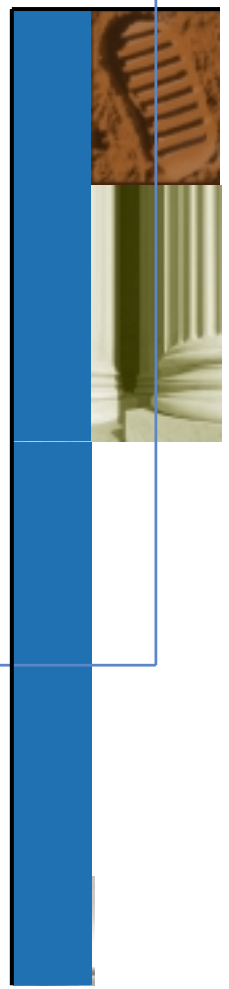
Understanding ENUM

Global IPv6 Summit
Madrid, May 14th, 2003

Jim Reid, Director of European Operations

Nominum.



Introduction

- What is ENUM?
- Explaining the jargon & roles
- The Politics of ENUM
- Getting a delegation
- DNS Considerations for ENUM
- International & National Trials
- Web sites & mailing lists for more information

What is ENUM?

- A protocol to map E.164 telephone numbers into domain names
  - Defined in RFC2916 (currently being revised)
- Very simple:
  - Phone number +44 1698 852881 becomes **1.8.8.2.5.8.8.9.6.1.4.4.e164.arpa**
- Resulting name looked up in the DNS
  - Returns a set of NAPTR records

NAPTR Records

- Defined in RFC2915
- Horribly complex
  - Define preferences and order to reach services
  - Can include regular-expressions and substitutions
  - Ultimately identify URIs
  - Example:

NAPTR 100 10 "u" "sip+E2U” "!^.*$!sip:jim@sip.nominum.com!"

  - How to reach a SIP gateway for some phone number
  - Order and Preference fields allow intelligent selections of services & protocols to be made:
    - “Send email if the SIP gateway is unable to process fax now”
    - “Don’t call my cellphone when I’m overseas”
    - “Divert to voicemail if busy”

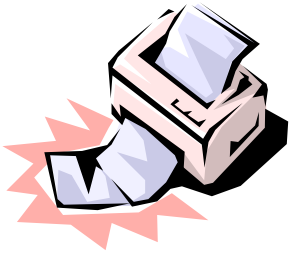
What ENUM Is And Is Not

- ENUM IS NOT:
  - A directory
  - A search service
  - A transport service
  - A telephony service or voice encoding method
  - A rendezvous protocol
- ENUM IS:
  - A partial mapping of E.164 numbers to domain names that define a set of services identified by a URI labels

ENUM Misconceptions

- It's not just about SIP (Session Initiation Protocol)
  - SIP gateways are often the targets of NAPTR records
- Or just Voice over IP (VoIP)
  - Not just voice traffic
  - Not just about IP-based services
- ENUM can be used for other telephony (like) services
  - Fax
  - SMS, MMS
  - Paging
  - Instant Messaging

E.164 as a common address substrate ?



tel:+44 1698 852881

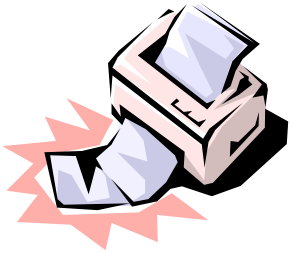
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

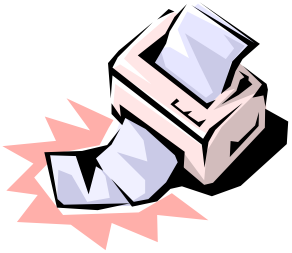
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

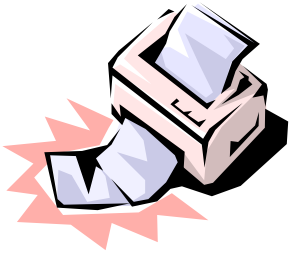
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

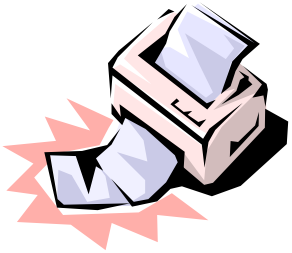
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

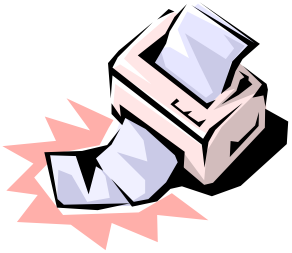
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

