Implications of ENUM

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Telephone Numbers are Important

- For IP telephony to be useful, IP telephones need to behave like any other telephone.
- It should be able to:
  - Initiate a call any other telephone number by using its E.164 address
  - Receive a call from any other telephone that addressed it using its E.164 address

IP phones need phone addresses

- The implication of “normal behaviour” is that IP phones need to have a binding with an E.164 number as well as an IP address
  - Other phones will address the device using an application-level E.164 address
  - The transport-level address is the IP address of the device

Its another form of Address Mapping

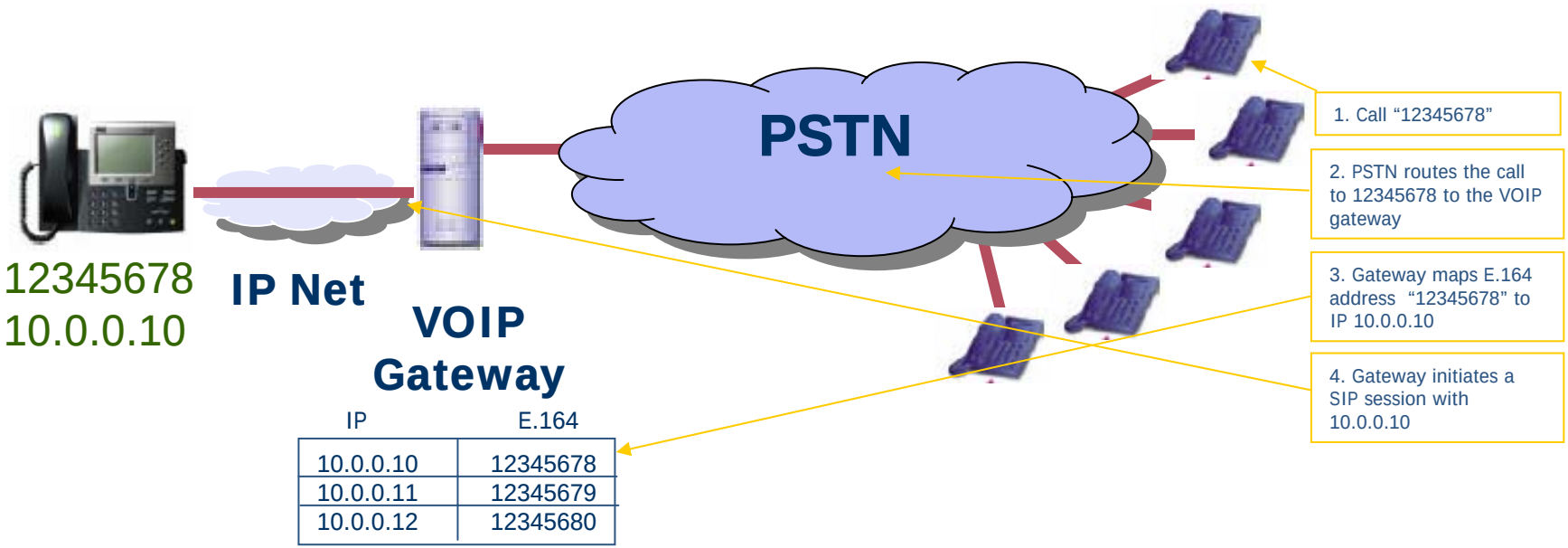
- For any useful form of IP telephony to be deployed, it is necessary that the IP devices are associated with real telephone numbers (E.164 addresses) in addition to the association with an IP address
- So the requirement here is for an address mapping from E.164 address to IP number

The Gateway VOIP Model

- Where should this E.164 -> IP mapping be held?
  - At the IP phone?
    - No – cannot relate back to transport level gateway
  - At the PSTN phone?
    - Obviously not
  - In PSTN switches or IP routers?
    - Obviously not
  - At the Gateway?
    - Yes! The mapping must be contained at the interface between the PSTN and the IP network segment that contains the IP phone

The Gateway VOIP Model

- The single gateway model is simple:
  - A PSTN / IP gateway maintains a mapping between IP and E.164 addresses



