UK ENUM GROUP (UKEG)

PRELIMINARY REPORT ON THE IMPLEMENTATION OF ENUM IN THE UK

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EXECUTIVE SUMMARY

This report was commissioned by the DTI, which set-up an industry group to study the issues surrounding the implementation of ENUM in the UK. The main task of UKEG was to make recommendations on the preferred options for implementing ENUM in the UK as well as highlight a number of regulatory aspects that need to be considered if ENUM is commercially implemented in the UK

The main body of the report covers the implementation issues and Section 5 together with Annex 5 highlights some of the regulatory aspects that need to be taken into account.

A major issue with ENUM is the protection of users' data and authentication of telephone numbers and UKEG strongly recommends a user opt in policy for ENUM together with the requirement that all user numbers stored in ENUM databases must be uniquely assigned to end users.

The main players in ENUM are the Tier 1 Registry, the ENUM Registrar, the Authentication Agency and the ENUM DNS Provider. A brief description of their roles and responsibilities are discussed in Section 6.

One of the key considerations in deciding how the ENUM registry system is to be implemented in the UK is the way in which the tier 1 and 2 registries should be configured to ensure that we have the best competitive outcome for UK players. There are a number of implementation options that can yield different outcomes in terms of competition, user benefit, cost and security and the report comprehensively reviews the pros and cons of each option.

This process of evaluating pros and cons of different option led to a clear preference for an ENUM implementation solution that provides for maximum competition between those entities operating at the tier 2 level and which provide registration service to customers. Therefore, a business entity can decide to operate any of the Tier 2 services either individually or combined. The Tier 2 players consist of: the ENUM Registrar who registers the ENUM Applicant for ENUM services; the ENUM Authentication Agency which authenticates the ENUM Applicant i.e. validates the ENUM Applicant has the right to register their number in ENUM; and the ENUM DNS Provider who holds the NAPTR records.

Multiple Tier 1 registries was considered by UKEG as a possible implementation solution but based on operational and cost considerations a single registry at tier 1 was the preferred option. A single tier 1 registry effectively working in a monopoly mode will require governance procedures to be established to ensure its operation is based on the principles of non discrimination, transparency and fairness and these issues are outlined in section 9 of the report.

The Tier 1 Registry operates the delegation +44 for the UK and holds pointers to the relevant ENUM DNS Providers for each individual number. The rationale for this decision is discussed in Section 8. .

The report itself is considered to be preliminary since there are many issues that still need to be resolved and UKEG has agreed that some level of trialling is therefore necessary and essential. To this extent a UKEG trial group has been established to pave the way for trialling to take place in the UK and section 12 of the report briefly outlines the key objectives of the trial.

Because there are a number of issues in the implementation of ENUM concerned mainly with security authentication and privacy there is a need to identify and establish some of the basic criterion that may need to be met by the participating entities. Section 10 of the report reviews some of the preliminary criterion that may need to be applied and will be further investigated during the trial process

One of the key issues, discussed in section 10, that needs to be agreed in any commercial deployment of ENUM, is how to authenticate that users requesting to be registered in ENUM have rights and use of their claimed number as well being able to confirm that the user claiming these rights is indeed the entity making the request. The report has proposed the concept of an authentication agency to carry out these checks and has suggested that with the exception of 08 09 mobile and ex directory numbers the agency can implement the necessary procedures through access to a Directory Enquiries database. Authentication of the exception numbers however is dependent on co-operation with the telephone service provider and this aspect will require further review

Finally, a summary of the key recommendations emerging from this preliminary review as well as a brief overview of some issues that still requires further elaboration and resolution prior to commercial deployment of ENUM are given in sections 13 and 14. It is the intention to investigate these matters further during the trial process.

What is ENUM?

ENUM (RFC2916) describes how a telephone number can be inserted in the DNS in the form of a domain name. Once the telephone number is registered in the DNS, the owner of that number can configure a set of data (known as the NAPTR record) that can be associated with that number: for example, an e-mail address, a fax number, mobile number. This data can be stored by order and preference, which is important as this will allow user applications to be written to exploit this information. For example: a voice over IP application can be written to always search for a SIP address associated with a telephone number. If a SIP address exists then a voice session can be set-up between two IP clients rather than the original IP call being routed to the PSTN. Section 3 of this report describes other aspects of ENUM and a more detailed description of other possible ENUM applications are described in Section 4.

Glossary of Terms

DTI	Dept of Trade and Industry	
UKEG	UK ENUM Group	
IETF	Internet Engineering Task Force	
RFC	Request for Comment	
ITU-T	International Telecommunications Union	
ETSI	European Telecommunications Standards Institute	
Oftel	Office of Telecommunications	
NAPTR	Naming Authority Pointer Record	
DNS	Domain Name Server	
IAB	Internet Architecture Board	
PSTN	Public Switched Telephone Network	
IP	Internet Protocol	
URI	Uniform Resource Identifier	
VoIP	Voice Over IP	PCM voice samples mapped into IP packets
SIP	Session Initiation Protocol	A VoIP signalling protocol based on Internet model
FTP	File Transfer Protocol	
MAP	Mobile Application Part	
SLA	Service Level Aggreement	
T1	Tier 1	
DNSSEC	DNS Security Extensions (Secure DNS)	
TSIG.	Transaction Signatures	
IPv6	IP Version 6	
A6	DNS resource record describing an IPv6 address or part of an IPv6 address	
DNAME	DNS resource record for reverse lookup of IPv6 addresses	
AAAA	DNS resource record describing an IPv6 address	
OS	Operating System	
24x7	24 hours a day, 7 days a week service	
DQ	Database Query	
RIPE NCC	Organisation handling IP address allocation in Europe. Reseaux IP Europeens* Network Co-ordination Centre	
TSP	Telephone Service Provider	
T2E	Tier 2 Entity	
POC	Policy Oversight Committee	

Preliminary Report

1 Introduction

Following an initial workshop held by the DTI in September 2001, a decision was taken to set up an industry Working Group with the aim of proposing a preferred framework that would facilitate ENUM implementation within the UK. It was also charged with the task of identifying any appropriate government actions needed. This document forms the preliminary report of that group.

ENUM is a protocol that is defined in RFC2916 to map E.164 telephone numbers into domain names. When those domain names are looked up in the DNS, attributes known as NAPTR records can be returned. Each NAPTR record describes a Universal Resource Identifier (URI) which indicates how to contact the owner of the telephone number that was mapped into a domain name for lookup in the DNS. RFC2915 defines the format and content of NAPTR records.

Using ENUM, when an E.164 number is mapped to a domain name and looked up in the DNS, a number of NAPTR records, each defining a URI, can be returned. These URIs can identify a number of ways of contacting the owner of a telephone number: phone, fax, email address, web home page, voicemail, PGP keys for secure email, SIP gateway for Internet telephony, mobile phone and so on. In addition each NAPTR record has ordering and preference values for the URI associated with it. This means powerful and flexible communication strategies can be applied: eg to use Voice over IP (VoIP) if the mobile phone is unreachable or to use email if the fax number is busy. With suitable tools, users would be able to manipulate their NAPTR records to allow for services like call forwarding/diversion or roaming with a hand-held device (mobile phone or electronic organiser) or laptop.

ENUM is therefore an enabler for emerging telecommunications services and technologies. E.164 telephone numbers can become the unique identifier to locate all the possible ways of contacting a user. The telephone number will become the key for access to all the available communication applications and services. Applications such as Voice over IP using the Session Initiation Protocol (SIP) and integrated messaging services will be able to exploit ENUM. It will also be possible to use ENUM in the setup and routing of telephone calls. Therefore ENUM will be at the core of the convergence between the
worlds of telephony and the Internet.

2 Working methods

The UK ENUM Group (UKEG) produced this report as the initial output of studies undertaken between October 2001 and March 2002. During this process a number of sub group activities were undertaken in order to progress individual aspects.
One such activity was the introduction of a UK based field trial to evaluate the preferred option for implementation. That activity is outside the scope of this report. The results of that field trial will be recorded in a separate document.

3 Background

The IETF published RFC 2916[1] which specified the protocol requirements to facilitate ENUM. Recognising that ENUM used numbers specified in ITU-T Recommendation E.164[2], the IETF began co-ordinating activities with the ITU in October 2000 to determine the top level implementation arrangements that would facilitate the insertion of E.164 Country Codes within ENUM. This has resulted in the production of two separate (draft)[3] documents under the auspices of ITU-T SG2.

[1] http://www.ietf.org/rfc/rfc2916.txt.
[2] ITU-T Recommendation E.164 titled 'The International Public Telecommunication Numbering Plan'
[3] ITU ENUM Supplement draft & Recommendation A-ENUM

Within the US a study team was set up during Spring 2001 to look at how ENUM could be implemented within E.164 Country Code +1. In order to define a framework for ENUM implementation within Europe ETSI SPAN11 also began work on a draft ETSI Standard[4] . This document set out a proposed architecture and a range of implementation scenarios, all of which adhered to a top level set of principles aimed towards providing consumer safeguards and alignment with the competitive and regulatory goals of the European communications industry.

The manner in which ENUM is implemented within a national environment is left to each country to decide. The final choice of scenario and the processes and rules that are applied are expected to vary in order to obtain a 'best fit' with national requirements.

This report considers the issues and options that need to be considered for ENUM implementation within the UK, (for E.164 Country Code +44) and proposes a preferred implementation.
It has been produced by a cross–industry team that included representatives from the traditional TSP environment and the Internet world, Oftel and the DTI. A list of the companies and organisations involved in producing this report is attached as Annex A and the terms of reference for the group are included in Annex B.

3.1 Brief Description of ENUM

In its simplest form ENUM is a protocol, described by RFC 2916, that can be used to populate a DNS database with a set of user data (known as the NAPTR record – defined in RFC 2915[5]). The key to accessing and manipulating this data is a 'telephone number'. The data contained against the telephone number depends on what the end user configures but examples include fax number, mobile number, SIP address, email address etc. Probably the most important aspect of the ENUM protocol is that it allows the user not only to store a list of contact information but it also allows them to put the data in terms of order and preference. This is significant because it opens the way for the development of client software to exploit this information.

3.2 How are E.164 Numbers Mapped into the DNS?

RFC 2916 describes how a telephone number can be mapped into a domain name. The number can then be interpreted by the conventional Domain Name System (DNS).

The Internet Architecture Board ("IAB"), has stated that the domain that will be used for ENUM shall be "e164.arpa". There is not yet consensus by ITU Member States on the usage of the e164.arpa domain or of any particular administrator of that domain. However, for the purpose of this document e164.arpa is considered to be the domain where E.164 numbers are stored in the DNS.

Consider the following example: The requirement is to construct the related DNS domain to look up NAPTR resource records associated with the number +44 20 7634 8700 which corresponds to the main switchboard number at Oftel.

- Write the E.164 number in its full form, including the country code, then remove all non-digit characters with the exception of the leading "+"
- Example: +442076348700
- Remove all characters with the exception of the digits and put dots (".") between each digit.
- Example: 4.4.2.0.7.6.3.4.8.7.0.0
- Reverse the order of the digits and append the ENUM Tier-0 zone to the end.
- Example: 0.0.7.8.4.3.6.7.0.2.4.4.e164.arpa

If Oftel had chosen to provision its number in the DNS for ENUM services, the client application could now perform a lookup on this name and, for example, retrieve the NAPTR records for a corresponding fax number, email address or any other URI for the E.164 number +44 20 7634 8700

[4] Draft ETSI TS 10X XXX 'ENUM Administration within Europe'
[5] http://www.ietf.org/rfc/rfc2915.txt.

ENUM – An Enabler of IP Telephony?

One of the technical challenges raised by the ever-closer integration between circuit-switched and packet-switched networks is how to address calls that pass from one network service to another. Generally, it is assumed to be desirable that an integrated global subscriber access plan exists. For example, the same ITU-T E.164 telephone number would reach a subscriber regardless of whether IP-based or PSTN network technologies are used.

It is now widely possible to originate calls from IP address-based networks to other networks, but it is uncommon to terminate calls from other networks to IP address-based networks. Rather, calls are generally terminated on the PSTN, so the called party can only use a terminal device connected to those networks.

In order to access a subscriber on an IP address-based network from the PSTN, some sort of interworking between the E.164 numbers and URIs is required. ENUM presents a candidate for this, but there are substantive issues that require resolution. The main problems are how it would be determined that an ENUM query is necessary, and how such an ENUM query would be invoked. Any solutions to address these issues would probably require substantial development of PSTN equipment, at a time when development of such legacy networks is generally being reduced.

Section 4 describes some more applications that ENUM will enable.

4 Applications

ENUM in itself is not an application. It is a key enabler that will allow applications to be developed that use the information stored in the NAPTR records.

4.1 User ENUM and Operator ENUM

There are two types of ENUM that are distinguished by the arrangements for making data entries into ENUM and the type of information held in the NAPTR records. Two types are:

- "User ENUM", which is the application originally intended and described in RFC 2916. Its purpose is to provide a wide range of information relating to E.164 numbers where the underlying assumption is that the users must provide this information as only they will know the information that relates to their numbers.
- "Operator ENUM", whose primary aim is to provide information to assist operators in handling calls. The main information envisaged is the identity for the operator who is serving the E.164 number. For example, this application would enable ENUM to be used as a number portability database.

Since the purposes are different and since the users and operators may want to choose different ENUM DNS Providers, it might be logical to have separate hierarchies in DNS for these different types of ENUM or an alternative would be to use other solutions like ‘split DNS’.

4.2 User ENUM

There has been much discussion surrounding the types of applications that might use ENUM. This section of the report discusses some possible end user applications that could be developed. Most of these applications require the ENUM customer to be able to manipulate the data in the NAPTR record in near real time so applications must be written to enable this.

Voice over IP (VoIP) is considered by some to be the ‘killer application’. In this scenario the NAPTR record is used by a piece of client VoIP software to determine if the called party has a SIP address. If so a voice call that would otherwise have gone to the PSTN could be directed to a VoIP client on the Called Party’s terminal equipment. From the Calling Party viewpoint they are just dialling a PSTN

number. The added advantage with ENUM is that the Called Party does not need a new number to receive a telephone call on their PC/IP device.

Lookup service: An end user requests the contact information of another end user by interrogating the ENUM database. They can then decide which medium is most appropriate to contact them.

e-mail using a phone number: The sending user has no idea if the receiving user has an e-mail address and uses their telephone number to send an e-mail.

Instant messages using a phone number: Sending user can send instant messages to a phone number rather than to a URI.

Fax sent to phone number: Sending user can send a fax to a phone number rather than a specific fax number. Thus, if a number that the recipient uses for voice communication is the only one known, ENUM allows the call to be directed to a number with a fax machine attached.

Web site / File transfer protocol : Internet resources, such as a web site, or FTP site, may be identified by their telephone number for example, a company Freephone number could be used to access a Web site.

Unified messaging platform / intelligent service selection: A service provided to an ENUM enabled end user to allow them to manipulate incoming communications onto the preferred medium/location. For example, all incoming communications could be directed to a mobile using ENUM data.

Global call forwarding / "follow me" services: Call forwarding services on a global basis could be offered because the ENUM databases will automatically be linked via the DNS.

4.3 Operator ENUM

RFC 2916 describes how an end user can populate an ENUM database to produce a NAPTR record that is stored in DNS. This ability for ENUM to act as a type of translation database has been picked up by some players who see the potential for this to be used for network/provider applications. This would be know as 'operator ENUM' as opposed to 'user ENUM' described in the previous sections. Unlike user ENUM it may not necessary for users to 'opt in'. Operator ENUM is created by the operator, for their own private use, by loading all the relevant customer information. The following describes a list of services/applications that could be developed or provided to operators but it should be noted that the following descriptions are for information only and the focus of this report is User ENUM.

Routeing VoIP calls: A phone number can be translated into a URI or an IP address for routing calls on an IP network.

Home location / visit location register for wireless : An ENUM enabled DNS can be used to map the E.164 number of a network element to an IP resource. This capability allows two mobile networks elements to exchange Mobile Application Part (MAP) messages over IP instead of over SS7 networks. This may be highly applicable to 3G networks.

Number Portability: At present, Number Portability in the UK is accomplished by routeing calls via the "donor" network. However, it is conceivable that in the future, either on the grounds of network efficiency or regulatory mandate, a solution could be required where all calls are queried to a central database of ported numbers. While the conventional approach to such an architecture is to have a monolithic database, an alternative approach could be to have the number portability data stored in operator ENUM. Since the queries to ENUM would have to be generated from PSTN elements, either those elements would have to be modified to support DNS queries, or interworking between IN and DNS elements would have to be put in place.

Other translation services: Any network based on IP that needs to translate from a telephone number to another communication medium has the potential to use operator ENUM.

The use of 'Operator ENUM' alongside User ENUM also has the potential to benefit from economies of scale.

5 Regulatory Issues

5.1 ENUM Regulation

ANNEX C provides information, supplied by Oftel, on the potential regulation relating to ENUM. Both existing and future guidelines have been considered.

5.2 Consumer Protection/ Data Privacy

The ENUM Registrant will choose whether or not to load his or her data and no telephone numbers will be registered without the consent of the authorised assignee of that number. This known as 'opt-in'. The UKEG have agreed that this principle will be incorporated into the guidelines and working practices for the UK. It was also agreed that as part of the 'opt-in' principle no database will be populated with numbers that are not assigned to end users.

RECOMMENDATION 1: The UK will adopt a policy of 'opt-in' for the UK implementation of ENUM.

RECOMMENDATION 2: No database will be populated with numbers that are not assigned to end users.

The ENUM Registrant will also determine what information will be loaded onto his or her record(s), set preferences regarding how such information would be associated with his or her telephone number as well as the manner of use. This is in line with recommendations received from the Information Commission.

Consumer choice is one of the hallmarks of ENUM. From a Data Protection point of view, and assuming there in no overriding legal obligation to provide or disclose information, the fundamental premise is that there should be transparency, that is that consumers should know how their information is going to be used. Where consumers are in a position to make an informed choice about what information they wish to share with which individuals/organisation, or make available generally, there should not be a problem from a Data Protection point of view.

There will be a need to ensure that individuals have a good understanding of how their data will be used and of the likely consequences to them.

There is a need to ensure that any consolidated database of personal data should be subject to appropriate security controls to minimise the risk of 'hacking'.

RECOMMENDATION 3: The UK implementation will adopt all recommendations on consumer protection and data privacy in line with guidelines and best practice as advised by the Information Commissioner's Offices.

There are a number of aspects to be considered on Consumer Protection and Data Privacy for ENUM subscribers, as individuals or as corporate users[6].

There is also the issue of the Information Commissioner (I/C) maintaining a public register of data controllers. Each registry entry should include the names and addresses of the data controllers (i.e. Level 2 Registrars) and a general description of the processing of personal data by a data controller. Notification is the process by which a data controller's details are added to the IC Register. The Data Protection Act 1998 requires every data controller who is processing personal data to notify unless they are exempt.

[6] A "subscriber" is a person who is party to a contract with a Telecommunications service provider for the supply of publicly available Telecommunications services. A "corporate subscriber" is a "subscriber who is not an individual and who has legal personality". Individual is a living person and includes an unincorporated body of such individuals.

The principles of European Data Privacy legislation must be adhered to in addition to the UK Regulations concerning the processing of personal data and the protection of privacy in the telecommunications sector, which was adopted on 15 December 1997 under Directive 97/66/EC. The Telecommunications (Data Protection and Privacy) Regulations 1999 are designed to "particularise and complement Directive 95/46EC". This Directive only applies to personal data that is information relating to living identifiable individuals. However, the Telecommunications Data Protection Directive (TDPD) applies to the processing of personal data in connection with the provision of publicly available telecommunications services[7] in public telecommunications networks in the Community. Although ENUM is not an application, the ENUM Registrars and telecommunications operators must adhere to the current UK legislation that is regulated by the I/C.

