preferred NAPTR RRs to the trial DNS through a Web interface. Those NAPTR RRs are then updated within a few minutes and can be examined via an ENUM client-like Web interface.
- c. Trial applications include:
 - a. ENUM enabled SIP Proxy (Softfront).
 - b. ENUM enable VoIPRouter (Yamaha, CISCO).
 - c. ENUM enabled InternetFAX (Panasonic).
 - d. Sample Software ENUM Client (JPRS). Source codes and object codes of runtime libraries used by the sample software are open to the members; API:
 - SetDNS : specifies DNS server
 - SetAUS : specifies the Telephone Number
 - CreateAUS : create the AUS Number using the locale info
 - ENUMQuery : look-up NAPTR records
 - ENUMGetData : picks up NAPTR records one by one

12.2.3 Alongside the trial two ETJP working groups were established to resolve particular issues.²⁰ The Privacy and Security WG was formed to discuss data treatment policy in each phase of trial and develop guidelines. A set of guidelines were published in March 2004.

12.2.4 DNS working group was tasked with:

- Defining possible ENUM DNS models in Japan, their requirements and evaluation criteria, and to evaluate current DNS implementations
- Studying the application of DNSSEC to ENUM

In Feb 2004 DNS WG produced a definition of possible ENUM DNS models, requirements, and evaluation criteria. In March a Testbed was built and evaluated and the results were published in April 2004.

²⁰ DNS Operational Experiences in JPRS/.JP - DNS itself, IPv6, IDN, ENUM - February 22, 2005, APRICOT 2005 Tutorial, Yasuhiro Orange Morishita, Japan Registry Services Co., Ltd. (JPRS). Available online: http://jprs.co.jp/enum/enum_jprs/activity/pdf/050222T11-4.pdf



12.3 Trial objectives

12.3.1 The purpose of the Japanese ENUM trial was to

- Ensure that the basic technical facility was both functional and feasible.
- Demonstrate technology for international use
- Accumulate and share know-how about ENUM DNS operation
- Feasibility test communication applications (device, software) using ENUM
- Feasibility test communication services

12.3.2 The trial is expected to determine:

- Technical verification
- Clarification and consideration of relevant issues including issues such as whether there should be full deployment of ENUM and the nature of that deployment in terms of Registry selection and specifications, cost recovery and ENUM validation techniques.

12.4 Current status

12.4.1 The Trial is due to finish on September 2005. Interconnection trials between communication providers including overseas communications are expected. ETJP plans to issue the final report in the fourth quarter of 2005.

12.4.2 At March 2004, trial experience had led to the following technical aspects of ENUM implementation in Japan:²¹

- Ignores non-terminal NAPTRs to decrease delay
- Returns multiple URIs from which the User may select one.
- Process SERVICE match before ORDER field sorting.
- Accept '\' as delim-char, but note that this may not work when delim-char is '\000' or 0x80-0xff.
- Can handle multiple services eg. a cellular phone can handle http:, mailto:, tel: URIs in JAPAN.

12.4.3 The issue of having a special number block for ENUM and/or IP Telephony is under investigation by the trial team and the government.

12.4.4 As a member of APEET (Asia Pacific ENUM Engineering Team), JPRS plans to offer a live trial of ENUM/SIP at APRICOT 2005. This will show SIP communication services including overseas transmission and ENUM registration services. APRICOT participants can join the demonstration through the use of wireless SIP phones which can be borrowed or purchased at the venue.²²

²¹ Kazunori Fujiwara, Japan Registry Services, 'Experiences from implementing ENUM system', Presentation to IETF59 Seoul enum wg, March 3, 2004. Available online: http://jprs.co.jp/enum/enum_jprs/activity/pdf/040303ietf59enum-impl.pdf