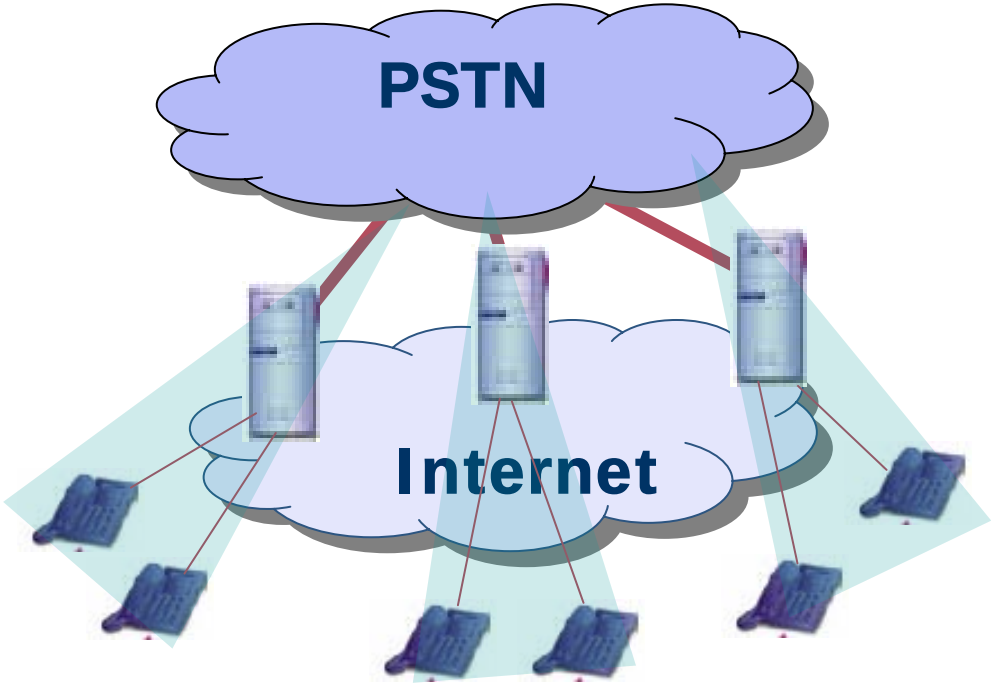
IP	E.164
10.0.0.10	12345678
10.0.0.11	12345679
10.0.0.12	12345680

The multi-Gateway VOIP World

- Use PSTN / VOIP Gateways
  - Each Gateway maps a set of telephone numbers to a set of served IP service addresses
  - Each Gateway knows only about locally served devices
  - Gateway-to-Gateway calls need to be explicitly configured in each gateway to use IP or some private connection, or use the default of the PSTN
  - The PSTN currently is the glue that allows the VOIP islands to interconnect with each other