5.3 Number Portability

ENUM in itself is not an application. Therefore the impact of Number Portability is limited to the process of authentication in that it may be more difficult to authenticate a ported number, this issue is discussed further in section 10.3.2. Number portability should have no other impact on ENUM.

Although, ENUM is not an application, the applications that use ENUM must ensure that the existing requirements for number portability will be retained.

RECOMMENDATION 4: ENUM applications must ensure that the existing requirements for number portability are retained.

5.4 Numbers included in ENUM

In principle all numbers should be treated equally and any number range can be included in ENUM. However, there may be a different authentication process for some numbers such as specially tariffed and pre-paid mobiles.

RECOMMENDATION 5: In principle any UK number range can be included in ENUM

5.5 Shared numbers.

Fundamentally there is only one assignee of a number. Therefore, a family sharing a number for the household will only have one number and only the person to which the number is assigned can participate in ENUM. There may be a case here for assigning numbers from a special number range specifically for ENUM, although there is already a personal numbering range in existence.

5.6 WHOIS support

WHOIS is a capability that allows users to determine the owner of a given domain name. If WHOIS was fully enabled for ENUM, it would yield the owner of the domain name associated with a given E.164 number, i.e. the assignee of a given number. As such, it would allow a reverse lookup from a

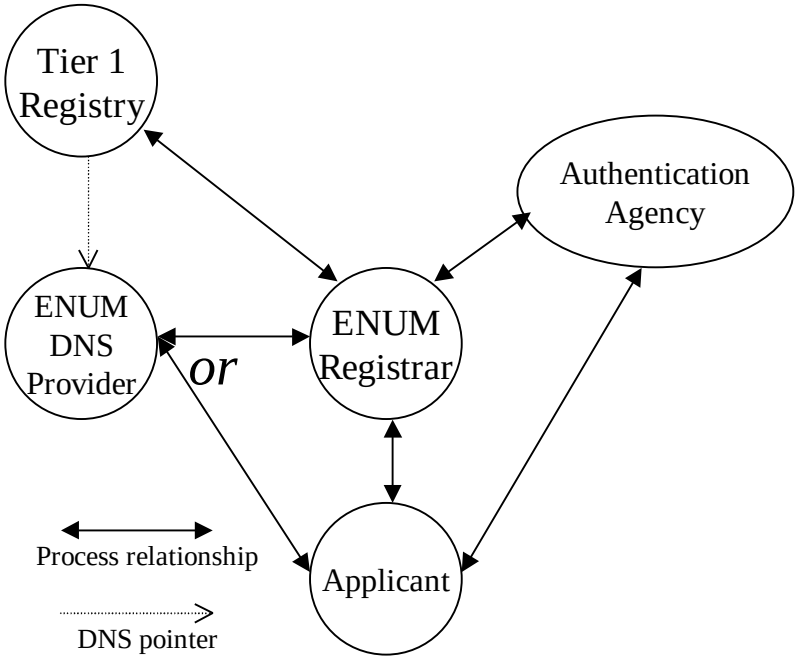
[7] "Definition of Telecommunications Services" means service which consist of, in whole or in part, of the transmission and routing of signals on telecommunications networks, not being services by way of radio or television broadcasting. The I/C's view is that the transmission of messages using the above media will be covered by the Directive unless specifically excluded (Radio and Television Broadcasting). This is an argument that email may be covered. The Department of Trade and Industry has taken the view that not all the provisions of the TDPD apply to email.. This is based on the use of the word "call" in Article 10 and 12 of the Directive which they consider implies that those provisions only apply to conventional telephone calls. The I/C recognizes the basis of this approach but considers that the relevant definitions are those relating to **public telecommunications networks** and **telecommunications services** and that these cover email. The I/C recognizes that it may not, in practice, be easy to apply all the provisions of the TDPD, and of the Regulations giving effect to the Directive, to email services as they are currently organized. In considering compliance with the Regulations, she will take all relevant circumstances into account. In any event, it is important to appreciate that any processing of personal data within the I/C's jurisdiction that is not expressly caught by the TDPD (97/66/EC) will be caught by the Data Protection Act 1998 which gives effect to the requirements of Directive 95/46/EC.

telephone number to a customer identity, which raises profound privacy questions. In addition this also causes specific problems where the assignee of the number has chosen to remain Ex-Directory and not have that number published. Set against this, if WHOIS was not enabled, it could make the tracing of the ownership of fraudulently obtained ENUM entries more problematic. A possible compromise is to enable WHOIS, but such that the result gave the identity of the ENUM Registrar associated with a given number rather than the identity of the domain name holder themselves. Issues associated with WHOIS will require further consideration during the trial.

6 Players in ENUM

During discussion in UKEG it was agreed that the terms Tier 2 Registrar and Tier 2 Registry were confusing and misleading. It was agreed to change these terms to ENUM Registrar and ENUM DNS Provider respectively

It should be noted that throughout Annex D, which evaluates the options, it is assumed that the ENUM Registrar provides the authentication services. However, it was recognised after these evaluations were concluded that the entity performing the authentication of a user could be a separate business entity known in this report as the ***Authenticating Agency***.



The following list indicates the functions of various players in ENUM:

Tier 0 – Top level of ENUM, not within scope for discussion of UK options

Tier 1 Registry:

- Maintains and updates the authoritative zone file for the domain of which it is responsible.
- In most options holds pointers to ENUM DNS Provider for each individual number

ENUM Registrar:

- Ensures that an entry in the Tier 1 database is provided and points to the appropriate ENUM DNS Provider
- Bills the customer for registration service
- May also provide the ENUM DNS Provider services.

ENUM DNS Provider:

- Provides DNS name server services
- Loads and maintains NAPTR records
- May bill the customer directly for services provided.

Authentication Agency:

- Validation that the registrant has the right to enter the requested telephone number in the database.
-
- Ongoing validation to ensure that the ENUM database is accurate and up to date

7 Options for implementation

The following 9 options were evaluated by UKEG. Details of these options can be found in Annex D.

Options

Option A - Single T1 Registry + competitive ENUM Registrars

Option B - Single T1 + competitive ENUM DNS Providers + competitive ENUM Registrars

Option C - Single T1 + competitive ENUM DNS Provider/Registrar

Option D - Single $T1_a$ + multiple $T1_b$Registries + competitive ENUM Registrars

Option E = Single $T1_a$ + multiple $T1_b$ Registries + competitive ENUM DNS Providers + competitive ENUM Registrars

Option F = Single $T1_a$ + multiple $T1_b$ + competitive ENUM DNS Provider/Registrar

Option G - Multiple T1 Registries + competitive ENUM Registrars

Option H = Multiple T1 Registries + competitive ENUM DNS Providers + competitive ENUM Registrars

Option I = Multiple T1 + competitive ENUM DNS Provider/Registrar

8 Evaluation Process

The following decision process was used.

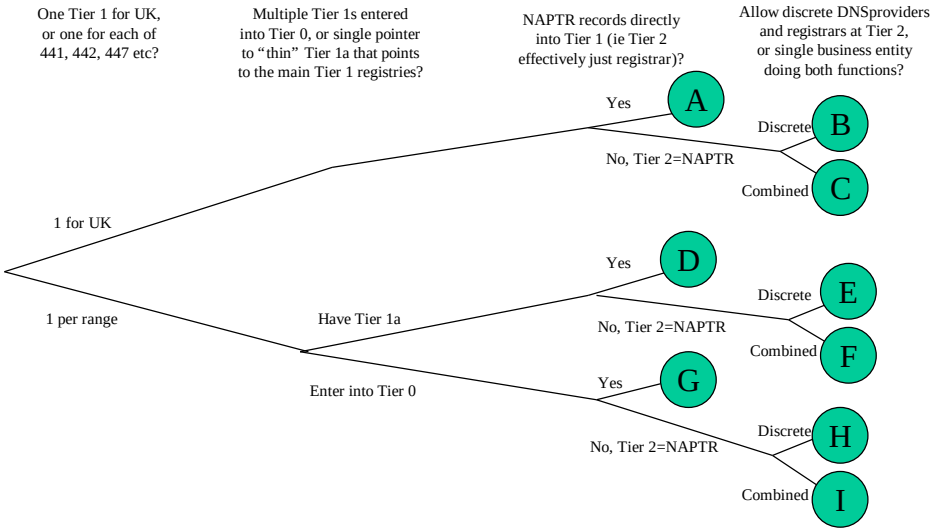


Figure 8.1 Decision Points

The two right hand questions, regarding the Tier 2 aspects, were evaluated independently from the two left hand questions, which consider the Tier 1 issues.

8.1 Impact of options

Full analysis of the questions can be found in Annex D. However, the conclusions can be summarised as follows:

8.1.1 Tier 1

The first question addressed whether it was best to have a single Tier 1 entity for the entirety of the UK numbering plan, or whether to divide the role according to number range, for example fixed versus mobile ranges. In the categories of Regulatory/Competition, Security and Operational/Technical, the usage of Tier 1 has clear advantages over segmenting the scheme between multiple Tier 1s. Given that the remaining category of User Experience resulted in no preference for either scheme, it is clear that an architecture of a single Tier 1 entity for the UK should be recommended.

Many of the disadvantages of having a single Tier 1 can be mitigated against by having clear governance of that entity, in the form of contractual arrangements, Service Level Agreements and open processes. It is likely that in order to meet the governance requirements, the Tier 1 entity could need to either be a not for profit organisation, or have a regulated rate of return.

It is also worth noting that it is assumed that as part of the SLAs and contractual arrangements required to support the case for a single Tier 1, formally agreed back-up and data escrow procedures must be strictly adhered to.

Given the recommendation of having a single Tier 1 entity for the UK numbering plan, there is no need to answer the questions of how multiple Tier 1 entities would be accommodated. However, it is worthy of note that no decisive arguments in favour of either option of accommodating such an approach.

RECOMMENDATION 6: The UK will implement a single Tier 1 Registry architecture serving all UK E.164 numbers.

8.1.2 Tier 2

In terms of Tier2 architecture two questions are posed. The first question addressed is where NAPTR records are stored. NATPR records can be stored in Tier1 Registry or alternatively in ENUM DNS Providers.

The second question addressed is whether it is allowed to have a single business entity offering ENUM Registrar, authentication and ENUM DNS Provider services, or whether it is necessary to introduce some form of regulation to prevent the same business entity from operating in all these areas and offering an overall service

In relation to the first question, in the categories of Regulatory/Competition, Security, Operational/Technical and User Experience the storage of NAPTR records in ENUM DNS Providers has advantages compared to the solution where these records are stored at the Tier1 Registry level. The storage of NAPTR records in ENUM DNS Providers introduces more competition and customer choice, works better from a technical and operational point of view and reduces security risks.

It therefore recommended that NAPTR records are stored in the ENUM DNS Providers. For each E.164 number inserted in ENUM, Tier1 registry contains pointer to the appropriate ENUM DNS Provider where the correspondent NAPTR record is stored.

RECOMMENDATION 7: NAPTR records will be stored in the ENUM DNS Provider's database.

In the relation to the second question, in the categories of Regulatory/Competition, Security, Operational/Technical and User Experience there is not a clear indication of the benefits to prevent a single business entity from offering all three services: registry, authentication and DNS Provider services.

It is therefore recommended that the decision to provide all or one service is left to business and commercial considerations that may vary from company to company.

RECOMMENDATION 8: The UK will implement an architecture at Tier 2 that will allow entities to provide one or all of the following services:

- **ENUM Registrar services**
- **DNS Provider services**
- **Authentication Agency services**

8.2 The preferred model

The preferred model for the UK is shown in Figure 8.1

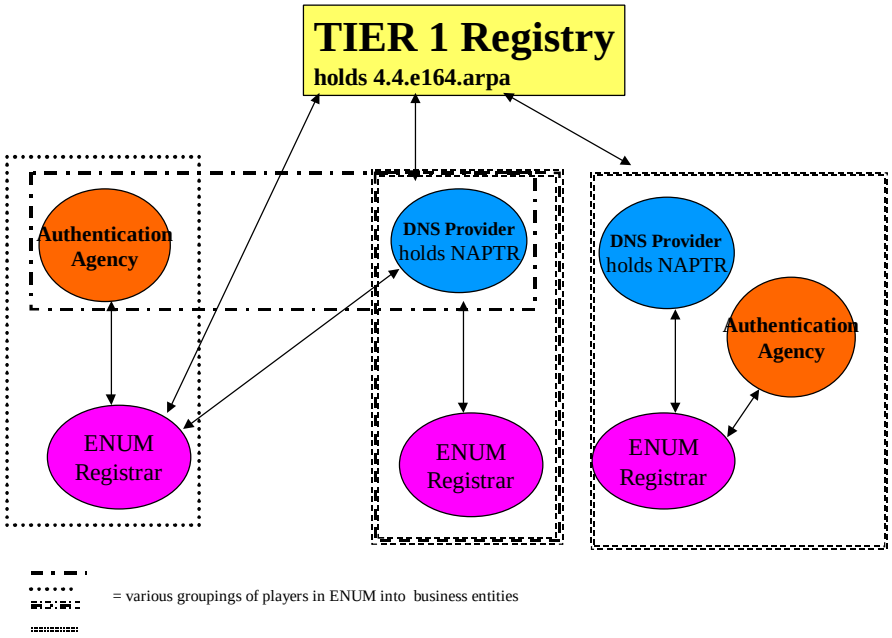


Figure 8.1 Preferred ENUM Model for the UK

In this model there is a single Tier 1 registry and the option to implement either discrete and combined ENUM DNS Provider/Registrar/Authenticating services at Tier 2.

9 Governance and selection criteria of Tier1 registry

This report has argued that the role of a Tier 1 Registry is best carried out by a single entity as opposed to competing or multiple entities. Competition in ENUM services is proposed to take place at the ENUM Registrar level. Whilst in principle, there is nothing preventing deployment of multiple tier 1 entities, section eight of this report has reviewed the pros and cons of single versus multiple tier 1 entities and concluded that the balance lies in favour of a single entity. It has also been suggested that there is an analogy between the monopoly role of the entity who allocates and assigns telephone numbers and the monopoly role of the entity who provides tier 1 ENUM services.

The Tier 1 Registry is the UK national registry for ENUM and is responsible for the authoritative name servers and zone files for 4.4.e164.arpa. The Tier 1 Registry does not handle NAPTR records but points at the ENUM DNS Providers where NAPTR records associated to E.164 numbers of the national numbering plan are stored.

It should be noted that the Tier 1 Registry does not have any policy or governance responsibility in ENUM, but will be responsible for the implementation of policy effecting the Tier 1 level.

In order to ensure the presence of an appropriate and effective policy framework it is suggested that a Policy Oversight Committee (POC) be established. The membership of the POC will be drawn from the stakeholders in UK ENUM and will include consumer and business representatives together with ENUM players. The role of the POC will include policy formulation, review and implementation, regulatory matters (e.g. Tier 1 Registry functions, ENUM Registrar accreditation, Validation Entity functions) and the monitoring of the operational framework for the provision of ENUM in the UK. The POC is also responsible for advising the DTI, and any other appropriate governmental agency, on ENUM policy and governance. The selection of the Tier 1 registry, re-delegation of the Country Code 44, resolution of disputes between Registrars, Validation entities and the Tier 1 Registry are examples of situations that may require governmental actions or decisions.

Figure 9 illustrates the POC interactions with other ENUM players.

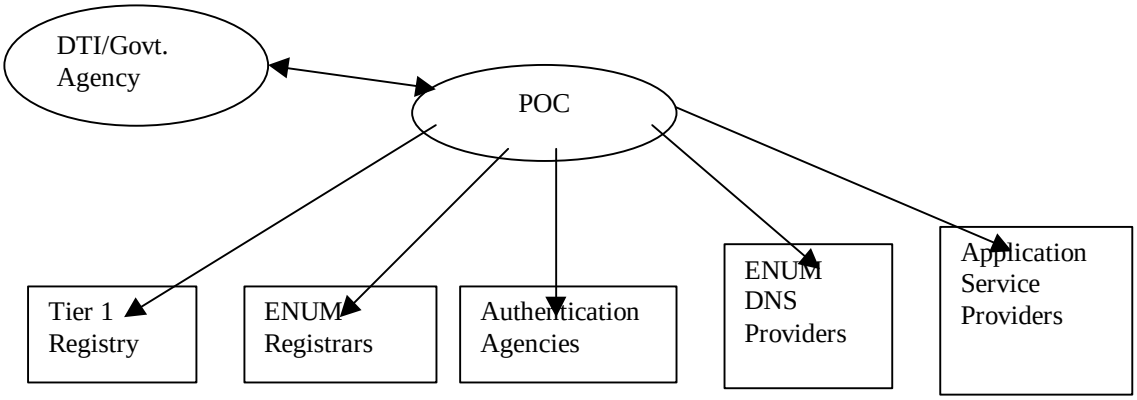


Figure 9

The detailed membership of the POC, its working methods, legal status and the role of the government in this committee are still to be defined further. One approach is to open membership of the POC to all parties having an interest and participation in the implementation of ENUM and related services in UK. Because of its policy role, particular attention has to be paid to avoid possible conflicts between the commercial interests of POC members and POC overall policy and regulatory functions.

Given that the single tier 1 entity will be a natural monopoly in the market of tier 1 registry services then it is essential that principles are established to ensure that the operational framework for the tier 1 registry are based on fair, non-discriminatory, transparent and objective criteria. The POC will have a role in the establishment and monitoring of this operational framework.

RECOMMENDATION 9: The UK should create a Policy Oversight Committee for UK ENUM

9.1 Role of Tier1 Registry and selection criteria

The ENUM Tier 1 Registry will provide DNS functions (authoritative Name Servers and zone files) for 4.4.e164.arpa and offer Registry services to the ENUM Registrars.
Based on technical and operational considerations, it is recommended that the Tier 1 registry role is best carried out by a single entity as opposed to competing entities.

Competition in ENUM is proposed to take place at the next level, more specifically in terms of ENUM Registrars and ENUM DNS providers.

The decision to have a single Tier 1 Registry implies that the organization offering these services operates in a monopolistic regime. It is therefore crucial to have in place a number of safeguards to ensure that the Tier 1 Registry does not abuse its unique position and offers stable and innovative services to the whole industry in a non-discriminatory and efficient way. Such safeguards may include regulation, self-regulation or co-regulation.

In order to achieve these goals, the Tier 1 Registry must operate in accordance with the following principles:

1) Cost recovery: The Tier 1 Registry should apply charges that are structured in such a way and at such a level that they will permit the Tier 1 Registry to cover its costs for the development and provision of the registry services, whilst ensuring financial resources for technical innovation and continuity of the service;

2) Cost and operational efficiency: The Tier 1 Registry will perform its functions and offers its services in such a way as to minimize its costs and optimize the use of deployed resources;

3) No discrimination: The Tier 1 Registry will offer its services to ENUM registrars, ENUM DNS Providers and any other interested party on the basis of fair and equal treatment;

4) Stability, Security and Reliability: The Tier1 Registry will offer technical and financial guarantees to be able to provide its service in a stable, secure and reliable way without service disruption for ENUM registrars, ENUM DNS Providers and any other interested party;

5) Transparency: The Tier 1 Registry will perform its functions and offer its services in a transparent way, allowing easy access to the relevant information by the appropriate bodies;

6) Technical innovation: The Tier 1 Registry will ensure technical innovation that allows the provision of better and innovative registry services with benefits for the whole industry;

7) Neutrality: The Tier 1 Registry will confine its services and commercial interests to the Tier 1 level and will not offer services as an ENUM Registrar, ENUM DNS provider ENUM Application Service Provider or at any other level within the ENUM structure.

To ensure that the Tier 1 Registry follows the above listed principles in performing its functions, the Tier 1 Registry will be accountable to the POC.