²² APEET ENUM/SIP Live Trial in APRICOT 2005 <https://apricot2005.apenum.org/>

13 Australia

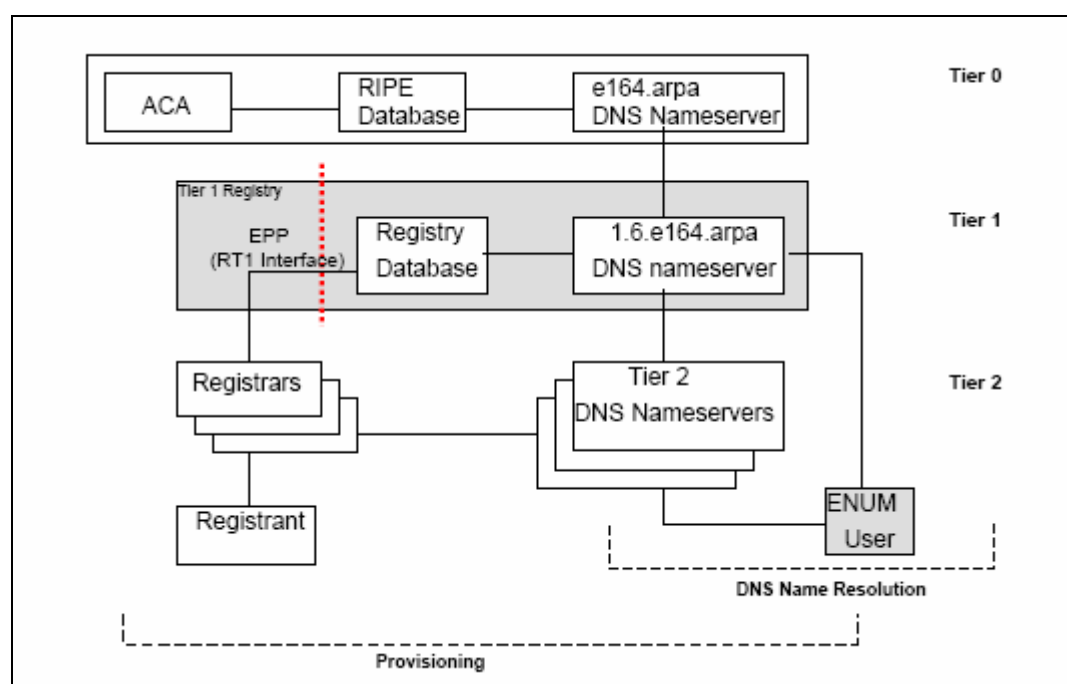
13.1 Introduction

13.1.1 Implementation of ENUM in Australia is being managed by the Australian Communications Authority. The ACA has established the ENUM Discussion Group (AEDG) to oversee an ENUM Trial. The Australian ENUM trial is due to begin in 2005.

13.1.2 The purpose of the trial is to allow technical, commercial, regulatory and consumer issues to be explored by the ACA, industry and other interested persons.²³

13.2 Trial Framework

13.2.1 The trial is based on testing User ENUM services that require the use of both an E164 number and a domain name within the .1.6.e164.arpa sub domain. The top level trial reference architecture is shown in the diagram below.²⁴



Source: ACA

²³ Australian ENUM Discussion Group WG1/DOC 01 Rev 6.00, CONTEXT DOCUMENT FOR THE AUSTRALIAN ENUM TRIAL, Australian Communications Authority.
Online: http://internet.aca.gov.au/ACAINTER.852416:STANDARD:1776244641:pc=PC_2475
Accessed 23 March 2005.

²⁴ Ibid. page 23.