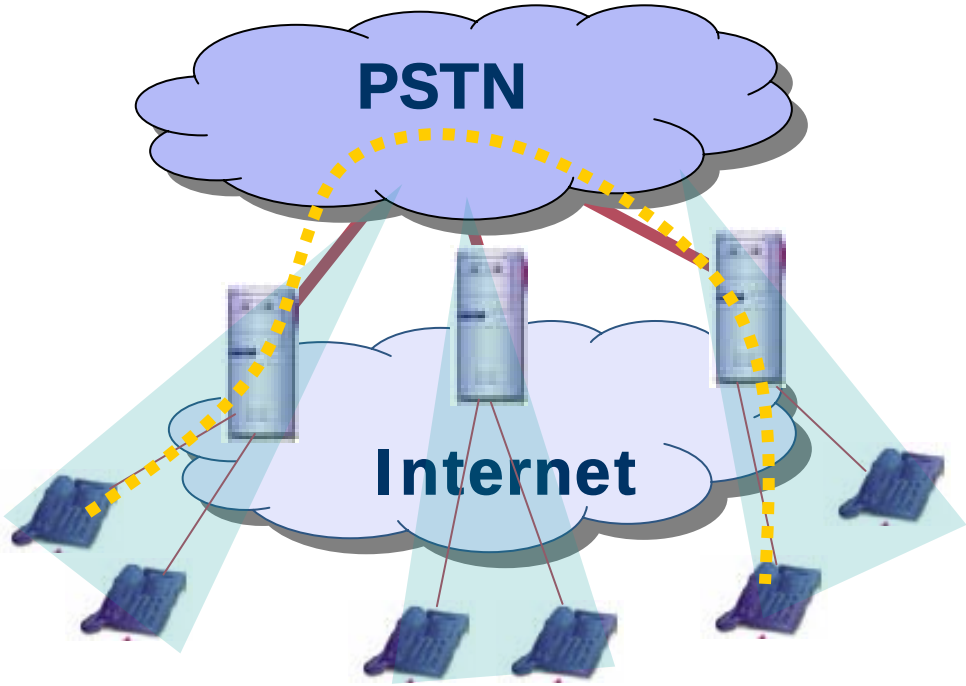
The multi-Gateway VOIP World

- VOIP Islands
  - E.164 numbers are only routable over the PSTN
  - Enterprise or carrier VOIP dialling plans cannot be remotely accessed by other VOIP network segments



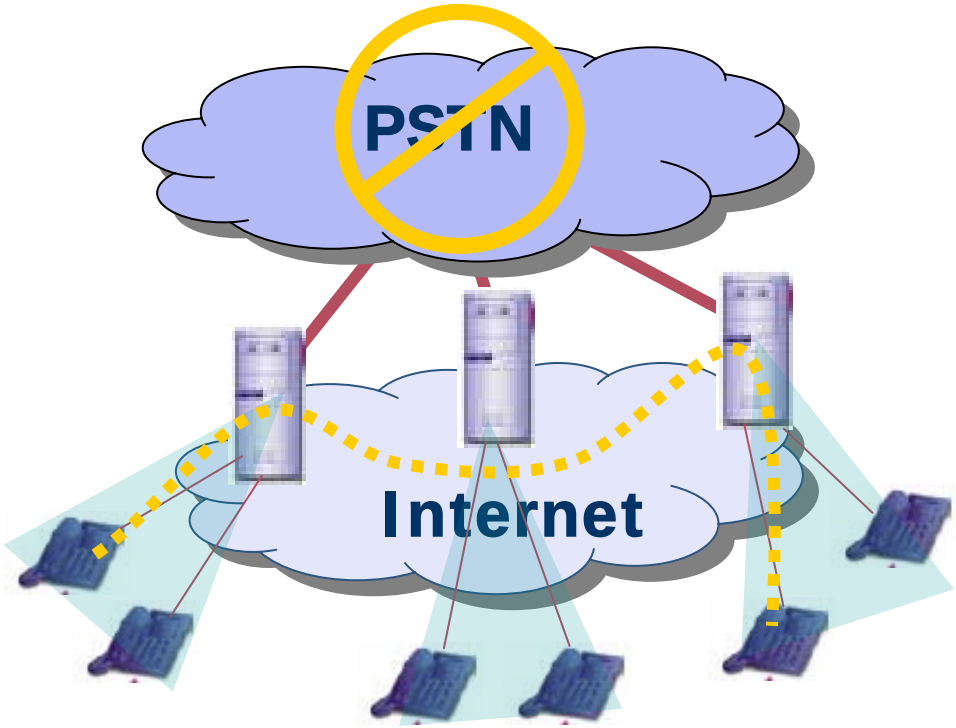
The multi-Gateway VOIP World

- The PSTN is used as the inter-VOIP network
  - Obvious implications of revenue protection for PSTN operators
  - More subtle implications for extended private VOIP networks



The Core ENUM Problem

- How can a VOIP gateway find out dynamically:
  - If a telephone number is reachable as an Internet device?
  - And if so, what's its Internet service address?



Problem statements for ENUM (1)

1. How do network elements (gateways, SIP servers etc) find services on the Internet if you only have a telephone (E.164) number?

Problem statements for ENUM (2)

2. How can subscribers define their preferences for nominating particular services and servers to respond to incoming communication requests?

The ENUM Objective

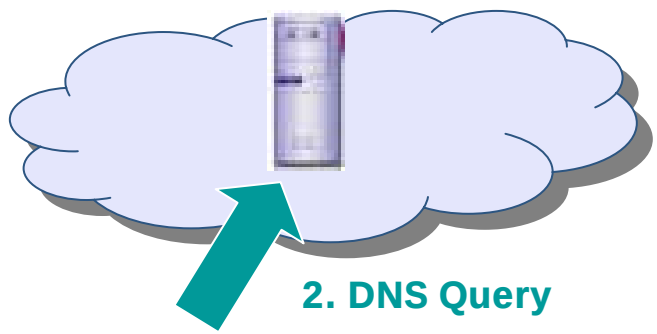
- Allow any IP device to establish whether an E.164 telephone address is reachable as an Internet-only Service
  - And ... what the preferred Internet Service Point actually is
  - And ... what IP address, protocol address, port address and application address should be used to contact the preferred Service Point

How Does ENUM Work?