One option would be for the organization selected as the Tier 1 Registry to operate on a contractual basis for a period of time under the direct control of the POC and ultimately of the government. The duration of the contract is an important factor. It should be long enough to allow Tier 1 Registry to recover investments and running costs of the required resources to offer reliable, successful and innovative registry services. On the other hand, the duration of the contract should not be too long in order to prevent, because of lack of competition, the Tier 1 Registry from providing unsatisfactory services and exploiting, in a anti-competitive way, its unique position.

In particular, questions arise regarding the selection process for the tier 1 registry - who should do the selection?, who defines the governance principles for running the registry?, what are these principles?, and how do we ensure continuity if at some point in the future if the incumbent Tier 1 Registry is not able to carry on?.

The DTI has indicated that they have not taken any position, at this time, on whether there should be a role for government in these matters, but as a general principle government would prefer to see maximum use made of self-regulatory procedures, where appropriate. It is not clear at this stage as to what legal powers the government has to intervene in this process and even with these powers, there would be a reluctance to put in place *ex-ante* regulation unless there are strong imperatives to do so.

This UKEG report is therefore not proposing whether there should or should not be a government role in the tier 1 selection and operation.

It is suggested that the selection of Tier 1 Registry has to take place through an open, public and transparent process (e.g. public bid, etc.). The POC has an advisory role in the selection process offering its evaluations to the body in charge of appointing the Tier 1 Registry.

The selection of the Tier 1 registry will be based on the above criteria, together with cost and relevant experience.

RECOMMEDNATION 10: **The selection of the Tier 1 registry for the UK should take place using an open, public and transparent process and selection based on the criteria proposed, together with cost and experience.**

10 Criteria and Principles of ENUM Registrars, ENUM DNS Providers and Authentication Agencies

The recommendations covered in this section are a set of preliminary criteria that needs to be investigated and elaborated further during the trialling period. They are not being put forward as a proposed set of regulatory criteria for compliance purposes.

ENUM Registrars, DNS Providers and Authentication agencies have the right to be able to offer service to which ever market sector they decide is right for their business i.e. there is no universal service obligation.

10.1 Criteria and Principles for ENUM DNS Providers

Criteria for providing DNS hosting services for ENUM:

[1] Name servers must support NAPTR records.

[2] Name servers should support DNSSEC and TSIG.

[3] Servers should support IPv6: A6, DNAME & AAAA records; IPv6 transport.

[4] Servers should be installed in co-lo facilities with 24x7 monitoring, backup power supplies, etc.

[5] Name servers must have recursion disabled. They must not fetch glue.

[6] Name servers should not serve other zones.

[7] Servers must have adequate bandwidth and connectivity to the Internet.

[8] Servers should have sufficient capacity to support reasonably high query rates, typically a few hundred queries per second.

[9] Servers must not run insecure name server software.

[10] The operating systems of the servers must be secured against attacks: security penetration, denial of service, etc. Adequate logging and audit trails should be provided.

[11] Servers must be configured with the minimal set of network services enabled: secure access, network time protocol, DNS and some monitoring software.

[12] Query logging and traffic pattern data should be enabled for troubleshooting and statistical analysis.

[13] Technical and administrative contact information must be provided and kept up to date. This will include details of the server location(s), IP address(es), OS & name server configuration details, email addresses, contact names and phone numbers, etc, etc.

10.2 Criteria and Principles for ENUM Registrars

ENUM Registrar Recommendations:

[1] ENUM registrars should ideally have prior experience providing registrar services.

[2] ENUM registrars must be able to operate with the interfaces, provisioning systems, and protocols provided by the Tier 1 Registry. They should have flexibility to accommodate changes to those interfaces, protocols or systems should these arise.

[3] Adequate customer support services should be provided.

[4] Systems used for ENUM must be operated securely and in accordance with UK privacy and data protection legislation.

[5] ENUM registrars must comply with any authentication schemes or agents needed to identify the owner of a telephone number.

[6] An ENUM registrar must not use data from an application for any other purposes, including but not limited to entering the telephone number into any other domain, without the express permission of the owner of the telephone number. Similarly, data supplied for any other purpose must not be used to create ENUM entries without that express permission.

[7] ENUM registrars must pay the tier 1 registry the documented fees in accordance with the terms agreed between them.

[8] Name servers used by an ENUM registrar to host customer's ENUM data should comply with the DNS hosting recommendations described in Section 10.1.

10.2.1 Accreditation of ENUM Registrars

Consideration has been given to which, if any entities would need accreditation, and if so who would carry out this function. It is clear that the Authentication Agency(ies) would require accreditation, and that the ENUM DNS Providers would not require accreditation (given they are carrying out a "vanilla" DNS function). However, the position is not clear for ENUM Registrars. The advantages of accrediting ENUM Registrars are as follows;

- By accrediting ENUM Registrars, the Tier1 Registry can effectively treat them as a trusted party, in absence they would have to be treated as an untrusted party.

As an untrusted party, the ENUM Registrar would have to provide validation information from the Authentication Agency to the Tier1 Registry in each communication, implying that the Tier1 Registry would have to check this. This would imply additional (albeit small) functionality at the Tier1Registry - as this is a monopoly this is arguably inefficient.

- Without accreditation, only the Tier1 Registry would be considered to be trusted, meaning that functions around monitoring when the "subscription" on a given number was due to expire and initiating the removal of that subscription in absence of a renewal, would have to be carried out by the Tier1 Registry. As with the previous bullet, arguments around monopoly efficiency point to limiting the role of the Tier1.

Set against this, the principal disadvantage of accrediting ENUM Registrars is that some form of accreditation regime would be required, raising questions of who would accredit, against which criteria, with what legal basis and so on. A decision has therefore not been reached, and the issue will be explored during the trial.

It is also recognised that the whole business case for ENUM is critically dependent on the emergence of converged services and applications being competitively deployed over the ENUM infrastructure. This market for services is only likely to emerge if the costs for using the underlying ENUM infrastructure are not prohibitively expensive. Hence when considering what form of accreditation mechanism needs to be in place to ensure ENUM Registrars are considered as trusted entities there needs to be a balance between, on the one hand the need to prevent wide spread abuse of ENUM registrations, and on the other hand the need not to set up commercial barriers to market entry by having too cumbersome and costly procedures in place at the ENUM infrastructure level.

It should be noted that whether accreditation is in place will affect the administrative processes used for ENUM, see Section 11.

10.3 Criteria and Principles for Authentication Entities

Authentication was a major discussion item with the UKEG. It was assumed that one of the prime requirements of implementing ENUM was to authenticate the End User i.e. we must be certain that the person loading a telephone number into the DNS via ENUM has the authority to do so – they ‘own’ the number. The alternative view is that there is no need for an authentication process as this may hamper, add cost and complicate the ability of a user to opt-in to ENUM, then if a telephone number is ‘hi-jacked’ by a user who does not have rights to that phone number then a robust dispute resolution process will suffice. However, to enable the trial to move forward it was agreed that a certain level of authentication is required.

From the base assumption that authentication is required it is clear that it is fundamental part of provisioning, moves and change processes.

This section discusses the recommended authentication process that an Authentication Agency should employ. However, if a potential or existing Authentication Agency can demonstrate that they can employ another reasonable and robust process they should be able to argue this case to Policy Oversight Committee. It may then be adopted as an alternative process.

10.3.1 Proposed Authentication process

There are essentially two checks that must take place:

Check 1: It is necessary to verify that an entity has the right to use the number.

Upon the initial application the ENUM Applicant will supply their name, address and telephone number that will be registered in ENUM. The Authentication Agency will then verify that the person with that name and address has been allocated the number to be held in ENUM. Both the name and address should match, with an allowance for reasonable spelling errors.

The verification is normally carried out by checking the number with the name and address information in the Directory Enquiries (DQ) Database. However, some number ranges are not held in the DQ Database and also some subscribers information will not be stored if they are ex-directory. Treatment of these exceptions is specified in 10.3.2.

This check verifies that the named person, on the ENUM application form, has the right to register that number. It also verifies that the named person lives at the address supplied.

Note: The authenticating agency may also request the name of the subscriber's Telephone Service Provider (TSP). This may simplify the process for those numbers not included in the DQ Database – See section 10.3.2.

Check 2: It is necessary to verify that the ENUM Applicant is the entity with those rights.

This check is much more difficult to carry out. The UKEG decided that the best solution was to require the Authentication Agency to issue a paper letter with a PIN number. The address that the PIN number is sent to would be the address that appears in the DQ database. The PIN would then be used by the ENUM Applicant to complete the registration process, probably 'on-line'.

This check goes some way towards ensuring that the entity applying for ENUM registration is that person. The weakness in this part of the process is that another entity may tamper with the mail. However, it was considered that likelihood of this happening was small and that overall this was an acceptable risk.

10.3.2 Process for Exceptions

Check 1 of the authentication process relies on the number in question being in the DQ database. However, there are many numbers that do not appear in the DQ database which will probably require the ability to register in ENUM. Those exceptions are:

- **08 and 09 numbers:** Arguably it is these numbers that are most likely to require ENUM registration.
- **Ex-directory numbers:** It may appear to seem odd for an entity with an ex-directory number to want to load their number in ENUM. However, ex-directory numbers usually do not want their name matched to their number not the other way around. It is perfectly feasible for an ex-directory number appear in ENUM as it will enable the ENUM subscriber to have control and load contact information to parties who already know their phone number. *This said, it must be acknowledged that reverse look-ups may prove to be a problem.*
- **Mobile numbers[8]:** Given the fact that a substantial amount of telephone subscribers use their mobile as the prime means of communication it is perfectly reasonable to assume that these numbers should be able to be registered in ENUM.

In these cases, Check 1 can be completed in most cases by the Telephone Service Provider who was allocated the number block that contains the number. This TSP can be identifed by simple analysis of the number using information available from the Oftel web site. If the number has been ported, this TSP will have knowledge of the "recipient" TSP that possesses the information necessary for verification and can forward the request to them.

In the UK there are number portability processes already in place for all the numbers described above and these processes include verification of name and address similar to that needed for ENUM. Therefore, the UKEG recommends that the ENUM registration process should make use of the existing

[8] Pre-paid mobiles will be excluded from ENUM until a satisfactory authentication process has been identified.

number portability verification procedure for ENUM Check 1 for the exception numbers described in this section.

However, there are some major issues with this recommendation that may require further study, not least of which is that this explicitly relies upon the TSP who was originally allocated the numbers to provide the verification service. A TSP would be likely only to provide this service:

- If required to do so by regulation
- If paid sufficient to cover costs and an appropriate profit element

It is possible that Data Protection laws can be invoked in this case to force the TSP to provide this verification information but this needs further study.

10.3.3 Accreditation of the Authenticating Agency

It is assumed that a TSP would automatically assume the status of an accredited Authentication Agency. However, with respect to other Authentication Agencies, the UKEG agreed that initially they could be accredited by demonstrating to the Policy Oversight Committee that they had a robust and secure process. The following is an initial list of what may be demonstrated:

1. The authentication of a minimum amount of numbers (may or may not include the 'exception numbers')
2. A dispute resolution process exists
3. Records are accurate and secure
4. Data protection laws are adhered to
5. Scope of cover (e.g. are they intending to offer service to all or just DQ numbers?)

*Issue: What protection, **if any**, is required to stop an Authenticating Agency refusing to authenticate a legitimate end user? There was concern that especially in the area of 'exception numbers' there was an effective monopoly on authentication services.*

11 Process to initiate, change or cease an ENUM subscription

To enable application to take advantage of the information provided by ENUM an end user must first be able to register and upload their information to the DNS. Annex G includes a detailed description of the provide, change and cease process for an ENUM subscription. However, the following are some underlying assumptions:

- ***Authentication:*** For the purpose of this report the process in Annex F assume that authentication is largely done by adopting the process described in 10.3.
- ***Cessation:*** relies on customer notification, but with a renewal clause where the customer has to take action to keep the service. This ensures numbers no longer in use are reclaimed.
- ***Accreditation:*** As described earlier in this document, while it is assumed that the Authentication Agency(ies) will be accredited, no conclusion has been reached on accreditation of ENUM Registrars. The processes within Annex F assume that the ENUM Registrars will be accredited. If they were not, then the principal changes would be as follows;
    - Whenever the ENUM Registrar contacted the Tier1 Registry, they would need to send the Authentication Information and the Tier1 would have to validate this. This affects the initial provisioning, changes of Registrar, change of DNS provider and cessation.
    - Logs of the time since the entry of a given number in ENUM would have to be kept by the Tier1 Registry rather than the ENUM Registrar. This means that cessation processes would have to be initiated by the Tier1 Registry rather than the ENUM Registrar.
- ***ENUM Registrar is co-ordinator:*** Process flow is based around ENUM Registrar co-ordinating orders (Tier 1 & ENUM DNS Provider do not communicate directly - this is in line with ETSI, US ENUMF documentation)
- ***Cash flow model:*** Commercial aspects (who pays whom when) have been built in to this text as cash flow models.
- ***Resellers:*** No concept of resellers has been built into these processes but this does not preclude them. The reseller would provide the role of managing the customer relationship on behalf of the ENUM Registrar. Therefore, they are outside the scope of these processes.
- ***Time scales:*** Time scales are not built into the processes but must be included in future.

12 UK Trial of ENUM

The aim of the ENUM Field Trial is to test architectural, technical, operational and user experience aspects related to the provision of ENUM capabilities, as defined in IETF RFC 2916, for Country Code 44.

Results collected in the trial will enable UKEG, and any other interested party, to gain information and experience on how to provide and implement ENUM capabilities in the commercial phase.

Organisations who wish to participate in the UKEG trial will need to sign an MOU and study the Trial business plan. A preliminary copy of each document is included in Annex H.

Objectives of the trial

- To evaluate the pros and cons of the different options developed by UKEG to implement ENUM capabilities with particular emphasis on the Registry and Registrar role
- To evaluate processes/interfaces/protocols for the interactions between the different parties (Tier 1 Registry, ENUM Domain Name System (DNS) Provider, ENUM Registrar, Application Service Provider, Number Assignment Entity, Telephone Service Provider)
- To determine technical and operational requirements to provisioning ENUM records at Tier 1 Registry and ENUM DNS Provider level
- To assess DNS requirements/ implications in the provision of ENUM services
- To determine security and verification requirements for provisioning and operation of ENUM capabilities
- To test from a technical and user perspective applications based on the use of ENUM capabilities
- To evaluate and refine the economic benefits and costs of supporting ENUM.

The results of the trial will be used by UKEG to determine the preferred implementation framework for the provision of ENUM capabilities behind Country Code 44.

13 Outstanding issues

The following discusses, in brief, a number of issues that were unresolved during the period covered by this report. The next phase for the UK is to implement a trial and it is hoped that many of the following issues can be further developed by the trial group. Some issues will also be progressed by the UKEG which will continue to operate, in parallel to the trial group, during the trial period

13.1 Clarification of the regulatory framework applicable to UK ENUM

Although Annex C provides information regarding the potential regulation that could be applied to ENUM, this issue has not been sufficiently investigated to allow the UKEG to describe exactly what regulation will apply to ENUM and in what way.

13.2 New number range for ENUM

The advantages of providing a special number range specifically for ENUM are not clear. There may be advantages for opening a new range for certain applications that will use ENUM data (e.g. VoIP), although the existing personal numbering range may surfice.

There may also be advantages in the scenario described in section 5.4 where an individual does not ‘own’ a telephone number but wishes to participate in ENUM.

This issue will be driven by market forces and will follow existing Oftel procedures that would require a request to be made for a new number range for ENUM, possibly followed by a consultation period.

If a new number range is considered it should be in addition to existing numbers rather than a substitute.

13.3 Development of Policy Oversight Committee

The UKEG have recommended, for a number of reasons, that a Policy Oversight Committee be established in order to monitor the operational framework of ENUM and make judgements and/or recommendations on future issues. However, the role, status, membership and procedures of the Policy Oversight Committee and the relationship of the committee with other entities, such as the DTI, have not been developed.

13.4 Accreditation of ENUM Registrars

Although, the arguments surrounding this issue are discussed in section 10.2.1 it still remain unresolved.

13.5 Authentication process for Exception Numbers

The UKEG recommended that for the 'exception numbers' (ex-directory, 08&09 and mobiles) the front end of the existing Number Portability Process should be used. However, this requires more investigation. It also raises issues such as the role of the Telephone Service Provider in these ENUM processes and their willingness (or not) to participate.

13.6 Accreditation of the Authenticating Agency

Although a list of tentative criteria and an initial process for accreditation is proposed in section 10.3.3 this is by no means complete. It also raises questions regarding the ability of a TSP to discriminate between the end users they wish to deal with.

13.7 Authority/Process to change NAPTR record

Although not discussed in this report this issue requires further study. It may be advantageous (or not!) to agree a standard process to update or change NAPR records. At present there is no agreement (?) as to which of the following models (or both) should be implemented in the UK:

a. The user changes/updates the NAPTR record directly with the ENUM DNS Provider
b. The user must interface to a ENUM Registrar to update or change NAPTR records.

A method of digital certificates or other secure mechanism needs to be employed in order to allow the user to update their NAPTR.

13.8 Dispute Resolution

Depending of the level of authentication required for an initial ENUM subscription the dispute resolution process may be simple or complex.

14 Recommendations

RECOMMENDATION 1: The UK will adopt a policy of 'opt-in' for the UK implementation of ENUM.

RECOMMENDATION 2: No database will be populated with that are not assigned to end users numbers.

RECOMMENDATION 3: The UK implementation will adopt all recommendations on consumer protection and data privacy.

RECOMMENDATION 4: ENUM applications must ensure that the existing requirements for number portability are retained.

RECOMMENDATION 5: In principle any UK number range can be included in ENUM

RECOMMENDATION 6: The UK will implement a single Tier 1 Registry architecture serving all UK E.164 numbers.

RECOMMENDATION 7: NAPTR records will be stored in the ENUM DNS Provider's database.

RECOMMENDATION 8: The UK will implement an architecture at Tier 2 that will allow business entities to provide both Registrar and DNS Provider services or alternatively just one of them.

RECOMMENDATION 9: The UK should create a Policy Oversight Committee for UK ENUM

RECOMMEDNATION 10: The selection of the Tier 1 registry for the UK should take place using an open, public and transparent process and selection based on the criteria proposed, together with cost and experience.

15 History of the Report

Version	Comments	Date
Issue 1	Initial Report	April 2002

ANNEX A – Companies and organisations involved in the UK ENUM Group

BT Exact technologies
Nominum
Internet Computer Bureau plc.
Inmarsat
DTI
Neustar
Nominet
Thus
Oftel
Cable&Wireless
Vodafone
INTUG
Steptoe & Johnson
InterConnect Communications
NTL
Comorotel

ANNEX B – Terms of Reference for UKEG

Mandate for UK ENUM Group (UKEG)

Aim

To propose a preferred framework that would facilitate ENUM implementation in the UK identifying any appropriate government actions needed.

Scope

The work of the group is:

- to focus on ENUM as defined in RFC 2916 which is currently under discussion between ISOC and the ITU;
- to develop a set of principles (framework) that should be adhered to in order to maximise the potential benefits from publicly available ENUM within the UK;
- to take full account of International and European developments in reviewing what solutions are adopted in the UK;
- to limit itself to the initial phase deliverable and to consider if there is further longer term requirements that should be undertaken by the group

ENUM Framework Criteria

- The proposed UK framework should:

- comply with EU/UK privacy and data protection law;
- minimise scope for discriminatory action amongst various players;
- facilitate the best outcome for all end users;
- be reliable, secure and robust;
- not undermine the integrity of the number space;
- ensure customer protection;
- be coherent and fully interoperable on a global scale;
- be efficient and effective;
- align with agreed international standards and other relevant agreements.