- 13.2.2 The Australian ENUM trial allows one Tier 1 Registry Operator to ensure that a single entity has responsibility for maintaining and running the master registry of numbers. The Tier 1 Registry Operator is expected to establish and maintain a minimum base service for 1 year. The Tier 1 Registry Operator will operate the trial at no cost to the ACA but is able to charge trial participants for the provision of registry services.
- 13.2.3 Defining the rights of use of ENUM domain names is a prerequisite to establishing authentication and authorisation arrangements for Parts 2 and 3 of the ENUM trial. Different approaches to the rights and responsibilities associated with ENUM domain names may be tested during the Australian trial.
- 13.2.4 Existing telephone numbers will not be used in the initial trial phase. The ACA will assign unallocated or ENUM specific E164 numbers to Carriage Service Providers to be used as ENUM trial numbers. These Providers will then issue the numbers to Tier 2 Registrars.
- 13.2.5 The ENUM specific E164 numbers are independent of any carriage service and are not conditioned on the PSTN. Part 1 of the trial will use 10 digit ENUM only numbers in the range 0590 – 0599. Under the Numbering Plan, these numbers can only be used for ENUM services and will be withdrawn at the conclusion of the trial.
- 13.2.6 When a registrant requests an ENUM domain name from a Registrar, the Registrar will create a new ENUM domain name and the registrant will receive the right to use the associated E164 number; This right is conditional on maintaining the associated domain name. If the domain name is deleted, the registrant loses the right to use the E164 number.
- 13.2.7 The Trial specifies a minimum Base Service that must always be available from the Tier 1 Registry Operator in order to ensure that trial participants have a stable experimental platform (including Tier 2 Registrars and their customers).
- 13.2.8 The Tier 1 Registry Operator is expected to establish agreements with Tier 2 Registrars regarding methods of exchanging information, provisioning, privacy of registrants' personal information and reporting on trial outcomes. The Tier 1 Registry Operator is responsible for:
- a. Maintaining a confidential database for storing information about fully qualified ENUM records associated with E164 numbers in the *Telecommunications Numbering Plan 1997*. This will include:
 - o Registrant (ENUM subscriber) contact information, including name and address;
 - o Technical contact information;
 - o Identity of the Registrar; and
 - o The domain name and IP address of a Tier 2 nameserver that holds the subscriber's NAPTR record.
 - b. Using the information in the database to create a zonefile for the 1.6.e164.arpa domain and operating a set of Tier 1 nameservers to supply



DNS information using established DNS query mechanisms. The Tier 1 Registry Operator will maintain a primary nameserver and at least one secondary nameserver.

- c. Providing a directory service, like the WHOIS service used for domain names that provides publicly readable information about a particular ENUM record.
- d. Implementing the RT1 interface to allow Registrars to remotely connect to and interact with the Tier 1 Registry.
- e. Authenticating Registrars and interfacing with them via the RTI interface in order to perform registration related operations (eg. establishing a pointer to a nameserver holding a customer NAPTR record, transfer of ENUM domain between Registrars, deleting cancelled ENUM domains).
- f. Managing the set of E164 numbers allocated by the ACA for the Australian ENUM trial.

13.2.9 The Tier 2 Registrar(s) will interact with customers and must therefore be accredited to ensure adequate protection for users and the integrity of the Registry system. For the trial, the ACA is legally responsible for accrediting Registrars. It is proposed that the ACA and the Registry Operator formalise a Deed of Agreement that mandates the Registry operator to administer an application and accreditation process. Potential Registrars can then apply to the Tier 1 Registry Operator for registration. The accreditation procedure would include:

- an undertaking to comply with accreditation criteria; and
- a technical interface test conducted by the Tier 1 Registry Operator.

13.2.10 There is no limit on the number of Registrars for the ENUM Trial System and the Tier 1 Registry can act as a Registrar for the purpose of facilitating the Trial. Each Registrar is responsible for:

- a. Registering new ENUM subscribers;
- b. Authenticating the identity of ENUM subscribers and validating their authority to make changes to an existing ENUM domain or register an existing telephone number as an ENUM number;
- c. Interfacing with the Tier 1 Registry Operator to establish a pointer in the Registry to the Tier 2 nameserver holding the subscriber's NAPTR record;
- d. Interfacing with a Tier 2 nameserver operator to provision a subscriber's NAPTR record; and
- e. Issuing ENUM numbers to new ENUM subscribers. Registrars must be accredited prior to registering any subscriber's ENUM numbers.

13.2.11 Tier 2 nameserver operators are responsible for operating a nameserver (and probably a database with information about each entry in the zonefile) that contains NAPTR records associated with ENUM records in the Tier 1 Registry. Tier 2 nameserver operators will typically be service providers (e.g. a web hosting company), or Registrars. The provisioning system is not specified as this will vary depending on the particular application and business model used by the Tier 2 nameserver operator.