- For a normal VOIP call, a client or user agent on the IP network takes a fully qualified E.164 telephone number from the application and generates a DNS query

+61 2 12345678

1. Reverse the Digit sequence



2. DNS Query

8.7.6.5.4.3.2.1.2.1.6.e164.arpa

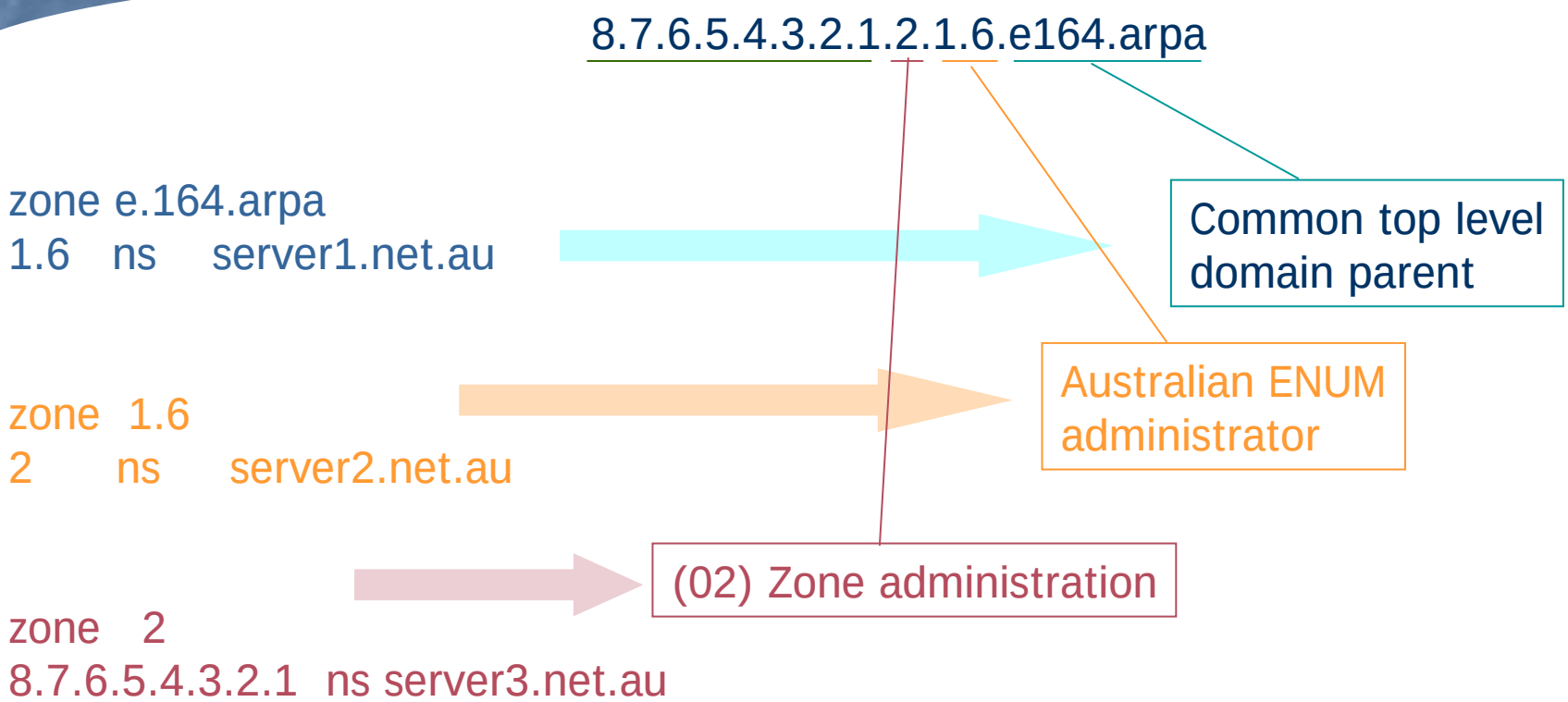
The DNS

- The same service that directs emails and web browsers to the correct destination.
- This same service is the basis of ENUM
- The DNS is a distributed association database that allows a query string to be associated with a response, using the preferences of the entity being queried to determine the response.