Tasks

The group's initial tasks are:

1. To develop a list of ENUM issues that need to be resolved at a national level in the UK. These should include regulatory, technical and operational aspects;
2. To elaborate each of these issues and propose solutions or identify where action is needed;
3. To review the pros and cons of different options for implementing ENUM in UK and provide argument for preferred solution(s) identifying where appropriate roles and responsibilities;
4. To propose how such a preferred solution can be developed in the UK and what rules or guidelines need to be established;
5. To determine the needs and potential benefits from an ENUM trial within the UK and if supported determine key representative parties and required actions (It may be appropriate to take account of the trials in Sweden, Netherlands and elsewhere);
6. To identify any issues that could adversely impact the potential for electronic communication services to develop commercially over ENUM. Propose what options may be appropriate or desirable in these cases;
7. To identify any further actions for the group following on from the report such as development of preliminary guidelines, codes of practice, trialling, industry agreements etc where these are appropriate;

Deliverables

There will be two deliverables presented in the initial phase of the group's work:

A UK industry position paper to be prepared by end of December 2001 proposing a preferred tld for ENUM that would be input to the UK SG2 co-ordination committee who are responsible for formulating national positions at ITU SG2;

A preliminary report to be submitted to DTI by the end of February 2002 making proposals on the preferred implementation framework that would facilitate the market for ENUM-based services in the UK. The issues covered should include interalia those identified in the section on "Tasks" above.

Constitution

The UK ENUM Group should:

- Be primarily industry and industry led;
- Comprise representatives from the telecommunication and internet community, user group representatives, administration and regulatory authorities;
- Be relatively manageable in size since its aim is to review and develop ENUM issues;
- Be constituted as an ad hoc group working under the general auspices of DTI for the initial phase of work identified above;
- Consider if this constitution should be changed subject to identification of further long term work being required beyond the initial phase.

Additional Note

DTI wish to make the following points:

Note 1

- That industry should seek to adopt solutions that meet the basic criterion indicated above but that it is a matter for the commercial players to determine how best this can be achieved within the set criteria;
- That other competing technology solutions that may facilitate similar converged services and which may be ENUM like in appearance are already emerging in the marketplace;
- That based on current understanding these other competing ENUM like solutions are likely to operate outside the emerging ITU and IETF framework and as indicated above would therefore fall outside the mandate of this group;
- That deployment of innovative competing technologies is likely in the long term to enrich the market for converged services.

Note 2

- That the rationale for moving forward with reviewing ENUM solutions in the UK is primarily to maximise commercial opportunities for UK players in the emerging global market for converged services;
- That ENUM is considered to be one of the key enablers to facilitating this emerging service market that exploits both telecommunications and internet domains;
- That the potential global scale of ENUM within a wider ITU and IETF context calls for government awareness of related policy issues.

Note 3

- That there is a need to make a distinction between the ENUM services which are primarily registry-type services and the actual electronic communications services that are based on ENUM solutions;
- That the development of these ENUM solutions in the UK should be mainly concerned with identifying and defining the registry type systems that will be the enabler for deployment of emerging electronic communication services in converged markets;
- That the development and deployment of the latter is a matter for the commercial players who wish to offer these type of services based on ENUM.

Annex C - Oftel informal guidance on ENUM regulation – 28 February 2002

Introduction

1. The following note is intended to provide general and informal guidance only, and is therefore not legally binding on the Director General of Telecommunications (the "Director General"). It simply outlines Oftel's current views on the potential regulation of ENUM services. However, these views may change at any time and should not be taken as providing you with legal advice.

2. If you require such advice on how any of the matters raised in this note affects (and applies to) your particular organisation and service, please seek your own independent legal advice. For the avoidance of any doubt, the Director General cannot legally fetter his discretion in advance and therefore he retains the ability to depart from any guidance contained in this note where the circumstances warrant it.

3. This guidance is based upon Oftel's current understanding of ENUM as a system that provides translation of E.164 telephone numbers into numbers or other identifiers. It is assumed that it will be connected to the Internet and will receive requests and transmit responses via the Internet.

4. It is also understood that the following types of ENUM services are possible: (i) a tier-1 registry that maintains and updates the complete authoritative database for the national domain; (ii) tier-2 registries that hold NAPTR records and (iii) tier-2 registrars that provide registration services to end-users.

5. Any reference in this note to the proposed new EU Directives is to the final texts adopted by the European Parliament and Council of 4 February 2002. Once those Directives have been come into force (i.e. when the Directives are published in the Official Journal of the European Communities), they must be transposed into UK legislation within 15 months after the date of entry into force. Further information as to the progress on the new EU regulatory framework may be obtained from the Information Society's website: http://europa.eu.int/information_society/topics/telecoms/regulatory/new.

6. Finally, please note that the regulation of any telecommunications services facilitated by ENUM is not fully considered in this note. However, Oftel has a technology-neutral approach to regulation. This means that Oftel neither imposes, nor discriminates in favour of, the use of a particular type of technology.

(A) Potential UK Competition Law constraints in the provision of ENUM services

7. The Competition Act 1998 (the "Competition Act") may apply to the provision of ENUM services. The Competition Act seeks to prohibit, amongst other things:

- 'anti-competitive' agreements between undertakings i.e. agreements which may affect trade in the UK and have as their object or effect the prevention, restriction or distortion of competition within the UK (the "Chapter I prohibition"). It also prohibits 'anti-competitive' decisions by associations of undertakings or 'anti-competitive' concerted practices by undertakings.
- An abuse of a dominant position by an undertaking in a market (the "Chapter II prohibition").

The Competition Act provides the Director General with powers to intervene where there has been a breach of any of those prohibitions.

8. In addition, Community law (Articles 81 and 82 EC Treaty) may prohibit anti-competitive agreements and abuses of a dominant position where they affect trade between EC Member States.

9. In the context of ENUM services, if a tier-1 ENUM registry supplier was found to be dominant in the relevant market (see note below regarding market definition), then examples of the type of behaviour that may be considered as abusive under the Competition Act include:

    - excessive pricing for ENUM services;
    - leverage into other markets (eg ENUM tier-2) through vertical integration and discriminatory behaviour; or
    - refusal to supply ENUM services.

10. In addition, anti-competitive agreements between ENUM tier-2 suppliers may also be considered to breach 'Competition law'. Where agreements infringe the Chapter I prohibition, they are void and cannot be enforced.

11. Where an infringement is identified, the Director General can direct the parties involved to bring the infringement to an end. The Director General may also impose financial penalties of up to 10 per cent of an undertaking's annual turnover in the UK, for up to three years. If a person fails to comply with such a direction, the Director General can seek a court order compelling the organisation to comply with the direction. In addition, third parties that consider that they have suffered loss as a result of any unlawful agreement or abusive behaviour may have a claim for damages in the courts.

12. It is to be noted that the identification of a relevant market is important for the Director General's analysis under the Competition Act in establishing whether or not particular undertakings fall within the scope of the prohibitions and to determine the effect of an agreement or conduct on competition. For instance, the Chapter I prohibition applies only to agreements which have an 'appreciable' effect on competition. The appreciability test requires a definition of a relevant market and demonstration that the agreement would have an appreciable effect on competition within that market. Also, it is necessary to define the relevant market in order to determine whether an undertaking is in a dominant position for the purposes of the Chapter II prohibition.

13. In relation to ENUM, it is to be noted that it is difficult for the Director General to predict at this stage how the market in which ENUM services are supplied might be defined without conducting a proper analysis of the market. However, if, for example, other services were considered to be substitutes for ENUM, then a wide market might be defined where a single ENUM tier-1 supplier would not necessarily be dominant.

14. Further guidance on the application of the Competition Act in the telecommunications sector can be found on Oftel's website at: http://www.oftel.gov.uk/publications/ind_guidelines/cact0100.htm. Additional information on the application of that Act generally can be obtained on the Office of Fair Trading's website at: http://www.oft.gov.uk/html/comp-act/.

(B) Potentially Applicable Telecommunications Specific Obligations on Providers of ENUM services

(i) Current Telecommunications regulatory framework

15. Under the Telecommunications Act 1984 (the "T Act"), any person running a telecommunication system in the UK must have a licence granted under section 7 of that Act (a "T Act licence").

16. If a system (eg a Domain Name System server) used to provide ENUM services could be considered a "system for conveyance" or "apparatus construed or adapted for transmitting or receiving signals", then it might be regarded as a telecommunication system under the T Act.

17. If a provider of ENUM services is regarded as running a telecommunication system, then that provider will need to have a telecommunications T Act licence. The licensing position – if indeed a licence is required – is explained below.

18. It is unlikely that an ENUM provider would be granted an individual PTO licence – in general terms, this type of licence is only granted to operators offering either public voice services or international facilities.

19. The appropriate licence is likely to be either the Telecommunication Services Licence (TSL) or the Self Provided Telecommunication Systems Licence (SPL) – these are both class licences. The SPL is not particularly onerous, ie it has few conditions. However, this is because it only permits telecoms services satisfying two very restrictive criteria:
- the services must not be provided for financial gain; and
- each Message must be initially sent or ultimately received, or both, by the licensee.

The first of these criteria is clear-cut but it is difficult to be sure at this stage whether an ENUM provider would fall within the second.

20. If the ENUM provider's activities were to be considered to be outside the scope of the SPL, then the appropriate licence would appear to be the TSL. This permits commercial services (ie services provided for profit) and also does not restrict who may send or receive the message. At first sight, the TSL appears to be more onerous than the SPL. However, many of its conditions would probably not be relevant to an ENUM provider, for example the requirement to produce itemised billing, as they only relate to the provision of public voice services.

(ii) New Telecommunications regulatory framework

21. Under the new proposed EU telecommunications framework, it is Oftel's current view that ENUM will likely be considered an "associated facility". Article 2(e) of the Framework Directive defines that term as follows:

> '"associated facilities" means those facilities associated with an electronic communications network and/or an electronic communications service which enable and/or support the provision of services via that network and/or service. It includes conditional access systems and electronic programme guides;'

22. Being a service for translating telephone numbers, it appears that ENUM would be a facility *associated* with an electronic communications service[9] and that it would *enable and/or support* the provision of services via an electronic communications network[10] and/or service.
23. As a result, Article 6(2) of the Authorisation Directive makes it clear that specific obligations may be imposed on providers of associated facilities under, amongst other things, Articles 5(1) and 8 of the Access Directive. In the context of ENUM, this means that obligations with regard to *access*[11] to that associated facility may potentially be imposed either:
    - where the national regulatory authority ("NRA", such as Oftel or, in the future, OFCOM) pursuant to Article 5(1) of that Directive considers that such access is necessary to promote efficiency, sustain competition and give maximum benefit to end-users, and the resulting obligation is objective, transparent, proportionate and non-discriminatory; or
    - where the NRA pursuant to Article 12(1)[12] of that Directive imposes significant market power (SMP) obligations to meet reasonable requests for access to, and use of, associated facilities.
24. In relation to SMP obligations imposed as a result of Article 8, it is noted that to designate an operator as having SMP on a specific market, NRAs must first carry out an analysis of the relevant market under Article 16 of the Framework Directive. In defining the relevant market(s), NRAs must take utmost account of the Commission's Recommendation on relevant markets and Guidelines for market analysis and the assessment of SMP. As the Commission has not yet adopted its Recommendation and Guidelines, it is not possible for Oftel to express even a view at this stage as to how it will ultimately affect ENUM providers.

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[9] See Annex C(I) to this note for the definition of "electronic communications service".
[10] See Annex C(I) to this note for the definition of "electronic communications network".
[11] See Annex C(I) to this note for the definition of "access". It is to be noted that this definition expressly includes "access to number translation or systems offering equivalent functionality;".
[12] Article 8 of the Access Directive requires NRAs to impose on SMP designated operators obligations set out in Articles 9 to 13 of that Directive as appropriate.

(C) Appropriate Use of Numbers by ENUM services

(i) Current Telecommunications regulatory framework

25. As discussed above, it may be that an ENUM registry would be run under the TSL. The TSL contains similar numbering related conditions as those in the PTO licence, although it is not clear to what extent they would be relevant to an ENUM registry. Otherwise, if ENUM were unlicensed or run under the SPL, no numbering related conditions would be relevant.

26. However, there are numbering related conditions in the standard Public Telecommunications Operator (PTO) licence that would be relevant if a PTO were providing public voice services that utilised ENUM. Condition 26 requires that operators adopt a Numbering Plan for such public numbers as the Director General may allocate to it. That Numbering Plan must be consistent with the National Numbering Conventions, including any sub-allocation of public numbers to end users must be in accordance with the Conventions.

27. Amongst other things, the Conventions specify the tariffs and uses that are associated with particular number ranges. Operators are also prohibited from using public numbers other than those allocated by the Director General from the Specified Numbering Scheme. In addition, it should be noted that number portability is required under Condition 28 of the current PTO licence.

(ii) New telecommunications framework

28. The position with regard to numbering is expected to remain the same in substance in most respects under the new framework. For instance, Article 10 of the Framework Directive requires, amongst other things, that Member States ensure that NRAs control the assignment of all numbering and management of national numbering plans. Also, Articles 5 and 6 of the Authorisation Directive set out the rights and conditions relating to the use of numbers and Article 30 of the Universal Service Directive sets out requirements for number portability.

(D) Non-telecommunications related issues

29. Many of the other issues raised with regard to ENUM may be covered by existing non-telecommunications legislation.

Data protection

30. The Data Protection Act 1998 together with the Telecommunications (Data Protection and Privacy) Regulations 1999 may apply where, for example:

- there is an unauthorised entry of user data in ENUM database; and/or
- there is unauthorised processing of data stored in the ENUM database.

Prevention of fraud

31. There may also be possible fraudulent uses of ENUM and ENUM services. For example the:

- unauthorised modification of ENUM data to route calls to another party; and/or
- unauthorised sign-up of ENUM to route calls to another party.

Annex C – (I)

(Definitions in the new proposed Directives)

Article 2(a) of the **Framework Directive** defines "electronic communications network" as follows:

> '"electronic communications network" means transmission systems and, where applicable, switching or routing equipment and other resources which permit the conveyance of signals by wire, by radio, by optical or by other electromagnetic means, including satellite networks, fixed (circuit- and packet-switched, including Internet) and mobile terrestrial networks, electricity cable systems, to the extent that they are used for the purpose of transmitting signals, networks used for radio and television broadcasting, and cable TV networks, irrespective of the type of information conveyed;'

Article 2(c) of the **Framework Directive** defines "electronic communications service" as follows:

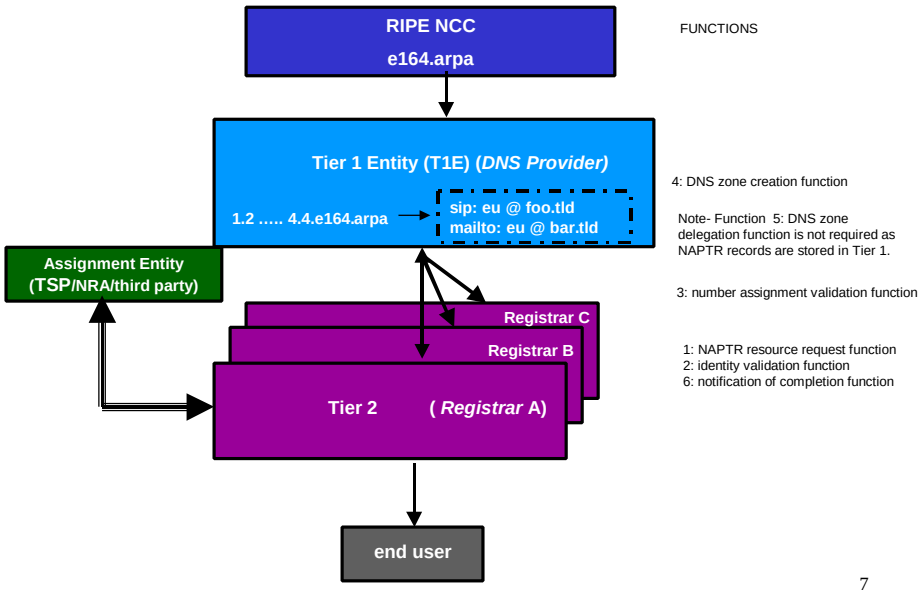
> '"electronic communications service" means a service normally provided for remuneration which consists wholly or mainly in the conveyance of signals on electronic communications networks, including telecommunications services and transmission services in networks used for broadcasting, but exclude services providing, or exercising editorial control over, content transmitted using electronic communications networks and services; it does not include Information Society services, as defined in Article 1 of Directive 98/34/EC, which do not consist wholly or mainly in the conveyance of signals on electronic communications networks;'

Article 2(a) of the **Access Directive** defines "access" as follows:

> '"access" means the making available of facilities and/or services, to another undertaking, under defined conditions, on either an exclusive or non-exclusive basis, for the purpose of providing electronic communications services. It covers, *inter alia*: access to network elements and associated facilities, which may involve the connection of equipment, by fixed or non-fixed means (in particular this includes access to the local loop and to facilities and services necessary to provide services over the local loop); access to physical infrastructure including buildings, ducts and masts; access to relevant software systems including operational support systems; access to number translation or systems offering equivalent functionality; access to fixed and mobile networks, in particular for roaming; access to conditional access systems for digital television services; access to virtual network services.'

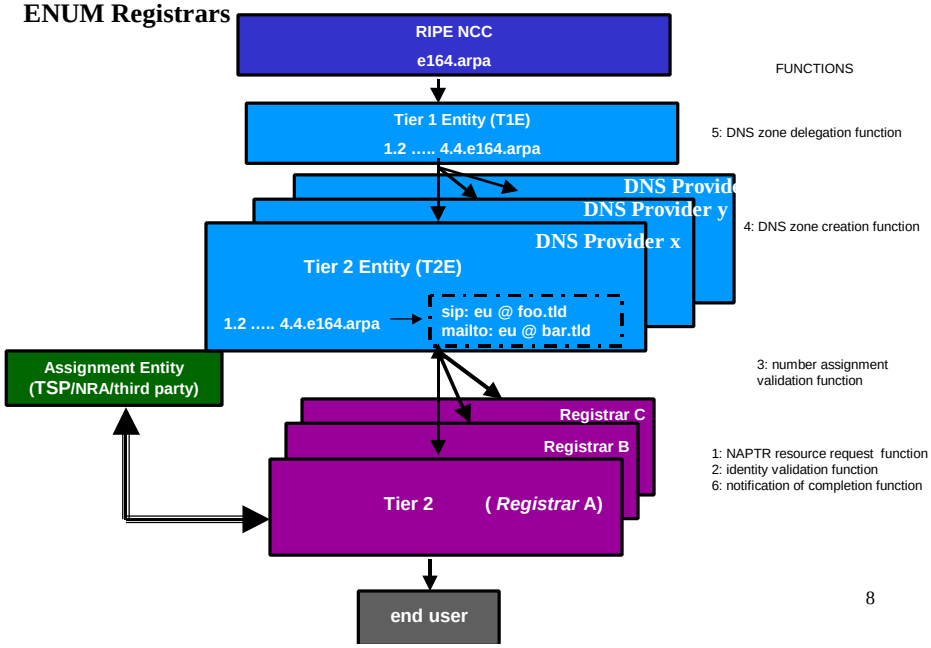
ANNEX D – Implementation Options

Option A - Single T1 Registry + competitive ENUM Registrars



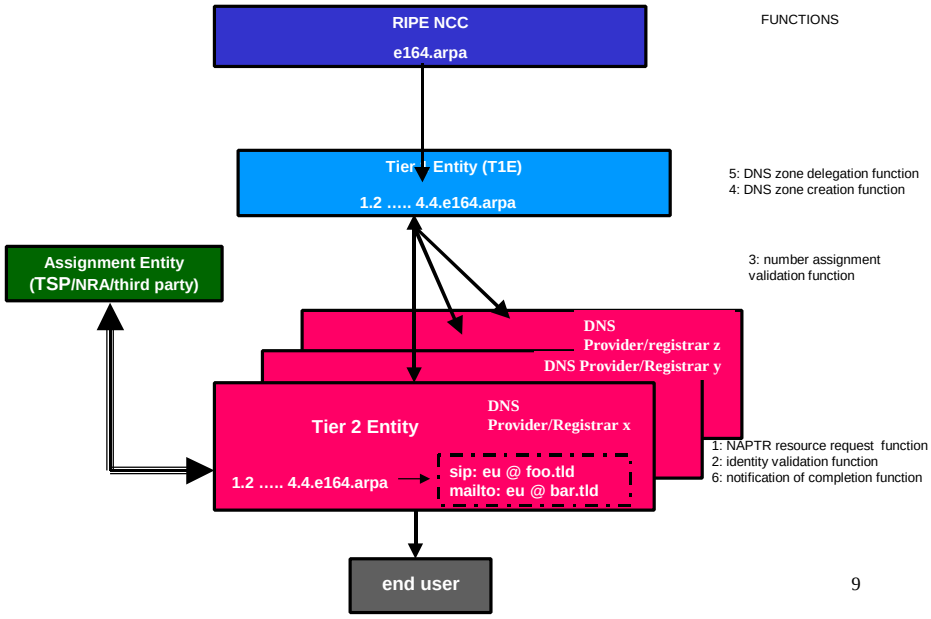
7

Option B - Single T1 + competitive ENUM DNS Providers + competitive ENUM Registrars