13.2.12 The major functions of the Australian ENUM Trial System include:

- a. Provisioning modules that allow customers (registrants) to register at Tier 2 and to have their information appear in DNS system.
- b. Name Resolution modules to allow a User to issue DNS queries to the ENUM Trial System for a specific E164 number and to receive the records associated with that number.
- c. Operations modules to represent the functions necessary to perform day to day operations including: Registrant account tracking, gathering performance statistics, reporting to the ENUM Discussion Group and ACA, management of the Tier 2 interface.
- d. Security modules which are spread throughout the trial architecture and involve:
 - o identifying and authenticating the entity requesting registration at Tier 1;
 - o validating the right of an entity to perform the action that they request;
 - o ensuring that all communications within and between modules are secure and authenticated.

13.2.13 To manage user privacy, trial participants can decide whether to make their contact information publicly available and can choose to remove their name from their ENUM listing.

13.2.14 The trial will evaluate ENUM with and without the use of proxies or user agents.

13.3 Trial Objectives

13.3.1 The Australian Trial is designed in three parts:

- Part 1 explores limited technical, regulatory and consumer issues to enable incremental progress towards Parts 2 and 3. There will be a single Tier 1 Registry Operator, allowance for multiple Tier 2 Registrars, and Tier 2 Nameserver Operators where required by trial participants for particular applications.
- Part 2 will examine issues associated with using already allocated nongeographic numbers from the *Telecommunications Numbering Plan 1997*. The first stage will focus on authorisation, authentication and regulation, while the second stage will examine regulatory and application issues such as charging, number portability and further PSTN/interworking.
- Part 3 is intended to examine issues associated with using geographic numbers from the *Telecommunications Numbering Plan 1997*, and how to provide connectivity based on such technology.

13.3.2 Part 1 of the ENUM trial is expected to enable participants to:

- a. Test interfaces between Registrars and the Registry.
- b. Identify possible applications/services that would require full service from the PSTN to the Internet using ENUM. This includes generic application/services



that may be possible in the future, are likely to have sound business cases and also be of strategic value to each of the participants. The trial should also identify:

- The associated regulatory issues and obligations;
- Any specific privacy issues not covered by current Australian Privacy legislation;
- Specific privacy principles and approaches that may solve the privacy issues;
- Security threats and likely security attacks associated with implementation of ENUM applications/services and the consequences and costs if a security attack is successful; and
- The security controls required to reduce the probability and cost of a successful attack to an “acceptable” level.

13.3.3 Progression to Parts 2 and 3 of the trial will be determined by ACA in consultation with the Tier 1 Registry Operator. Consideration will be given to: whether the objectives of Part 1 of the trial have been met; the readiness of arrangements to support Parts 2 and 3 of the trial (to resolve issues of rights of use and authentication and authorisation of ENUM customers with digital mobile and geographic numbers); and the level of industry interest and commitment to extending the trial.

13.4 Current status

13.4.1 The Australian ENUM trial is due to go live on 6 June 2005. AusRegistry International Pty Ltd (which allocates .au domains) has been selected as the Registry Service Provider for the trial.

13.4.2 In order to commence the trial AusRegistry have received a delegation from the ITU for the ENUM domain name zone corresponding with the Australian E164 country code +61. Information on the trial can be found at <http://www.enum.com.au>.



14 United States

14.1 Introduction

14.1.1 The US Federal agencies involved in ENUM discussions are: the Department of State which deals with the International Telecommunications Union, the National Telecommunications and Information Administration (NTIA) which handles DNS, and the Federal Communications Commission (FCC) which deals with the public telephone network.

14.1.2 Non governmental Parties involved in ENUM discussions include: The ENUM forum, IAB, IETF and RIPE NCC.

14.1.3 The United States, Canada and the Caribbean nations are members of the North American Numbering Plan (NANP). The ITU assigned code +1 to the NANP area. NANP numbers consist of a three-digit Numbering Plan Area (NPA) code, followed by a seven-digit local number. With 19 countries sharing country code 1, ENUM deployment in NANP is complicated by the fact that all countries have to support delegation of country code +1 even if they choose not to opt into ENUM. The IAB and ITU are in agreement that the US and Canada can request the delegation, but no opposition is allowed.