Explanation in some detail

- Each digit can become a definable as a distributed “zone” in DNS terms
- Delegation from one zone administrator to another can (but doesn’t have to) happen at every digit, including at last digit
- Zones such as country codes, area codes or primary delegated blocks of numbers can be delegated as well as individual numbers
- DNS defines authoritative name servers for NAPTR/service resource records

Delegation of DNS Zones

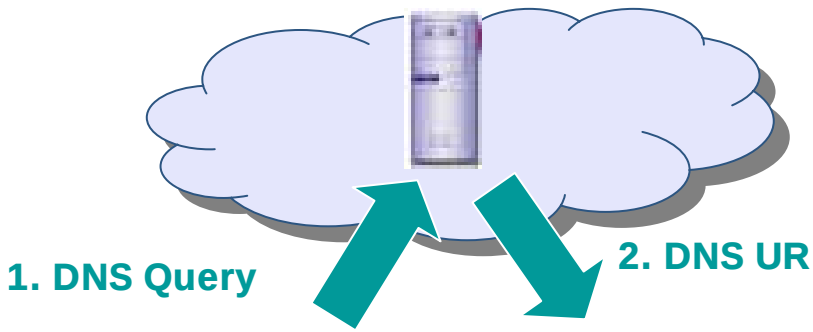


E164.arpa as a unique root for E.164 numbers in the DNS

- The implementation of a globally unique ENUM DNS name hierarchy provides ample opportunity for competition at the national level
- Having ENUM using domain e164.arpa means that one still maintains:
  1. Ability to have dialing plans in other domains
  2. Competition regarding registration according to registry/registrar model on all levels in DNS tree
  3. Competition when selecting the registries
  4. Competition regarding services

How does ENUM Work?

- The DNS response is an ordered collection of Service URIs (NAPTR records)



8.7.6.5.4.3.2.1.2.1.6.e164.arpa

1. sip:gih@sip.telstra.net
2. tel:61419231513
3. tel:61262081908

My preference for incoming voice calls is: try to set up a VOIP call to my sip server, then fall back to a mobile telephone then fall back to a desk phone.

How does ENUM Work?

- The client or user agent matches the desired service to the URI
- The client creates an IP connection to the target URI

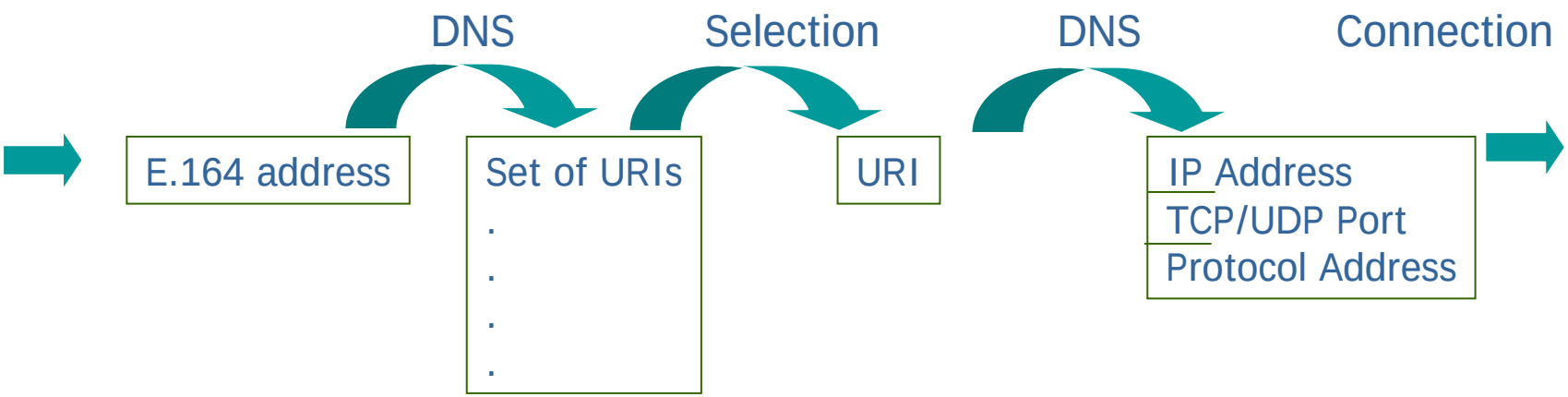
IP Fax Call to
+61 2 12345678

Ordered list of URIs for E.164 address + 61 2 12345678

1. sip:gih@sip.telstra.net
2. mailto:gih@telstra.net
3. http://www.telstra.net/gih
4. **fax:61264486165**
5. imm:gih@irc.telstra.net
6. tel:61419231513
7. tel:61262081908