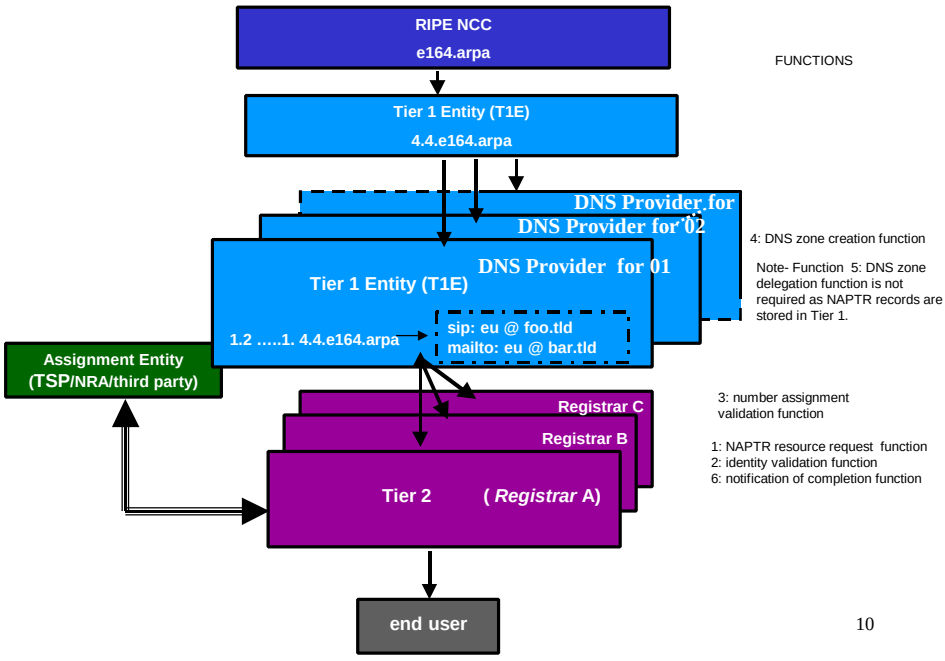
8

Option C - Single T1 + competitive ENUM DNS Provider/Registrar



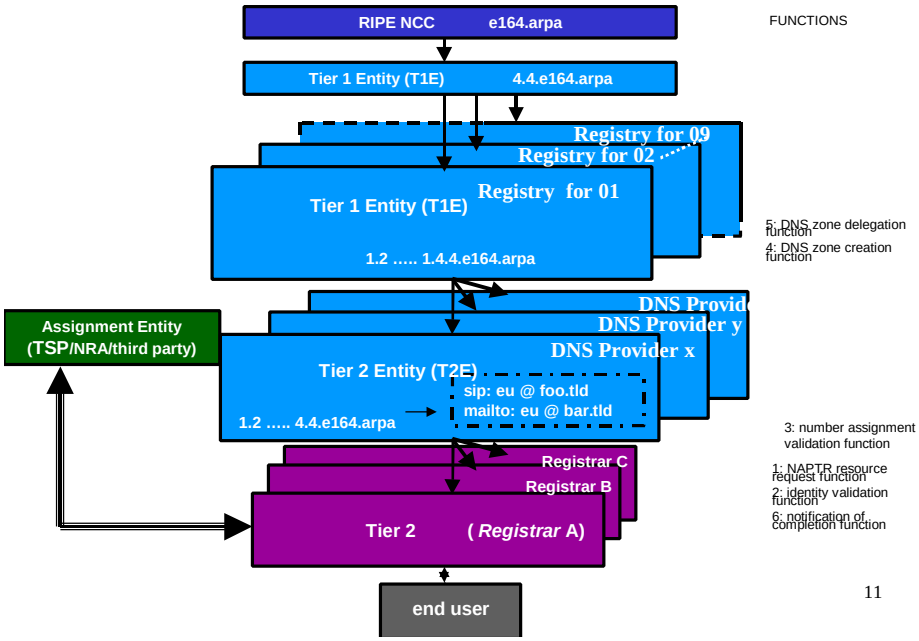
9

Option D - Single $T1_a$ + multiple $T1_b$ Registries + competitive ENUM Registrars



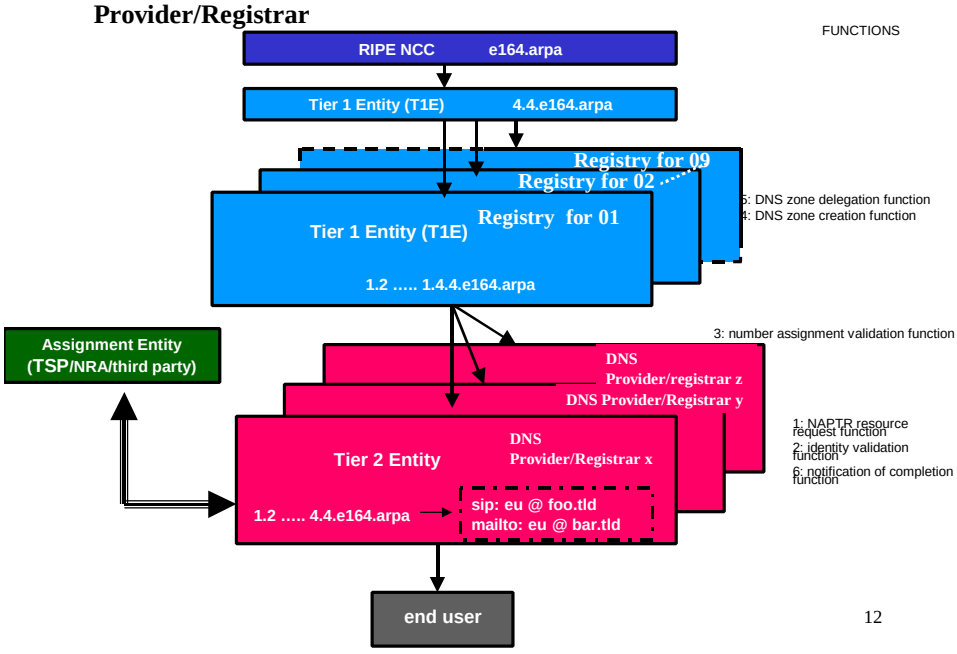
10

Option E = Single $T1_a$ + multiple $T1_b$ Registries + competitive ENUM DNS Providers + competitive ENUM Registrars



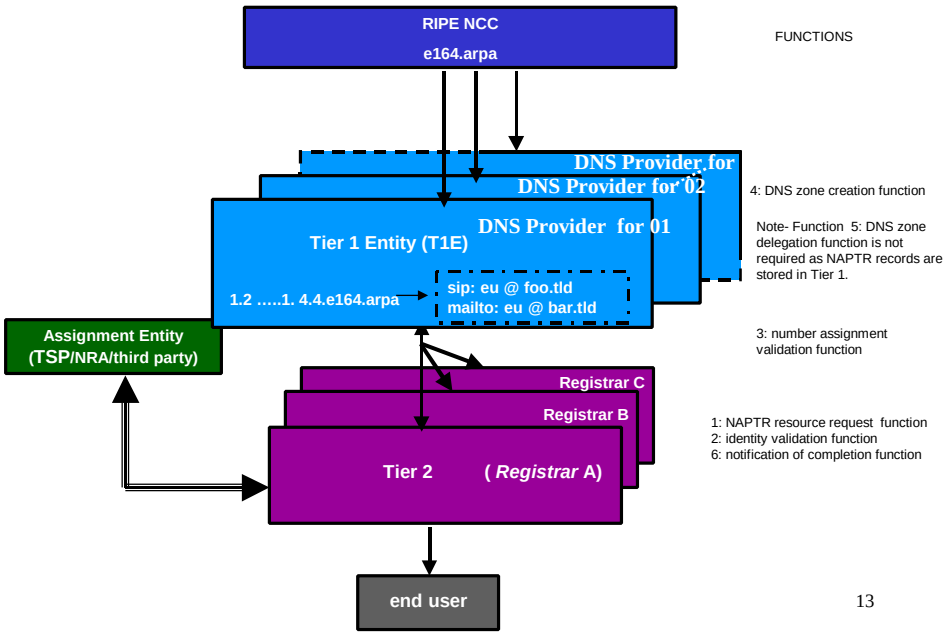
11

Option F = Single $T1_a$ + multiple $T1_b$ + competitive ENUM DNS Provider/Registrar



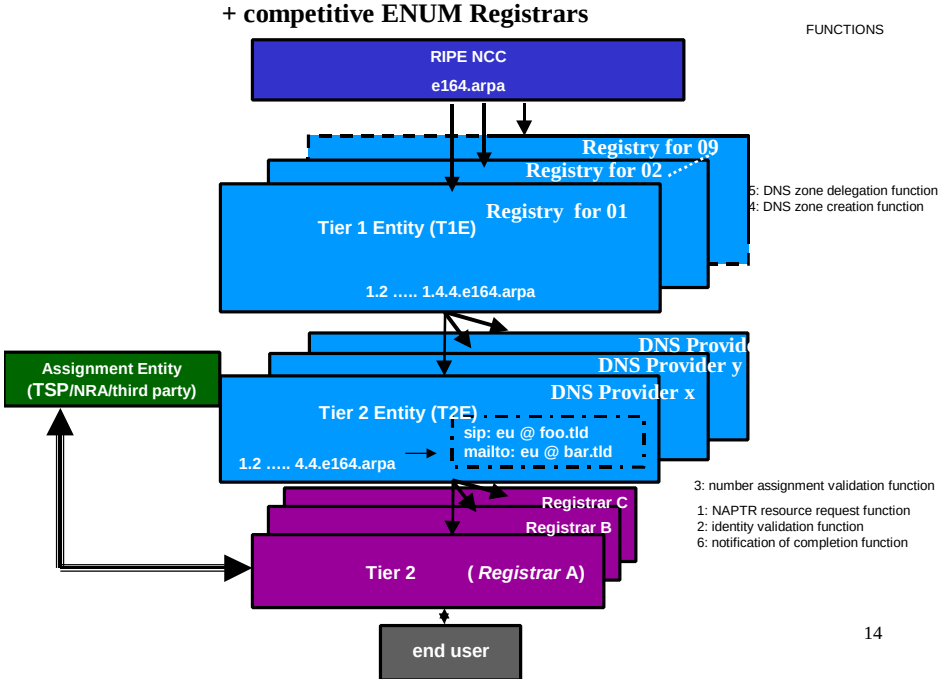
12

Option G - Multiple T1 Registries + competitive ENUM Registrars



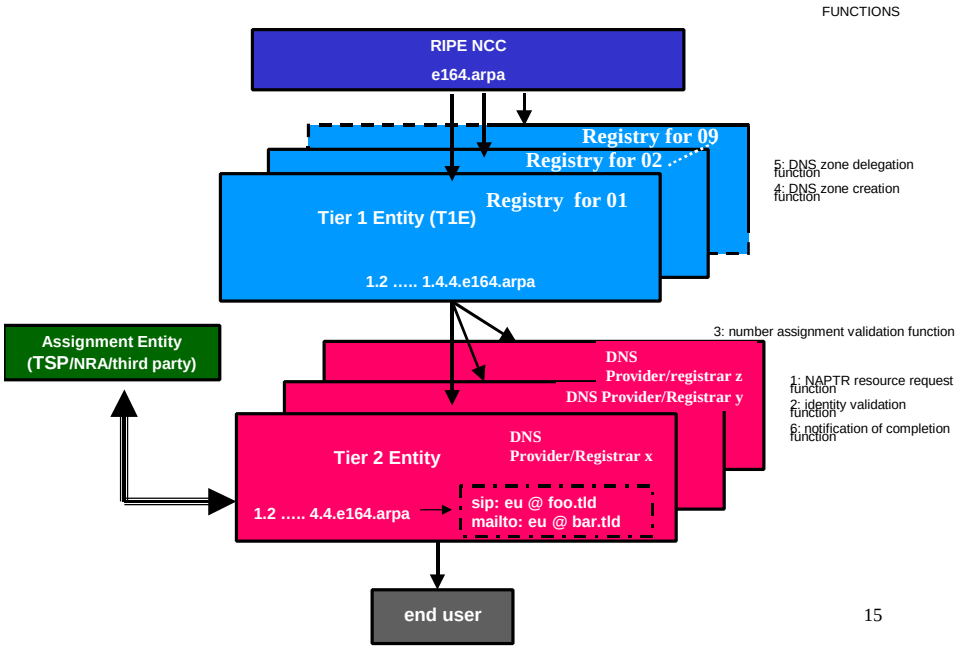
13

Option H = Multiple T1 Registries + competitive ENUM DNS Providers + competitive ENUM Registrars



14

Option I = Multiple T1 + competitive ENUM DNS Provider/Registrar



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Annex E - Analysis of "National" Architectural Questions

Note : Issues considered to be of high importance are marked in **bold text**, of medium importance in normal text and of low importance in *italics*.

Question One

Is it sufficient to have a single UK Tier 1 Registry, or is it preferable to have multiple Tier 1 registries according to number range, for example with a Tier 1 for geographic ranges, a Tier 1 for mobile ranges and so on? NB that even if there are multiple Tier 1 registries for the UK, there would only be a single Tier 1 registry for any given number [range], i.e. they would not compete in the context of user choice of Tier 1 registry for a given number.

Regulatory & Competition considerations

Single Tier 1	Multiple Tier 1s
Pros: **Simplest overall model.** **Consistency of service could be ensured (by definition, as there is only one entity providing the service).** **Easier to devise and implement an effective stakeholder governance model.** The use of a single entity would make the overall cost of selection of entity to perform Tier 1 lower. Cons: **There may be a need for mediation if different sectors (mobile, fixed) have differing aims hence want different modes of operation, different funding models and so on for the Tier 1 entity.** **The service quality could be consistently poor due to lack of competition if governance measures are not adequate.** *As only one entity would have experience of operating UK Tier 1, the prospect of providing an incentive to offer high quality service or face loss of the contract would be reduced as new entrants would be limited.*	Pros: **This approach allows development of different models (operational, funding) for individual industry sectors.** **There would be a greater incentive to develop operational processes to match "best practice"** **Potentially, the performance of one Tier 1 entity could be used to leverage enhance performance of another.** *This approach allows multiple organisations to have experience of operating Tier 1 entity in UK, therefore enhanced competition when contracts are renewed (providing operational models are the same).* Cons: **More complex model to regulate.** **The selection process would be more complex, as would ongoing management. It is debatable whether this increased complexity is justified for country of size of UK.** **Will require escrow arrangements, agreement re database rights in the event of one of the registries going out of business, and procedures to cover registry poor performance or liquidation etc.** Runs the risk of fragmenting the UK E.164 numbering scheme which could endanger future initiatives. *Having multiple Tier 1s would open the issue of how UK will be divided between Tier 1s, and how this will be incorporated into the ENUM hierarchy.*

Security considerations

Single Tier 1	Multiple Tier 1s
Pros: • **The use of a single entity means uniform security levels; meaning that there would be uniform performance across UK numbering space** • **A single Tier-1 approach means it is simpler to define, implement, test and audit the security policy. With a single Tier-0 entity, there are fewer components in the overall system, meaning it is simpler and therefore easier to make it secure because the system and components are easier to understand and analyse. It is very difficult to make complex systems secure because the interactions between components are more numerous and diverse.** Cons: • If for any reason security was breached at the Tier 1, total loss of service to UK would be experienced. However, this risk could be mitigated via the use of adequate security procedures and slave servers.	Pros: • **The use of Tier 1s with narrower scope mean lower impact if registry security is breached at any one.** • It could be possible to get Tier 1 for part of the number space act as slave server for other Tier 1s to distribute data. Cons: • **It is inevitable that this approach would lead to diverse degrees of robustness.** • If there are multiple Tier-1 entities, monitoring them becomes more complex, both for registry and name server operations. Policing registries and registrars is harder and there is a great chance of E.164 resources being misused. If DNSSEC is used, the problems of key management and rollover become more complicated because each Tier-1 entity would have its own signing key and data signing policy. The parent zone - e164.arpa -- would have to sign each of those keys which may be impractical.

Operational & Technical considerations

Single Tier 1	Multiple Tier 1s
Pros: **Usage of a single entity would result in uniform operational & technical expectations.** **The number of operational (process) interfaces would be reduced.** **Use of a single Tier 1 would result in scale economies** Cons: *Potentially, with no peers there could be a lack of incentive to improve performance. However, this risk could be mitigated against via appropriate contract terms and SLAs.*	Pros: **There would be a greater incentive to develop operational processes to match "best practice"** There would be more incentive to match operational processes around particular expectations/applications associated with industry sector e.g. mobile applications. Cons: **Inevitably, this approach would result in diverse operational and technical procedures & performance.** **There would be an increased number of operational interfaces, with resultant costs.** **Each Tier 1 would be smaller, hence less chance of scale economies.** If Tier 1 is to be signed, could be problems with complexity of key management.

User Experience

Single Tier 1	Multiple Tier 1s
Pros: • Although largely transparent to customer, usage of a single Tier 1 would increase the uniformity of "ENUM experience" Cons: • The lack of incentives around monopoly operation could push up overall costs. However, if the contract to provide Tier 1 functionality was renewable on a periodic basis, this risk would be reduced. Additionally, scale economies could actually drive costs down.	Pros: • There is the potential that this approach could drive down costs, because any tendering process for the renewal of contracts would be more competitive given more entities with experience of Tier 1 operation. Set against this, there could be a loss of scale economies. Cons:

Question Two

If it is agreed to have multiple Tier 1 Registries, which architecture should be adopted for delegating the relevant DNS Zones? There are two basic options;

I. The delegation is made directly from the Tier Zero registry. This would mean that rather than a single entry for .4.4.e164.arpa within the Tier Zero registry, there would be a series of entries, for example against .1.4.4.e164.arpa, .2.4.4.e164.arpa, .7.4.4.e164.arpa etc, with each entry pointing to the relevant individual Tier 1 registry.

II. Introduce an additional thin Tier 1-a registry for the UK. The Tier Zero registry would have a single entry for the UK (.4.4.e164.arpa), pointing to the Tier 1-a registry. The Tier 1-a registry would have a limited number of entries, for example against .1.4.4.e164.arpa, .2.4.4.e164.arpa, .7.4.4.e164.arpa etc, with each entry pointing to the relevant individual Tier 1 registry.