14.1.4 A public trial of ENUM using e164.arpa has not yet been undertaken in the US. However, in 2001 NeuStar (a private company that provides extensive telecommunications clearing house services in the US) initiated a trial of ENUM services in order to allow equipment manufacturers and service providers to test a publicly shared database and use numbers registered in that database to test client resolvers. The trial was intended to assist in developing services and equipment for ENUM.

14.1.5 The State Department has a federal advisory council called the International Telecommunications Advisory Council (ITAC) which includes members of the communications industry. ITAC provides advice to the State Department on negotiations of the ITU including ENUM through the ENUM Ad Hoc Working Group of Study Group A.²⁵ In July 2001 the ENUM Ad Hoc presented the State Department with a Report recommending that:

- ENUM be administered through a single unified database located at the e164.arpa domain,
- The ITU facilitate administration of this database, and
- The US should work rapidly to implement ENUM.

ITAC-T noted the need for open competition, particularly for ENUM Tier 2 and also recognised the option to use other ENUM domains instead of e164.arpa.

²⁵ ITAC Study Group A is responsible for U.S. policy, standardisation, regulatory, and competitive aspects of the operations and tariffs of telecommunications services. <http://www.state.gov/e/eb/adcom/c668.htm>



14.1.6 The US Department of Commerce, NTIA has taken steps to encourage the introduction of ENUM. In August 2002, an NTIA forum on ENUM demonstrated a strong consensus by industry and non-profit entities that the United States should opt into e164.arpa, but only if implementation ensures competition, interoperability, security and privacy. Given this response, NTIA developed the following set of principles to guide ENUM implementation with the intention of maximizing opportunities for industry while protecting the security and privacy of consumers in the United States:²⁶

- **Preserve national sovereignty:** Any participation by the United States in a coordinated, global approach must preserve the United States' national sovereignty. That is, the United States and every other participating nation should have the right to determine whether and in what manner ENUM or any alternative is implemented domestically.
- **Support competition:** Domestic implementation of ENUM must also allow for competition among providers and operators on as many levels as feasible.
- **Promote innovation:** Adoption of ENUM or ENUM alternatives must encourage innovation and promote advanced voice and data services through new products, services, and vendors.
- **Protect users' security and privacy:** Domestic implementation of ENUM must be done in a manner that maximises the privacy and security of user data entered in the ENUM DNS domain. For example, ENUM providers should develop systems to ensure the authentication and authorisation of users who enter and update their personal information.
- **Minimise regulation:** Governance of ENUM on the international and national level must be accomplished through the least regulatory means possible. For example, a coordinated, global approach to ENUM should not give rise to a new regulatory apparatus to govern international and domestic implementation.
- **Preserve opportunity for alternative deployments:** The implementation of ENUM within the United States must not preclude alternative deployments of ENUM or other solutions that may provide competitive alternatives to ENUM.
- **Allow for interoperability:** In order to support competition and the emergence of alternative technologies and networks, the implementation of ENUM within the United States should accommodate alternative deployments' interconnection with the ENUM tree.
- **Preserve stability and security:** Any implementation of ENUM must not diminish the stability and security of the Internet or telecommunications systems.

14.1.7 The NTIA, FCC and Department of State have since been working together to consider federal issues in implementation of ENUM. In August 2003 these

²⁶ Nancy J. Victory, Assistant Secretary for Communications and Information, US Department of Commerce, Letter to The Honourable David A. Gross, U.S. Coordinator for International Communications and Information Policy, Department of State dated February 2003. Available online: http://www.ntia.doc.gov/ntiahome/ntiageneral/enum/enum_02122003.htm Accessed 26 March 2005.



agencies sent a joint letter to the ENUM forum supporting an industry-based mechanism for ENUM implementation.²⁷ In particular they expressed support for the ENUM Forum's proposal for a limited liability company (LLC) to select at least one Tier 1 provider. They also encouraged the industry to adopt the principles developed by NTIA for implementation of ENUM in the US.