Initiate PSTN session
To +61 2 62486165

ENUM Resolution



- The PSTN is a multi-service platform
- To emulate this in IP, IP services associated with a single E.164 may be provided on a collection of different IP service points
- An ENUM DNS request should return the entire set of service points and the associated service.

Why URIs?

- URIs represent a generic naming scheme to describe IP service points
  - Generic format of
    service:service-specific-address

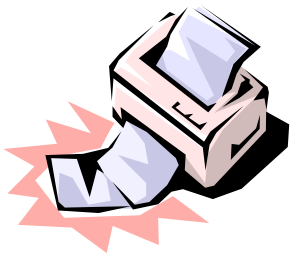
- A URI in IP context is ultimately resolvable to

  IP address
  TCP/UDP selection
  Port address
  Address selector within the application session

ENUM Issues

- With widespread ENUM, VOIP networks do not require the PSTN to provide interconnection glue
  - Potential toll revenue impact on PSTN
  - No need to tightly link VOIP E.164 numbers to the PSTN

E.164 as a common address substrate ?



?

tel:+61 2 62486165

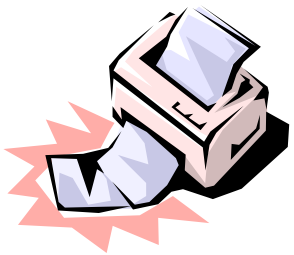
mailto:gih@telstra.net

tel:+61 2 12345678

sip:gih@sip.telstra.net

Today there are many service-specific addresses that are used to refer to the same party

E.164 as a common address substrate ?



tel:+61 2 62486165

mailto:gih@telstra.net

tel:+61 2 12345678

sip:gih@sip.telstra.net

ENUM

Use this number for any service
+61 2 12345678

The Longer Term

- Telephone numbers are well accepted identifiers
- Any collection of service URIs can be linked against an ENUM entry
  - mail, www, irc, sms,...
- What is the longer term role of an E.164 address?
  - Who administers this role?
  - How is this administration undertaken?

Registry / Registrar

- A registry runs the DNS server for a specific domain name
  - one domain -> one registry
- A customer contacts a registrar when he want to have things registered, not the registry
- Registrar verify customer data, do billing, and send data to registry when delegation is to be done, changed or cancelled

See next slide...

Selection of registry

- Registries are needed which runs the DNS
  - On a country code level
  - Inside a country code, according to local policy
- The model we use today with DNS is

What ENUM does/does not do

- A customer in ENUM announces what services the customer subscribes to
  - Examples:
    - Email
    - Web homepage
    - SIP service (VoIP)
    - Telephony
- Each one of these services can be handled by separate contracts between customer and service provider, e.g. phone, mobile, email, . . .
- These contracts have nothing to do with the announcement via ENUM of their existence

Issues

- Who should manage the ENUM database?
- Should there be one national ENUM database or multiple databases for different number ranges, area codes or even numbers?
- How to verify changes to the ENUM database?
- Should telephone number holders ‘opt-in’ or ‘opt-out’ of the system?
- Portability and ownership of a phone number?
  - Can I cancel all phone services and keep my phone number?

Issues (cont.)

- How to protect the security, integrity and privacy of the ENUM database?
- Compliance with legislative framework
  - What is a “public telephone call” from a strict regulatory perspective?
- What is the business case for the various providers that may play a role in ENUM?

Trial in Australia

- AARNet to provide Tier 1 for Australia as part of trial on behalf of ACA under the management of ACA.
- Interested parties provide Tier 2 to trial customers.
- Trial to determine list of issues.
- Determine if ENUM will do what is expected or is it another X.400?
- provide options for commercial deployment.