Regulatory & Competition considerations

Thin Tier 1a	No Tier 1a (Multiple Tier 0 entries)
Pros: • **This approach simplifies the process with ITU/Tier Zero.** • Changes to the UK plan do not impact Tier Zero Cons: • **A single entry point into UK is introduced, hence resulting in some of the disadvantages of having single Tier 1.** • **Costs would be increased as operation of the Tier 1-a would need to be funded.**	Pros: • **Arguably, this approach results in a lower cost as it removes an entity (Tier 1a) from the hierarchy** • There would not be a single monopoly entry for all of the UK hierarchy. Cons: • Depending upon the approach taken for dividing the UK numbering scheme between the Tier 1 entities, it might be necessary to involve the Tier Zero entity in national numbering changes. • *Processes with ITU/Tier Zero would be complicated, thus potentially delaying implementation.*

Security considerations

Thin Tier 1a	No Tier 1a (Multiple Tier 0 entries)
Pros: • **A single entry into Tier Zero would result in a more robust architecture insofar as the number of relationships that the Tier Zero entity would need to manage would be reduced.** Cons: • The approach would mean that if for any reason security at the Tier 1-a was breached, total loss of service to UK could result.	Pros: • No single entity controls all of UK ENUM implementation, hence the effect of any breach would be limited. Cons: • **The introduction of more relationships with Tier Zero increases risk of spoofing with resultant impact on integrity of E.164 numbering plan.**

Operational & Technical considerations

Thin Tier 1a	No Tier 1a (Multiple Tier 0 entries)
Pros: • **A single Tier Zero relationship would result, thus reducing complexity.** Cons: • **Development of processes around an extra entity in hierarchy would be required.**	Pros: • There are no clear advantages. Cons: • **The usage of multiple Tier 1s requires multiple Tier Zero relationships, hence increases complexity.** • *More entries into Tier Zero increases size of that database. This would probably be acceptable for the UK in isolation, but if all countries took this approach, a large Tier Zero database could result, hence impacting performance.*

User Experience

Thin Tier 1a	No Tier 1a (Multiple Tier 0 entries)
Pros: • *Not having to resolve issues around having multiple Tier Zero entries could potentially speed implementation.* Cons: • **Costs could potentially rise due to the need to fund the Tier 1-a entity.**	Pros: • **Eliminating the Tier 1-a entity would potentially reduce costs.** Cons: • *The implementation of ENUM in the UK would potentially be delayed due to resolution of issues of having multiple Tier Zero entities.*

Annex F - Analysis of Tier Two Architectural Questions

Note : Issues considered to be of high importance are marked in bold text, of medium importance in normal text and of low importance in italics.

Question Three

Should the NAPR record be stored in the Tier 1 Registry or in the ENUM DNS Provider? Note: this question assumes that there is 1 Tier 1 Registry and that there are multiple Tier Two entities irrespective of whether they are combined or separate Registry/Registrar functions.

Regulatory & Competition considerations

NAPR in Tier 1	NAPTR in Tier 2
Pros: • Simple model to regulate as only dealing with one business entity. • *Consistency of service could be ensured (by definition, as there is only one entity providing the service- registry and DNS service).* Cons: • **Monopoly in both Registry and DNS functions** • **The service quality could suffer due to lack of competition.** • Doubts over one business entity's desire/ ability to cope with registry function and customer facing issues (as part of DNS function?). • *Would need to be run as two separate entities anyway? Registry as one entity and DNS servers that hold the NAPTR as another?* • **Severe effects if business entity failed – whole of UK ENUM business would be in jeopardy**.	Pros: • Preferred approach by ICANN? - DNS function is distributed across business entities. • **Allows development of different models (operational, funding) for individual industry sectors.** • Greater incentive to develop operational processes to match "best practice" • Allows multiple organisations to have experience of operating DNS in UK, therefore enhanced competition. Cons: • More complex model to regulate.

Security considerations

NAPR in Tier 1	NAPTR in Tier 2
Pros: • Uniform security levels; meaning that there would be uniform performance across UK ENUM systems. Cons: • **Security breach at the Tier 1, could mean total loss of service to UK– both Registry and more importantly, DNS service**.	Pros: • **Security risk is minimised.** • Best practice security could be enhanced throughout the industry by sharing experience, spreading the risk, sharing virus antidotes etc. Cons: • *Diverse degrees of robustness.*

Operational & Technical considerations

NAPTR in Tier 1	NAPTR in Tier 2
Pros: • *Uniform operational & technical expectations.* • The number of operational (process) interfaces would be reduced. • **Economies of scale** Cons: • **Potentially, with no peers there could be a lack of incentive to improve performance**.	Pros: • **Greater incentive to develop operational processes to match "best practice**" • More incentive to match operational processes around particular expectations/applications associated with industry sector e.g. mobile applications. Cons: • *Diverse operational and technical procedures & performance.* • *Each NAPTR repository would be smaller, hence less chance of scale economies.*

User Experience

NAPTR in Tier 1	NAPTR in Tier 2
Pros: • *Uniform operational & technical expectations.* • The number of operational (process) interfaces would be reduced. • **Economies of scale** Cons: • **Potentially, with no peers there could be a lack of incentive to improve performance**.	Pros: • **Greater incentive to develop operational processes to match "best practice**" • More incentive to match operational processes around particular expectations/applications associated with industry sector e.g. mobile applications. Cons: • *Diverse operational and technical procedures & performance.* • *Each NAPTR repository would be smaller, hence less chance of scale economies.*

Question Four

If it is agreed to have the NAPTR stored at Tier 2, which architecture should be adopted for Tier 2 ?
There are two basic options;

III. Introduce separate competing Tier 2 Registries and Registrars
IV. Implement competing combined Registry/Registrars i.e. the same business entity would run the registry and registrar function as an overall service to the customer.

Regulatory & Competition considerations

Separate Registry/Registrar	Combined Registry/Registrar
Pros: • **Competition provided through multiple entities at all levels** • **Allows different price models** • **Most flexible model – allows entities to choose which part of the market to operate in.** • *Transparent – most open model* Cons: • More complex model to regulate/set up • **Are different companies prepared to work with this model i.e. is it economical for a company to be restricted to just being a registry or a registrar?**	Pros: • **Competition provided through multiple business entities** • **allows different price models to exist** • **lower cost as it removes a level from hierarchy** • *Offers environment for customer focussed services to be developed* Cons: • *requirement to ensure registry are 'competent'* • limits low level market entry

Security considerations

Separate Registry/Registrar	Combined Registry/Registrar
Pros: • **Any security breach to one registry does not jeopardise the whole network** Cons: • *different standards of security for each entity*	Pros: • **Any security breach to one registry does not jeopardise the whole network** • Security can be guaranteed for end to end service i.e. from registry of ENUM entry to day to day access of entry. Cons: • *different standards of security for each entity*

Operational & Technical considerations

Separate Registry/Registrar	Combined Registry/Registrar
Pros: • Simpler initial set-up of business entity • *Diverse and innovative capabilities could develop* Cons: • Tier 1 entity must deal with multiple registries and registrars • *Complex process and user interfaces*	Pros: • Single interface from Registry to Registrar so processes are simpler Cons: •

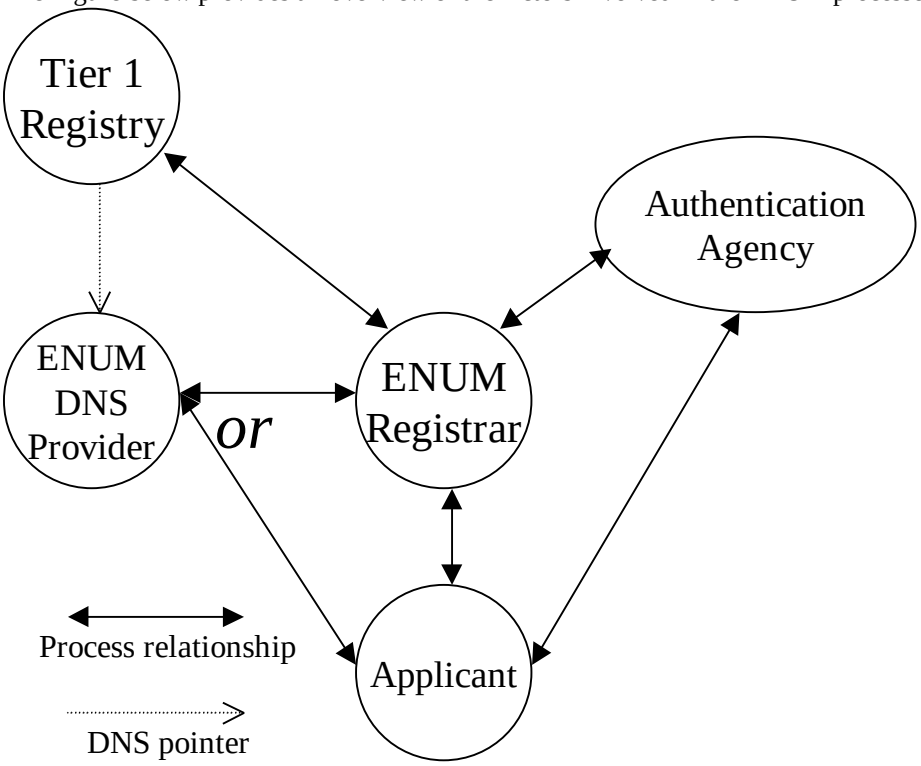
User Experience

Separate Registry/Registrar	Combined Registry/Registrar
Pros: • **More choice – customers can choose both registry and registrar** Cons: • *More complex to understand – no one entity has overall responsibility – 'rail track effect'* • **Increased cost because more profit margins are introduced.**	Pros: • *One stop shopping for customer* • **Reduced costs due to flatter hierarchy**. Cons: • **Less choice**

Annex G - Processes

Actors

The Figure below provides an overview of the Actors involved in the ENUM processes.



1 Provide Processes

Assumptions :

- There are three models which can be adopted for ENUM provision and which can co-exist.
  - In Model One, the customer deals only via an ENUM Registrar.
  - In Model Two, the customer acts as their own ENUM DNS Provider, but still needs to act via the ENUM Registrar for relations with the Tier 1 Registry and Authentication Agency.
  - In Model Three, the customer acts via the ENUM Registrar for relations with the Tier 1 Registry, but manages the relationship with the ENUM DNS Provider directly. All of these models are valid, and the choice of model will be customer specific.
- The ENUM Registrar and Authentication Agency will exist in competitive markets, but will require some form of accreditation. Depending upon the solution adopted for authentication, the Authentication Agency may need to be licensed as a telecoms operator.
- In order that redundant data is not kept in DNS related to customers who no longer wish to utilise the ENUM functionality, it is assumed that customers will have to periodically renew their subscription to keep the data active. The frequency of this renewal is for further study. In absence of renewal, the pointers from Tier 1 will be removed (see Cessation Processes).

1.1 Application to initiate ENUM subscription – Model One (ENUM Registrar is single point of contact for ENUM provision)

Involved entities: Applicant, ENUM Registrar, Authentication Agency, ENUM DNS Provider, Tier 1 Registry
Initiated by: Applicant approaching ENUM Registrar for provision of ENUM functionality.

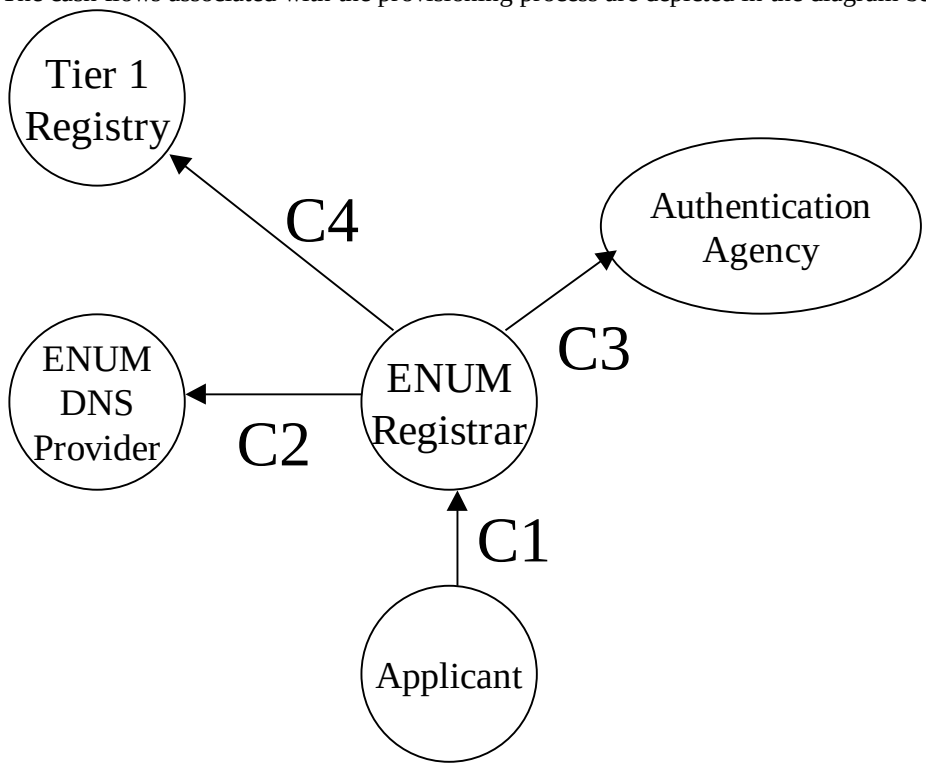
1.1.1 Process:

Note : in the case of an integrated ENUM DNS Provider & ENUM Registrar, much of this process will be internal
The nature of " Authentication Information" is for further study but would require standardisation.

1. Applicant approaches ENUM Registrar for provision of ENUM functionality
2. ENUM Registrar obtains from Applicant sufficient material to complete Initial Authentication Process (see Section 1.4), proposed contents of NAPTR records, preferred ENUM DNS Provider (if applicable).
3. Initial Authentication Process is carried out by Authentication Agency
4. Optional : Proposed contents of NAPTR records are validated by ENUM Registrar
5. ENUM Registrar passes details of number, NAPTR contents to ENUM DNS Provider for provisioning
6. ENUM DNS Provider provisions NAPTR records and confirms nameservers details to ENUM Registrar
7. ENUM Registrar passes details of number, nameservers to Tier 1 Registry. Administrative contact = ENUM Registrar, Technical contact = ENUM DNS Provider.
8. If there is no existing entry for the number in question, or any existing entry already has the ENUM Registrar as the Administrative Contact, then Tier 1 Registry builds pointers to ENUM DNS Provider and tests them. Note : If there is an entry AND the ENUM Registrar is the one initiating the request, then it means that this is a change of ENUM DNS Provider while retaining the same ENUM Registrar – see Section 2.1.
9. If there is an existing entry for the number in question, then Tier 1 Registry contacts previous ENUM Registrar to notify them of change. Note : this means that the Customer already has an ENUM subscription but is changing ENUM Registrar. "Losing" ENUM Registrar may take opportunity to contact previous ENUM DNS Provider to delete redundant data. It is recommended that a winback period of 5 days is built in at this stage to allow the losing operator to make a single call to retain the customer. Tier 1 Registry then builds pointers to ENUM DNS Provider and tests them.
10. Tier 1 Registry confirms to ENUM Registrar that pointers are provisioned
11. ENUM Registrar confirms to Applicant that ENUM functionality is now operational, provides Authentication Information for future customer relationship.

1.1.2 Cash Flows

The cash flows associated with the provisioning process are depicted in the diagram below;



1.2 Application to initiate ENUM subscription – Model Two (Customer maintains own DNS records)

Involved entities: Applicant, ENUM Registrar, Authentication Agency, Tier 1 Registry
Initiated by: Applicant approaching ENUM Registrar for provisioning of ENUM functionality.

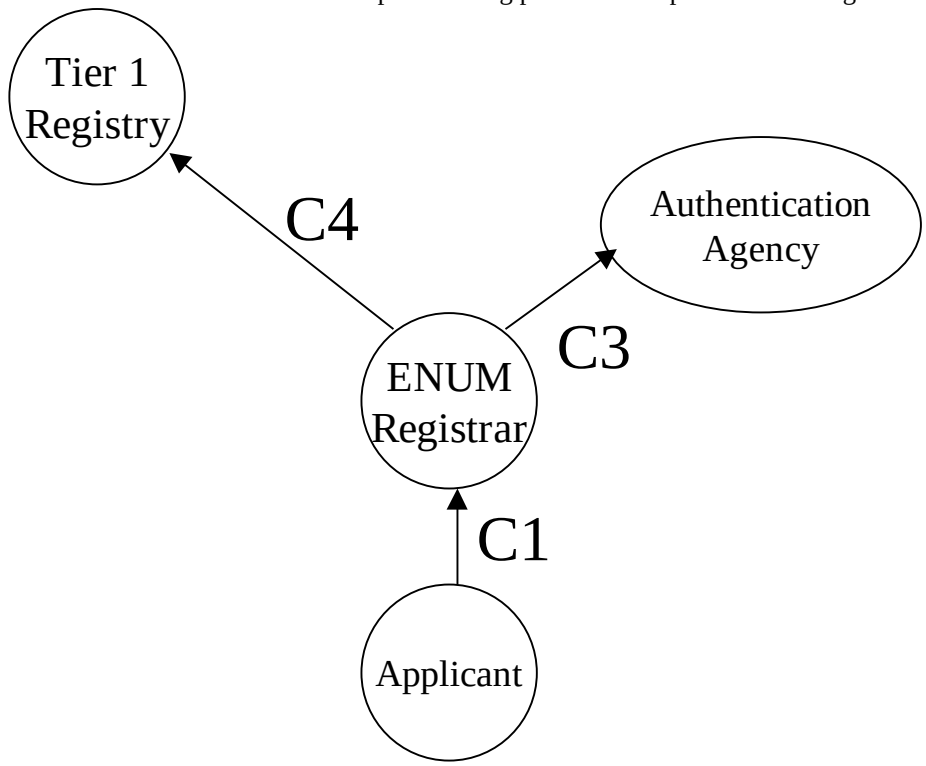
1.2.1 Process:

Note: In this case, only role of ENUM Registrar is to act as an accredited interface to Tier 1 and Authentication Agency. The nature of "Authentication Information" is for further study but would require standardisation.

1. Applicant provisions NAPTR records
2. Applicant approaches ENUM Registrar for accreditation of right to provision ENUM functionality
3. ENUM Registrar obtains from Applicant sufficient material to complete Initial Authentication Process (see Section 1.4), nameserver details
4. Initial Authentication Process is carried out by Authentication Agency
5. ENUM Registrar passes details of number, nameservers to Tier 1 Registry. Administrative contact = ENUM Registrar, Technical contact = Customer
6. If there is no existing entry for the number in question, then Tier 1 Registry builds pointers to ENUM DNS Provider (i.e. Customer's nameserver) and tests them.
7. If there is an existing entry for the number in question, then Tier 1 Registry contacts previous ENUM Registrar to notify them of change. Tier 1 Registry then builds pointers to ENUM DNS Provider (i.e. Customer's nameserver) and tests them.
8. Tier 1 Registry confirms to ENUM Registrar that pointers are provisioned
9. ENUM Registrar confirms to Applicant that ENUM functionality is now operational, provides Authentication Information for future customer relationship.

1.2.2 Cash Flows

The cash flows associated with the provisioning process are depicted in the diagram below;



1.3 Application to initiate ENUM subscription – Model Three (Customer has direct relationship with ENUM DNS Provider)

Involved entities: Applicant, ENUM Registrar, ENUM DNS Provider, Authentication Agency, Tier 1 Registry

Initiated by: Applicant approaching ENUM Registrar for provisioning of ENUM functionality.