14.1.8 On 28 October 2004, a group of companies announced formation of the Country Code 1 ENUM Limited Liability Company (CC1 ENUM LLC).²⁸ These included AT&T Corp., MCI Inc., GoDaddy.com, SBC Laboratories, Sprint, Verizon together with unidentified cable companies, telephone companies, and ISPs.²⁹

14.1.9 The goal of the CC1 ENUM LLC is to create and manage the public infrastructure needed to promote development and deployment of ENUM technology in NANP. This will adhere to national and industry privacy requirements. The type of ENUM being proposed for implementation is infrastructure ENUM.

14.2 Trial Framework (still in draft stages)

14.2.1 CIRA as ENUM Tier 1A Trial Registry will publish DNS zone 1.e164.arpa to delegate authority for sub domains to appropriate Tier 1B nameservers and maintain at least 2 nameservers for this purpose. Authorisation of NPAs into the trial will be managed by CC1 ENUM LLC who will seek proper permission from Governments seeking to participate in the trial. The trial will be conducted in line with CC1 privacy laws and trial results may be used to refine CC1 ENUM technical requirements. The trial will not be open to commercial and retail users, or be used for performance or stress testing.

14.2.2 The CC1 ENUM Trial will begin on the day CC1 delegation is received and will finish after 12 months or on receipt of permanent CC1 delegation, whichever comes first. For each participating nation the trial will run for up to 6 months. The trial may be extended if both CC1 ENUM LLC and CIRA agree.

14.2.3 The reference architecture being developed by CC1 ENUM LLC will contain a single common ENUM DNS domain, 1.e164.arpa, within CC1, along with Tier 1 functionality split into:

- Tier 1A with the CC1 delegation from Tier 0. Tier 1A will hold the NPAs, both geographic and non-geographic, for all of CC1.
- Tier 1B which will serve different CC1 (NANP) member states. Entries in Tier 1 B will correspond to both Numbering Plan Areas (NPAs) and non-

²⁷ Ambassador David Gross, The Honourable Michael K. Powell, The Honourable Nancy. J. Victory, Joint letter to Mr. Gary W. Richenaker, Chairman, ENUM Forum, 13 August 2003. Available online: http://www.ntia.doc.gov/opadhome/opad_enum.htm. Accessed 26 March 2005.

²⁸ Available on line: <http://www.enumllc.com>

²⁹ Minutes of meeting for Working Group 2.8.5 Telephone Number Mapping (enum), Monday, November 9, 2004. Available online: http://www1.ietf.org/proceedings_new/04nov/index.html



geographic resources such as toll free and caller-pays 900 services, referred to as Service Area Codes (SACs).

- 14.2.4 A Tier 1A Registry will be an SRS that maintains the addresses of authorised nameservers of the Tier 1B registries in Country Code 1. It will be required to:
- Support the “thick registry” model in managing contact information about Tier 1B registries information and support IRIS-ereg query response protocol.
 - Detect dual registrations for the same ENUM NPA domain name and inform the requesting ENUM Registrar so that it can initiate the dispute resolution process.
 - Describe systems and procedures to allow Tier 1B operators to manage the records for their NPAs in the Tier 1A registry.
 - Follow procedures to update the zone files and information in local data stores for handling the area code split when it occurs;
 - Meet requirements for zone file operations;
 - Provide a WHOIS service or third party diagnostic service ‘ContactInfo’;
 - Provide a reporting service to allow ENUM Tier 1B Registries to retrieve reports on performance statistics for resolving entries in Tier1A.
- 14.2.5 Tier 1B Registries will interface directly with the CC1 ENUM Tier 1A Registry:
- To input the NPAs or SACs into the CC1 ENUM Tier 1A DNS; and
 - To provide Tier1B host names where the registry NS records for the NPAs are located.
- 14.2.6 The Tier 2 Provider for an E164 number will maintain the actual NAPTR records that contain information for specific communication services.

14.3 Current status

- 14.3.1 The CC1 ENUM LLC Technical Advisory Committee is currently in the process of finalising the document “Technical and Operational Requirements for an ENUM Tier 1A Registry for Country Code 1”.³⁰ This document is intended to lead to:
- A memorandum of understanding between the industry and government entities in CC1 for delegation of CC1;
 - Subsequent preparation of a request for proposal for the management of CC1;
 - Vendor selection to provide CC1 Tier 1A services.
- 14.3.2 The envisioned timeline involves issuing the RFP for Tier 1A in June 2005, awarding a contract by October 2005, and having a registry operational by January 2006. There are plans to hold a US ENUM trial after delegation.
- 14.3.3 In light of developments in the US, there have been discussions in Canada of conducting an ENUM trial simultaneously with the Country Code 1 and US ENUM Trial. The Canadian Internet Registration Authority (CIRA) is the not-

³⁰ Available online: http://enumllc.com/tac/docs/TAC_Tier1A-requirementsv.3.2.doc#_Toc94111906



for-profit corporation mandated by the Government of Canada to operate Canada's Internet space, the .ca Internet domain. In February 2005, CIRA and the CC1 ENUM LLC signed a memorandum of understanding whereby CIRA will act as the ENUM Tier 1A registry for countries participating in Country Code 1 ENUM Trial at its own cost.

- 14.3.4 The Canadian Steering Committee on Numbering (CSCN) have also been considering the possibility of a carrier or private ENUM instead of a public ENUM based on e164.arpa.³¹
- 14.3.5 The CSCN has noted that there are production environment concerns as to how non-US nations and entities in NANP will participate in the governance and management of the ENUM system for Country Code 1.³² If the Tier 1A Registry is a U.S. corporation operating under USA laws it may create legal or regulatory difficulties for non USA nations in Country Code 1. Other NANP nations may consider Country Code 1 to be a shared numbering resource of all nations in the NANP and not want to be put in the position of complying with the requirements of a U.S. corporation.

³¹ CSCN TIF 60 Co-Chairs Contribution to CSCN, Canadian Steering Committee on Numbering, 15 March 2005 Available on line: <http://www.crtc.gc.ca/cisc/COMMITTE/C-docs/CN053CN023.doc>

³² Minutes of the CSCN Meeting February 8, 2005, Telephone Number Mapping (tElephone NUmber Mapping (ENUM). Available online: <http://www.enumorg.ca/docs/Minutes/>



15 APEET³³

15.1 Introduction

15.1.1 The Asia-Pacific ENUM Engineering Team has concluded a successful regional test of ENUM at the March 2005 meeting of APRICOT, the Asia-Pacific Regional Internet Conference on Operational Technologies.

15.1.2 Representatives from telecommunications groups of China, Japan, South Korea, Taiwan were involved in an informal technical project to attempt to “synergise ENUM activities in the Asia-Pacific regions”.

15.1.3 There is no separate domain reference for the trial: each country has its own domain reference.

15.2 Framework

15.2.1 The project team is not a formal entity. It is a grouping of engineers who receive support from their respective organisations.

15.2.2 The initial members were CNNIC (China), JPRS (Japan), KRNIC (Korea), SGNIC (Singapore), and TWNIC (Taiwan).

15.2.3 The trial involves sharing software, jointly conducting trials, using a common website for reporting findings, and demonstrating a live trial at APRICOT 2005.

15.3 Trial objectives

15.3.1 The main objective was to test international transfers of information.

15.3.2 The following capabilities were tested:

- Telephone calls;
- Email;
- Instant messaging;
- Voice mail;
- Video; and
- IPv6 SIP/ENUM capability.

15.3.3 Another important objective was to promote awareness and use of ENUM and demonstrate that ENUM was indeed ready for operation.

15.4 Current status

The live trial was held to be a major success at APRICOT 2005 in March 2005.

³³ Ching Chiao, Update from APEET, July 2004; APEET Reported Its Success in ENUM/SIP Live Trial in APRICOT 2005, March 2005; www.apenum.org