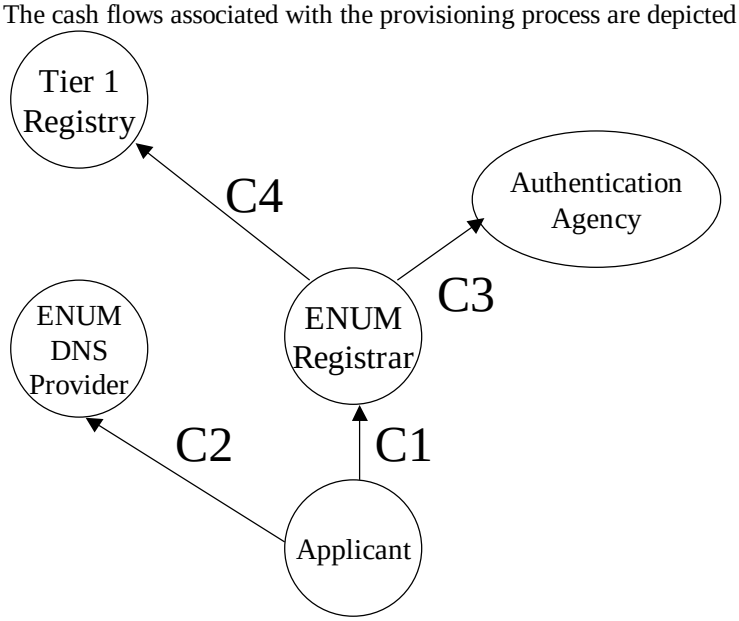
1.3.1 Process:

Note: In this case, only role of ENUM Registrar is to act as an accredited interface to Tier 1 and Authentication Agency. The nature of "Authentication Information" is for further study but would require standardisation.

1. Applicant approaches ENUM DNS Provider for provision of NAPTR records
2. (Optional) ENUM DNS Provider validates proposed NAPTR records
3. ENUM DNS Provider provisions, tests NAPTR records, provides nameserver details to Applicant
4. Applicant approaches ENUM Registrar for accreditation of right to provision ENUM functionality
5. ENUM Registrar obtains from Applicant sufficient material to complete Initial Authentication Process (see Section 1.4), nameserver details
6. Initial Authentication Process is carried out by Authentication Agency
7. ENUM Registrar passes details of number, nameservers to Tier 1 Registry. Administrative contact = ENUM Registrar, Technical contact = ENUM DNS Provider
8. If there is no existing entry for the number in question, or any existing entry already has the ENUM Registrar as the Administrative Contact, then Tier 1 Registry builds pointers to ENUM DNS Provider and tests them. Note: If there is an entry AND the ENUM Registrar is the one initiating the request, then it means that this is a change of ENUM DNS Provider while retaining the same ENUM Registrar – see Section 2.1.
9. If there is an existing entry for the number in question, then Tier 1 Registry contacts previous ENUM Registrar to notify them of change. Note : this means that the Customer already has an ENUM subscription but is changing ENUM Registrar. "Losing" ENUM Registrar may take opportunity to contact previous ENUM DNS Provider to delete redundant data. It is recommended that a winback period of 5 days is built in at this stage to allow the losing operator to make a single call to retain the customer. Tier 1 Registry then builds pointers to ENUM DNS Provider and tests them.
10. Tier 1 Registry confirms to ENUM Registrar that pointers are provisioned
11. ENUM Registrar confirms to Applicant that ENUM functionality is now operational, provides Authentication Information for future customer relationship.

1.3.2 Cash Flows

The cash flows associated with the provisioning process are depicted in the diagram below;



1.4 Initial Authentication Process

Involved entities: Authentication Agency, ENUM Registrar, Applicant, (potentially) telecoms service provider
Initiated by: Provide processes

1.4.1 Process:

Note : this is a generic process that will require tailoring to the particular needs of certain customer types, numbers.
1.ENUM Registrar contacts Authentication Agency with telephone number, customer name & address, *(potentially)* telecoms provider account number
2.If the telephone number is not ex-directory, then Authentication Agency verifies that the name, telephone number and address align by checking with Directory Enquiries database (e.g. available on CD, or various websites.
3.If the telephone number is ex-directory, then using the front-end of the Number Portability process, the Authentication Agency requests the telecoms service provider to verify that the name, telephone number, address and account information align.
4.Authentication Agency sends paper letter to Applicant with PIN that they must use on an authentication website to prove that they are the applicant. *Note : this is required to ensure that another entity is fraudulently trying to get a given telephone number provisioned by replicating the account details associated with a given telephone number.*
5.Applicant verifies application by logging onto site in question.
6.If stages (2)/(3) and (5) are completed, then Authentication Agency verifies to ENUM Registrar that application is valid, provides Authentication Information.

1.5 Renewal of registration

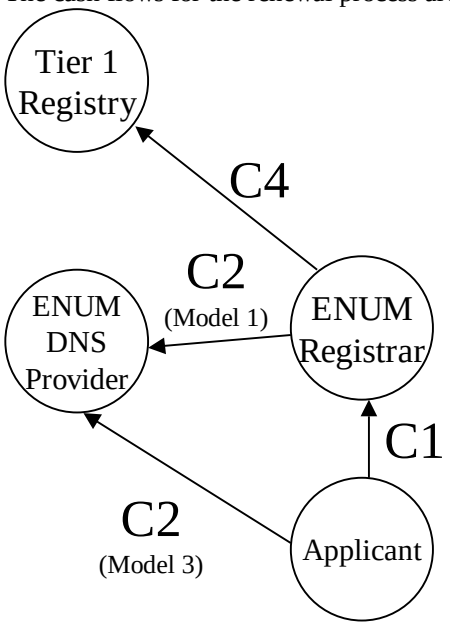
Involved entities: Customer, ENUM Registrar
Initiated by : Customer renewing registration. Note : It may be good practise for ENUM Registrars to warn their customers of the imminent expiry of the renewal timer, but this does not form an integral part of the process.

1.5.1 Process :

1. Customer provides ENUM Registrar with Authentication Information to validate that they are owner of ENUM subscription, requests renewal of subscription.
2. ENUM Registrar resets “renewal timer” for Customer’s ENUM subscription.

1.5.2 Cash Flows

The cash flows for the renewal process are shown in the diagram (C2 is not applicable for Model 2);



2 Change Processes

NB it is assumed that the timescales around these processes will be determined by contractual arrangements and potentially Codes of Practise rather than anything specified in the processes. Changes to the ENUM Registrar are accomplished via contracting directly with a new ENUM Registrar, see Section 1.1.

2.1 Change of DNS Provider

2.1.1 Change of ENUM DNS Provider – Model One (ENUM Registrar is single point of contact for ENUM provision)

Involved entities: ENUM Registrar, Losing ENUM DNS Provider, Gaining ENUM DNS Provider, potentially Customer
Initiated by : Either Customer requesting change of ENUM DNS Provider, or ENUM Registrar initiating change of ENUM DNS Provider.

2.1.1.1 Process:

1. If Customer initiated, Customer contacts ENUM Registrar with Authentication Information and requests change of ENUM DNS Provider
2. ENUM Registrar validates Authentication Information to confirm customer identity.
3. ENUM Registrar passes details of number, NAPTR contents to Gaining ENUM DNS Provider for provisioning
4. Gaining ENUM DNS Provider provisions NAPTR records and confirms nameservers details to ENUM Registrar
5. ENUM Registrar passes details of number, Gaining ENUM DNS Provider nameservers to Tier 1 Registry. Administrative contact = ENUM Registrar, Technical contact = Gaining ENUM DNS Provider.
6. If ENUM Registrar is recorded as the Administrative Contact for the number in question, then Tier 1 Registry builds pointers to Gaining ENUM DNS Provider and tests them. Otherwise, the request is rejected and the process halted.
7. Tier 1 Registry confirms to ENUM Registrar that pointers are provisioned.
8. ENUM Registrar contacts Losing ENUM DNS Provider and requests removal of NAPTR records.
9. Losing ENUM DNS Provider removes NAPTR records and confirms to ENUM Registrar.
10. If change was Customer initiated, ENUM Registrar confirms to Customer that ENUM DNS Provider has been changed.

2.1.2 Change of ENUM DNS Provider – Model Two (Customer maintains own DNS records)

Note : This process is null given that the customer IS the ENUM DNS Provider.

2.1.2.1 Change of ENUM DNS Provider – Model Three (Customer has direct relationship with ENUM DNS Provider)

Involved entities: ENUM Registrar, Losing ENUM DNS Provider, Gaining ENUM DNS Provider, Customer
Initiated by :Customer requesting change of ENUM DNS Provider

2.1.2.2 Process:

1. Customer passes details of number, NAPTR contents to Gaining ENUM DNS Provider for provisioning
2. Gaining ENUM DNS Provider provisions NAPTR records and confirms nameservers details to Customer
3. Customer contacts ENUM Registrar with Authentication Information and notifies change of ENUM DNS Provider
4. ENUM Registrar validates Authentication Information to confirm customer identity.

5. ENUM Registrar passes details of number, Gaining ENUM DNS Provider nameservers to Tier 1 Registry. Administrative contact = ENUM Registrar, Technical contact = Gaining ENUM DNS Provider.
6. If ENUM Registrar is recorded as the Administrative Contact for the number in question, then Tier 1 Registry builds pointers to Gaining ENUM DNS Provider and tests them. Otherwise, the request is rejected and the process halted.
7. Tier 1 Registry confirms to ENUM Registrar that pointers are provisioned.
8. ENUM Registrar confirms to Customer that changes have been made to Tier 1
9. Customer contacts Losing ENUM DNS Provider and requests removal of NAPTR records.
10. Losing ENUM DNS Provider removes NAPTR records and confirms to Customer.

2.2 Change of NAPTR contents

Involved entities: Customer, ENUM Registrar, ENUM DNS Provider. Note that this process only applies to customers entered under the process for Model One, since for the other models this would effectively be an internal process.
Initiated by: Customer requesting change of NAPTR record contents

2.2.1 Process :

1. Customer contacts ENUM Registrar with Authentication Information, required change to NAPTR records.
2. ENUM Registrar validates Authentication Information to confirm customer identity.
3. Optional ENUM Registrar validates proposed NAPTR record changes.
4. ENUM Registrar contacts ENUM DNS Provider and notifies required NAPTR record changes.
5. ENUM DNS Provider makes required changes to NAPTR records and notifies ENUM Registrar
6. ENUM Registrar confirms to Customer that changes to NAPTR records have been made.

3 Cessation Processes

3.1 Customer Initiated Cease

Involved entities: Customer, ENUM Registrar, ENUM DNS Provider, Tier 1 Registry
Initiated by:Customer requiring cessation of ENUM functionality.

3.1.1 Process:

1. Customer provides ENUM Registrar with Authentication Information to validate that they are owner of ENUM subscription, requests cessation of subscription.
2. ENUM Registrar validates Authentication Information to confirm customer identity.
3. ENUM Registrar requests Tier 1 Registry to remove pointer to ENUM DNS Provider
4. If ENUM Registrar is recorded as the Administrative Contact for the number in question, then Tier 1 Registry removes the pointer to ENUM DNS Provider. Otherwise, request is rejected and process halted.
5. Tier 1 Registry confirms to ENUM Registrar that pointer has been removed.
6. Model One only : ENUM Registrar requests that ENUM DNS Provider removes the NAPTR record associated with the number in question.
7. Model One only : ENUM DNS Provider removes the NAPTR record associated with the number
8. Model One only : ENUM DNS Provider confirms to ENUM Registrar that record has been removed.
9. ENUM Registrar confirms to Customer that ENUM functionality has been ceased, subscription is terminated.
10. Models Two and Three only : Customer arranges for NAPTR records to be removed from ENUM DNS Provider

3.2 Registrar Initiated Cease

Involved entities : Customer, ENUM Registrar, ENUM DNS Provider, Tier 1 Registry
Initiated by : The "renewal timer" for a given subscription reaching maturity without the customer renewing their ENUM subscription. Note : It may be good practise for ENUM Registrars to warn their customers of the imminent expiry of the renewal timer, but this does not form an integral part of the process.

3.2.1 Process:

1. ENUM Registrar requests Tier 1 Registry to remove pointer to ENUM DNS Provider.
2. If ENUM Registrar is recorded as the Administrative Contact for the number in question, then Tier 1 Registry removes the pointer to ENUM DNS Provider. Otherwise, request is rejected and process halted.
3. Tier 1 Registry confirms to ENUM Registrar that pointer has been removed.
4. Model One only : ENUM Registrar requests that ENUM DNS Provider removes the NAPTR record associated with the number in question.
5. Model One only : ENUM DNS Provider removes the NAPTR record associated with the number
6. Model One only : ENUM DNS Provider confirms to ENUM Registrar that record has been removed.
7. ENUM Registrar confirms to Customer that ENUM functionality has been ceased, subscription is terminated.
8. Models Two and Three only : Customer arranges for NAPTR records to be removed from ENUM DNS Provider

3.3 Registry/DNS Provider Initiated Cease

Involved entities: Customer, ENUM Registrar, ENUM DNS Provider, Tier 1 Registry
Initiated by : The Tier 1 Registry or ENUM DNS Provider initiating a cease request. NB this would normally only arise due to commercial disputes, hence could only be initiated via the processes in Section 4.

3.3.1 Process:

1. Registry notifies ENUM Registrar that number is to be removed in X days. Value of X is to be determined, and should be sufficient for customer to make alternate arrangements.
2. ENUM Registrar notifies customer that their records are to be removed, and advises them of options available to keep service.
3. Model One only : After X days, if deletion is initiated by Tier 1 Registry, ENUM Registrar notifies the ENUM DNS Provider to remove records, otherwise notifies the Tier 1 Registry to remove the pointers.
4. Models Two & Three only : After X days, if deletion is initiated by Tier 1 Registry, ENUM Registrar notifies the customer to arrange to remove records, otherwise notifies the Tier 1 Registry to remove the pointers.
5. Tier 1 Registry confirms to ENUM Registrar that pointer has been removed.
6. Model One only : ENUM DNS Provider confirms to ENUM Registrar that it has removed the NAPTR record associated with the number in question.
7. ENUM Registrar confirms to Customer that ENUM functionality has been ceased, subscription is terminated.

4 Dispute Resolution

For further study : scenarios that must be addressed
despite authentication, number is fraudulently entered into ENUM and real customer disputes
breakdown of commercial relationship between Tier 1 Registry, ENUM DNS Provider, ENUM Registrar
ENUM Registrar illegally blocks movement of customer to a new ENUM Registrar
Complaints about contents of NAPTR records.

5 Maintenance Processes

5.1 O&M Changes initiated by ENUM Registrar

Notes : type of changes involved likely to be e.g. change of Administrative Contact Information

Involved entities : ENUM Registrar, potentially ENUM DNS Provider, potentially Tier 1 Registry
Initiated by : ENUM Registrar

5.1.1 Process :

1. ENUM Registrar contacts Tier 1 Registry or ENUM DNS Provider as appropriate, supplying relevant information.
2. Tier 1 Registry or ENUM DNS Provider makes changes as appropriate.
3. Tier 1 Registry or ENUM DNS Provider notifies ENUM Registrar that changes have been made.

5.2 O&M Changes initiated by ENUM DNS Provider

Notes : type of changes involved likely to be e.g. change of Technical Contact Information, change of Nameserver information.

Involved entities: ENUM DNS Provider, ENUM Registrar, potentially Tier 1 Registry
Initiated by: ENUM DNS Provider

5.2.1 Process:

1. Model One : ENUM DNS Provider contacts ENUM Registrar supplying relevant information.
2. Model Two : Customer contacts ENUM Registrar supplying relevant information.
3. Model Three : ENUM DNS Provider contacts Customer who in turn contacts ENUM Registrar supplying relevant information.
4. ENUM Registrar amends their data & systems, and forwards notification to Tier 1 Registry as appropriate..
5. If appropriate, Tier 1 Registry updates their data & systems, and notifies ENUM Registrar that changes have been made
6. Model One : ENUM Registrar notifies ENUM DNS Provider that changes have been made.
7. Models Two & Three : ENUM Registrar notifies Customer that changes have been made.
8. Model Three : Customer notifies ENUM DNS Provider that changes have been made.

5.3 O&M Changes initiated by Tier 1 Registry

Notes : type of changes involved likely to be e.g. change of Contact Information, change of Nameserver information.

Involved entities : Tier 1 Registry, ENUM Registrar, potentially ENUM DNS Provider
Initiated by : Tier 1 Registry

5.3.1 Process :

Tier 1 Registry contacts ENUM Registrar supplying relevant information.
ENUM Registrar amends their data & systems, and forwards notification to ENUM DNS Provider as appropriate (in Models Two and Three via Customer).
If appropriate, ENUM DNS Provider updates their data & systems, and notifies ENUM Registrar that changes have been made
ENUM Registrar notifies Tier 1 Registry that changes have been made.

Annex H - ENUM FIELD TRIAL BUSINESS PLAN INCLUDING THE MEMORANDUM OF UNDERSTANDING FOR THE UKEG ENUM FIELD TRIAL

Contents

1. Introduction

ENUM (electronic number mapping) is a key development in the convergence process of telecommunication and IP networks. An ENUM service enables customers to give access to services associated with the called number.

An industry working group for the UK, known as the United Kingdom ENUM Group (UKEG), was launched with the full support of the Department of Trade and Industry (DTI) in September 2001. The group have been actively reviewing ENUM issues from a UK perspective and will shortly be submitting their preliminary report to the DTI..

It has been widely agreed that the stage has been reached where it would be appropriate to carry out an ENUM Field Trial.

The aim of the ENUM Field Trial is to test architectural, technical, operational and user experience aspects related to the provision of ENUM capabilities, as defined in IETF RFC 2916, for Country Code 44.

Results collected in the trial will enable UKEG, and any other interested party, to gain information and experience on how to provide and implement ENUM capabilities in the commercial phase.

This business plan invites parties to participate in the UK ENUM trial and is intended to provide further information to prospective participants. All trial participants will be required to sign the UKEG ENUM Trial Memorandum of Understanding (MoU).

2. Objectives of the trial

- To evaluate the pros and cons of the different options developed by UKEG to implement ENUM capabilities with particular emphasis on the Registry and Registrar role
- To evaluate processes/interfaces/protocols for the interactions between the different parties (Tier 1 Registry, ENUM Domain Name System (DNS) Provider, ENUM Registrar, Application Service Provider, Number Assignment Entity, Telephone Service Provider)
- To determine technical and operational requirements to provisioning ENUM records at Tier 1 Registry and ENUM DNS Provider level
- To assess DNS requirements/ implications in the provision of ENUM services
- To determine security and verification requirements for provisioning and operation of ENUM capabilities
- To test from a technical and user perspective applications based on the use of ENUM capabilities
- To evaluate and refine the economic benefits and costs of supporting ENUM.

The results of the trial will be used by UKEG to determine the preferred implementation framework for the provision of ENUM capabilities behind Country Code 44.

3. Project Plan

The trial comprises of five phases, some of which are not concurrent:

- phase 1, to prepare a business plan to assess the feasibility of the trial and a work plan for the trial, and to identify necessary actions and time-schedules for the implementation of the trial;

- phase 2, to invite participants to the trial, evaluate them, select the trial participants and appoint the trial manager(s);

- phase 3, to deploy resources and infrastructure to run the trial;
- phase 4, to operate the trial and liaise with UKEG to ensure the necessary cooperation;
- phase 5, to carry out an evaluation of the trial and to produce a report for the UKEG, summarising the results of the trial and the conclusions that may be drawn from it.

The timescale of the trial is as follows:

- Phase 1 to start in March 2002 and to last for no more than 30 days;
- Phase 2 to last for no more than 60 days;
- Phase 3 to last for no more than 60 days;
- Phase 4 to last for no more than 180 days;
- Phase 5 to last for no more than 45 days.

The duration of the whole trial from phase 1 to phase 5 is not longer than 12 months.

At the end of phase 2, the selected participants will sign the Trial MoU (appendix 8.1) that governs the trial and defines rights and obligations of all participants.

The following dependency has been identified:

- Phase 3 will only start after the delegation of Country Code 44 to the competent authority in accordance with the process agreed by ITU and IAB.

4. Potential Benefits of Trial Participation

Trial participants will potentially be able to:

- Gain expertise and experience in the emerging ENUM markets
- Take advantage of a unique opportunity to develop and test mechanisms and applications within a safe trial environment
- Benefit from their participating staff being more ENUM aware
- Use the trial as a staff development opportunity
- Quote trial participation in relevant marketing and PR materials
- Exploit presentation and seminar opportunities that may arise as a result

5. Trial Management

All parties participating in the trail must co-operate in accordance with the rules defined in the trial MoU. Decisions will be taken by consensus (and lack of sustained opposition) amongst the trial participants, with the involvement of the UKEG if appropriate.

The UKEG will act as the Steering Committee, closely following the developments of the trial, receiving regular updates regarding the progress of the trial, giving strategic guidance and solving possible conflicts between the participants.

A Trial Manager(s) will be appointed as it is recognised that the success of the trial will also depend on an adequate level of management of technical and financial resources, coordination amongst the participants and communication between the trial group and UKEG.

6. Trial Evaluation

Trial evaluation will be carried out during the period of the trial and it is expected that key learning points will be identified on an ongoing basis. Interim reports will be made to the UKEG.

The formal evaluation of the trial, from the perspective of the trial participants, will begin in phase 5.It is anticipated that a Trial Evaluation report will be produced by the Trial Group and presented to the UKEG.

7. Trial Participants,

Parties who may participate in the trial are:

- Tier 1 Registry
- ENUM DNS Provider
- ENUM Registrar
- Application Service Provider
- Validation entity
- ENUM End User

The Tier 1 Registry will be the UK national registry for ENUM for the duration of the trial. Tier 1 will be responsible for the authoritative name servers and zone files for 4.4.e164.arpa.

The ENUM DNS Provider will be responsible for the NAPTR records associated with individual E.164 numbers of the national numbering plan included in the ENUM trial.

The ENUM Registrar will be the commercial interface between the Tier 1 Registry and the ENUM End Users. It will provide direct services to ENUM End Users by processing name registrations and triggering the validation process.

The Application Service Provider will provide the applications direct to the ENUM End Users in the context of the trial.

The validation entity will be responsible for validating the assignment of E.164 numbers to ENUM End Users. The validation entity can be either the Telephony Service Provider or National Number Plan Administrator or his agent.

ENUM End Users will be the users using the applications offered within the ENUM trial on a non-commercial basis.

The trial MoU, that governs the trial and the relationship among participants, must be signed by all participants before joining the trial group.

All participants will underwrite their own expenses and associated costs in participating in the trial. Neither compensation nor financial benefits are foreseen for any trial participant.

8. Trial Participant Requirements

.8.1 The Tier 1 Registry should be able to demonstrate relevant registry experience and ensure that they are able to meet the following resource requirements (where ‘must’ means this requirement is a compulsory one and ‘should’ means this requirement is optional):

- The Tier 1 registry must commit to the provision of suitably experienced staff resources to the trial, for the time required to devote to the trial, for the duration of the trial

- The Tier 1 registry must commit to providing sufficient technical resources to the trial for the duration of the trial
- The Tier 1 registry must commit to strictly complying with all Data Protection legislation and relevant guidelines
- Servers must not run insecure name server software. .
- Servers must have adequate bandwidth and connectivity to theInternet.
- The operating systems of the servers must be secured againstattacks: security penetration, denial of service, etc. Adequatelogging and audit trails should be provided.
- Technical and administrative contact information must be provided and kept up to date. This will include details of the server location(s), IP address(es), OS & name server configuration details, email addresses, contact names and phone numbers, etc, etc.
- Name servers must support NAPTR records.
- Servers must be configured with the minimal set of network services enabled: secure access, network time protocol, DNS and some monitoring software.
- Name servers must have recursion disabled. They must not fetch glue records
- Name servers should support DNSSEC and TSIG.
- Servers should support IPv6: A6, DNAME & AAAA records, IPv6 transport.
- Servers should be installed in co-lo facilities with 24x7 monitoring, backup power supplies, etc.
- Name servers should not serve other zones.
- Servers should have sufficient capacity to support reasonably high query rates, typically a few hundred queries per second.
- Query logging and traffic pattern data should be enabled for troubleshooting and statistical analysis.

8.2 ENUM DNS Providers should be able to demonstrate relevant DNS provider experience and ensure they are able to meet the following resource requirements (where ‘must’ means this requirement is a compulsory one and ‘should’ means this requirement is optional):

- ENUM DNS providers must commit to the provision of sufficient staff and technical resources to the trial
- ENUM DNS providers must commit to strictly complying with all Data Protection legislation and relevant guidelines
- Servers must not run insecure name server software.
- Servers must have adequate bandwidth and connectivity to the Internet.
- The operating systems of the servers must be secured against attacks: security penetration, denial of service, etc. Adequate logging and audit trails should be provided.
- Technical and administrative contact information must be provided and kept up to date. This will include details of the server location(s), IP address(es), OS & name server configuration details, email addresses, contact names and phone numbers, etc, etc.
- Name servers must support NAPTR records.
- Servers must be configured with the minimal set of network services enabled: secure access, network time protocol, DNS and some monitoring software.
- Name servers must have recursion disabled. They must not fetch glue records
- Name servers should support DNSSEC and TSIG.
- Servers should support IPv6: A6, DNAME & AAAA records; IPv6 transport.
- Servers should be installed in co-lo facilities with 24x7 monitoring, backup power supplies, etc.
- Name servers should not serve other zones.

- Servers should have sufficient capacity to support reasonably high query rates, typically a few hundred queries per second.
- Query logging and traffic pattern data should be enabled for troubleshooting and statistical analysis.

8.3 ENUM Registrars should ensure they are able to meet the following resource requirements (where 'must' means this requirement is a compulsory one and 'should' means this requirement is optional):

- ENUM Registrars must commit to the provision of sufficient staff and technical resources to the trial
- ENUM Registrars must commit to strictly complying with all Data Protection legislation and relevant guidelines

8.4 Application Service Providers should ensure they are able to meet the following resource requirements (where 'must' means this requirement is a compulsory one and 'should' means this requirement is optional):

- Application Service Providers must commit to providing sufficient staff and technical resources to the trial

8.5 Validation Entities should ensure they are able to meet the following resource requirements (where 'must' means this requirement is a compulsory one and 'should' means this requirement is optional):

- Validation entities must commit to the provision of sufficient staff and technical resources to the trial
- Validation entities must commit to strictly complying with all Data Protection legislation and relevant guidelines

8.6 ENUM End Users should ensure they are able to meet the following resource requirements (where 'must' means this requirement is a compulsory one and 'should' means this requirement is optional):

- ENUM end users must commit to providing sufficient personal information to effect an ENUM registration
- ENUM end users must consent to their personal data being made available to parties in the trial who have agreed to comply with Data Protection legislation and relevant guidelines
- ENUM end users should undertake to use available ENUM applications during the period of the trial
- ENUM end users should provide feedback to the trial group for evaluation purposes

9. Selection of Trial Participants

Provided that the relevant resource requirements are met and the organisation or person concerned is prepared to agree to the Trial MoU, then they shall be permitted to participate in the trial.

Where there are two or more potential participants at the Tier 1 Registry level, who meet all resource requirements and are prepared to agree to the Trial MoU, then ways in which each may participate in the trial will be explored. For example, a co-operative approach, a different tier 1 registry for a set period of time etc. If no acceptable solution can be agreed, the matter will be referred to UKEG for a decision.

10. Appendices

10.1 Memorandum of Understanding for ENUM Field Trial

16th April 2002
DRAFT Version 3.0

This is a Memorandum of Understanding ("ENUM Trial MoU") by and between members of the UK ENUM GROUP ("UKEG"), for the purpose of establishing common understandings and voluntary cooperation in the conduct of the UKEG's ENUM Field Trial (the "Field Trial"). The ENUM Trial MoU reflects the intentions of all members of the UKEG and in particular all participants in the Field Trial .

Whereas,

ENUM as set forth in IETF RFC 2916 (www.ietf.org/rfc/rfc2916.txt?number=2916), specifies an open Internet standards track protocol for the Internet community on how the DNS can be used for identifying available services connected in relation to a domain name and a corresponding E.164 number;

discussions are taking place internationally in preparation for the launch of ENUM services in the future; and

an industry working group, known as the UKEG, has been formed in the UK with the full support of the Department of Trade and Industry.

Considering,

that the aim of the Field Trial is to test the architectural, technical, operational and user aspects related to provision of ENUM capabilities, as defined in RFC 2916, for Country Code 44;

that the Field Trial will provide valuable experience, data and information concerning the implementation of ENUM services;

that the results of the Field Trial will be used by UKEG to determine the preferred implementation framework for the provision of ENUM capabilities and services behind Country Code 44; and

that results collected in the Field Trial will enable the UKEG and other interested parties to gain information and experience on how to provide and implement ENUM capabilities in the commercial phase.

Now therefore,

The Signatories to this ENUM-MoU (the "Trial Participants") hereby agree to voluntarily cooperate, according to their respective roles and competencies, as follows in the implementation of the Field Trial:

A. Field Trial Objectives

The following list sets forth the high-level objectives of the Field Trial:

1. Evaluate the pros and cons of the current preferred option developed by the UKEG and others to implement ENUM capabilities with particular emphasis on demonstration of the Registry and Registrar functions;

2. Evaluate the processes, interfaces, and protocols for the interactions between the different parties (e.g., Tier1Registry, ENUM Domain Name System (DNS) Provider, ENUM Registrar, Application Service Provider, Number Assignment Entity and Telephone Service Provider);
3. Determine technical and operational requirements to provisioning ENUM records at Tier 1 and ENUM DNS Provider levels;
4. Assess DNS requirements and implications in the provision of ENUM services;
5. Determine security and verification requirements for provisioning and operation of ENUM capabilities;
6. Test from a technical and user perspective applications based on the use of ENUM capabilities; and
7. Evaluate and refine economic benefits and costs of supporting ENUM services.

B. General Principles

The following principles govern the activities of the Field Trial and reflect the common understanding of all Trial Participants:

1. This ENUM Trial MoU and the Field Trial are intended to promote the stability of ENUM capabilities and services, and to facilitate the UKEG and other interested parties to plan for the technical and commercial implementation of ENUM services for Country Code 44.
2. This ENUM Trial MoU and the Field Trial are intended to promote ENUM capabilities and services in a manner that will permit market mechanisms to support competition and consumer choice in the provision of such services. This competition will lower costs, promote innovation, and enhance user choice and satisfaction.
3. This ENUM Trial MoU and the Field Trial are aimed at reducing barriers to entry into the provision of ENUM services, thereby encouraging entry by new entities and increasing competition and growth, to the benefit of all industry players and consumers.

4. The Field Trial is intended to test the architectural, technical, operational and user aspects related to provision of ENUM capabilities in a manner that will not harm current technical and functional operations.
5. The Field Trial will be implemented by using to the greatest extent possible open and standardized protocols and interfaces in order to facilitate interoperability between the parties.
6. Participation to the Field Trial is open to all parties having a genuine interest in gaining experience concerning the implementation and provision of ENUM capabilities.
7. All Trial Participants must meet a minimum set of technical, operational and financial requirements, as set forth in the ENUM Field Trial Business Plan.
8. All Trial Participants shall co-operate in accordance to the provisions of this ENUM Trial MoU, and decisions will be taken by consensus (e.g., lack of sustained opposition) among the Trial Participants, with the involvement of the UKEG acting as Steering Committee (the "Steering Committee") when appropriate.
9. All Trial Participants shall provide their reasonable best efforts to make the Field Trial a success, and agree to act in a manner that is compatible with the aims and objectives of the Field Trial.
10. All Trial Participants must not expect any financial benefits or compensation for their participation in and support of the Field Trial.
11. All Trial Participants should make no assumptions that their involvement in the Field Trial will accord them any preferential status if and when ENUM services reach the commercial development phase in the UK and/or a RFP or tender is produced for any provision of ENUM services.
12. The failure or success of any part of the Field Trial – e.g., DNS hosting or a particular registry/registrar model – should not necessarily advantage (or disadvantage) the participants in that part of the Field Trial. It should be expected that some parts of the Field Trial may not succeed for reasons beyond the control of the parties involved. The Field Trial is intended to establish which procedures and models work and which do not.
13. Any entity may request to participate in the Field Trial after it commences. Such participation, however, will be permitted only at the discretion of the Trial Participants, with the involvement of the Steering Committee if agreement among the Trial Participants cannot be reached.

C. Responsibilities of Trial Participants and Organization of Field Trial

1. The Trial Participants agree to participate jointly in the Field Trial for testing the architectural, technical, operational and user aspects related to ENUM capabilities that should be in place for the technical and commercial implementation of ENUM services in the 44 Country Code, and to act in a transparent, non-arbitrary and reasonable manner.
2. The Trial Participants agree to participate in the Field Trial with the intention of observing all relevant commitments and remaining involved until the completion of the Field Trial.
3. The Trial Participants will use their reasonable best efforts to ensure the continuity of the Field Trial. In this respect, the Trial Participants agree that, if any one of them is prevented for any reason from completing the Field Trial, including for failure to meet the aims and objectives of the Trial, that Party will make available and facilitate the transfer of information and other material relevant to enable the Trial to continue to its completion, to another Trial Participant or Participants to be designated by the remaining Trail Participants, with input from the Steering Committee.
4. A Trial Participant can be removed from the Field Trial for failure to meet the aims and objectives of the Trial, through the recommendation of a majority of the other Trial Participants, with the approval of the Steering Committee.
5. In order to ensure the necessary co-ordination and management of the different elements of the Field Trial a Trial Manager(s) will be appointed, as provided in the Field Trial Business Plan.
6. At the completion of the Field Trial, each Trial Participant will be responsible to produce a report to be submitted to the Steering Committee, containing that Party's relevant findings, conclusions and data resulting from the Field Trial. The Trial Manager(s) will be responsible for co-ordinating and collating these contributions from the Trial Participants. The Trial Participants will determine in due course the suggested contents of this report, having input from the Steering Committee.
7. The Trial Participants will co-operate fully with any transition to an ENUM commercial and/or production service, including making available relevant Field Trial information and material, even if a particular Trial Participant is not to be involved (or was unsuccessful in bidding for) any element of the ENUM commercial and/or production services. This co-operation will extend, in particular, to the Tier 1 Registry functions.
8. The Trial Participants shall each bear their own costs and expenses in relation to participating in the Field Trial.
9. The Trial Participants agree that they will not promote or imply that their involvement in the Field Trial is endorsed by members of the UKEG, other Trial Participants or the Government, unless those entities have established a prior agreement defining that endorsement and how it can be used.
10. The Trial Participants may request to serve in the functions listed in the first five of the following six categories:

    - Tier1 Registry
    - ENUM DNS Provider
    - ENUM Registrar
    - Application Service Provider
    - Validation Entity
    - ENUM End User

The technical, operational and financial requirements vary in relation to these six categories. The criteria for each category are described in the Field Trial Business Plan.

11. The Field Trial will comprise five phases:

    - phase 1: to prepare a business plan to assess the feasibility of the Field Trial and a work plan for the Trial, and to identify necessary actions and time-schedules for implementation of the Trial;
    - phase 2: to invite participants to the Field Trial, evaluate them, select the Trial Participants and appoint the Trial Manager(s);
    - phase 3: to deploy resources and infrastructure to run the Field Trial
    - phase 4: to operate the Field Trial and liase with the Steering Committee to ensure the necessary co-operation; and

- phase 5: to carry out an evaluation of the Field Trial and to produce a report for the Steering Committee, summarising the results of the Trial and the conclusions that may be drawn from it.

12. Phase 3 of the Field Trial will not start before Country Code 44 is delegated to a competent authority in accordance with the process agreed by ITU and IAB.
13. Phase 4 of the Field Trial will last not less than 5 months and not longer than 7 months.
14. The Steering Committee will monitor the development of the Field Trial and provide, when appropriate, contributions to the activities of the Trial.

D. Legal Considerations

1. This ENUM Trial MoU is intended to be legally non-binding, and is based instead on the voluntary cooperation of all UKEG members and the Trial Participants.
2. "Trial Material" is defined to include all [TO BE ADDED: documents, data, technical specifications or other contributions, outputs] developed during the Field Trial by the Trial Participants. Trial Material does not include [TO BE ADDED: user data provided by end users and entered into the DNS and/or registry/registrar systems] during the Trial.
3. All Trial Material will be considered to be in the public domain. Findings and results generated or produced by the Field Trial and the Trail Participants should be made freely available to the UKEG, other Trial Participants and interested parties. The results of the Field Trial will be posted for public view at the following web site: [ADD URL].
4. It is understood that the Field Trial is intended to be a process for testing and experimentation, and therefore no representations or warranties of any kind whatsoever are made as to the accuracy, completeness or fitness for commercial use of the Trial Material or of any other Trial results. THE UKEG AND TRIAL PARTICIPANTS EXPRESSLY ACCEPT NO LIABILITY OF ANY KIND TO ANY PERSONS IN RELATION TO ANY RELIANCE ON SUCH MATERIAL AND RESULTS.
5. No Trial Participant will assert any form of legal ownership – e.g., copyright, trade secret, licence, patent, etc. – over the Trial Material. At the same time, Trial Participants are under no obligation to account to each other, to the UKEG or to the public for their own use of the Trial Material, as well as the experience and knowledge gained during the Field Trial.
6. Trial Participants may produce reports for internal use that are based on data which is in the public domain and available to other Trial Participants. Trial Participants are not precluded from using the knowledge and experience gained during the Field Trial to foster commercial benefit for themselves.

    - For example, if experts of registry provider A use their skills to build a better ENUM registry solution than provider B, A does not need to disclose that information to B, and B is not entitled to ask A for it.

7. Data made available for the Field Trial will not be used for any form of unsolicited communication, mass marketing or unfair trade practice.
8. The Field Trial will be conducted in accordance with applicable data privacy and protection regulation. At the end of the Field Trial, any personal data used during the Trial will be destroyed in accordance with relevant UK and EU law on data privacy and protection.
9. It is the clear and unequivocal policy of the UKEG, this ENUM Trial MoU and the Trial Participants to comply in all respects with the relevant competition and antitrust rules.
10. Trial Participants will not take part in any practice that would have the object or effect of restricting competition in the communications or DNS industries, nor will they provide a forum to promote anti-competitive conduct. Trial Participants will not become involved in the competitive business decisions of other Trial Participants.
11. Field Trial activities shall not involve discussions or agreements (including oral or informal agreements, decisions, and recommendations, whether binding or not) relating to restrictive practices, including:

    - Trial Participants shall not agree between themselves pricing and other terms and conditions of sale, including common prices and pricing policy, resale prices, price

changes, discounts, rebates, price elements, profit margins, recommended or target prices, and credit terms.

- Trial Participants shall not agree to share markets between themselves, in particular by the division of territories or customers.
- Trial Participants shall not exchange individualised up-to-date commercial information, particularly with regard to prices, discounts, costs, investments, output or sales, capacities, customers or market shares.

E. Period of ENUM MoU and Modification/Termination

1. This ENUM Trial MoU will become effective when signed by all Trial Participants to the Field Trial.
2. The ENUM Trial MoU will terminate on a date to be agreed by the Trial Participants, in consultation with the Steering Committee, but may be amended at any time by mutual agreement of the Trial Participants in writing.
3. Any Trial Participant may terminate its participation in this ENUM Trial MoU by providing thirty (30) days notice to the other Trial Participants.

SIGNATURES

Done in London:

Date: [date]

SIGNATORIES:

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_____

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_____

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10.2 Trial Manager Job and Person Specification

ENUM Trial Manager
The role of the ENUM trial manager will be to manage and co-ordinate the UK ENUM trial for a period of 6-9 months starting from mid March 2002.

Responsibilities:
Full project planning, co-ordination and monitoring
Close liaison with all members of the trial group
Facilitation of communication within the trial group and with the wider UKEG group
Cost and budget management
External communications on behalf of the trial group (e.g. responding to press enquiries)
Co-ordination of trial group meetings and tele-conferences
Co-ordination of trial group reports to the UKEG group

Person Specification:
Management experience in an appropriate industry
Proven project management skills
Strong project management experience
Excellent communication skills
Proven organisational and diplomatic skills
Understanding of telephony/DNS/registry operations