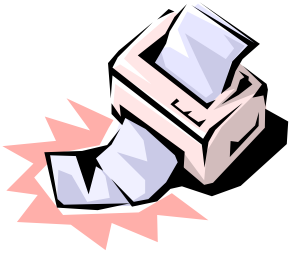
mailto:jim@nominum.com

sip:jim@sip.nominum.com

ENUM

Use this number for any service
+44 1698 852881

E.164 as a common address substrate ?



tel:+44 1698 852881

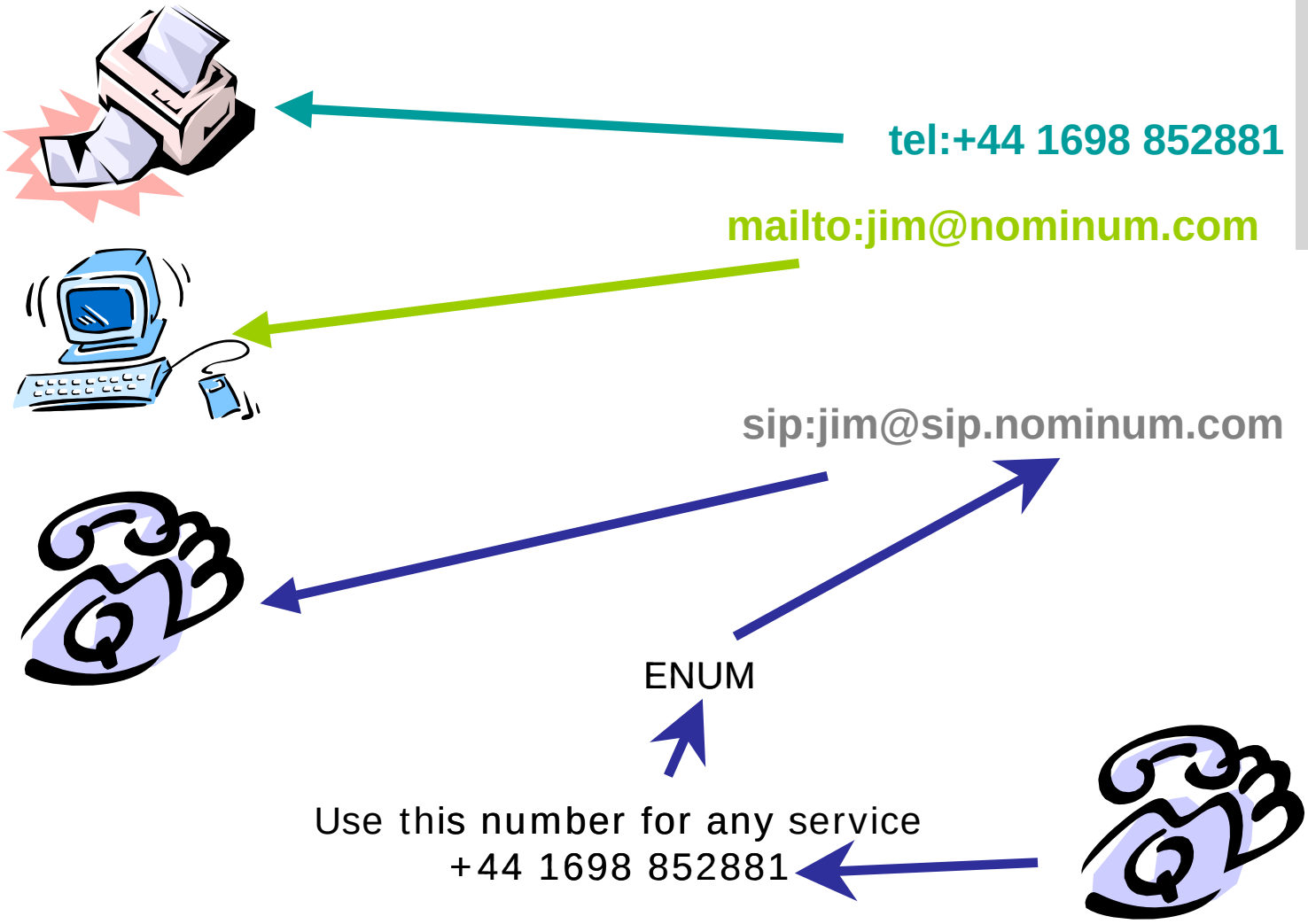
mailto:jim@nominum.com

sip:jim@sip.nominum.com

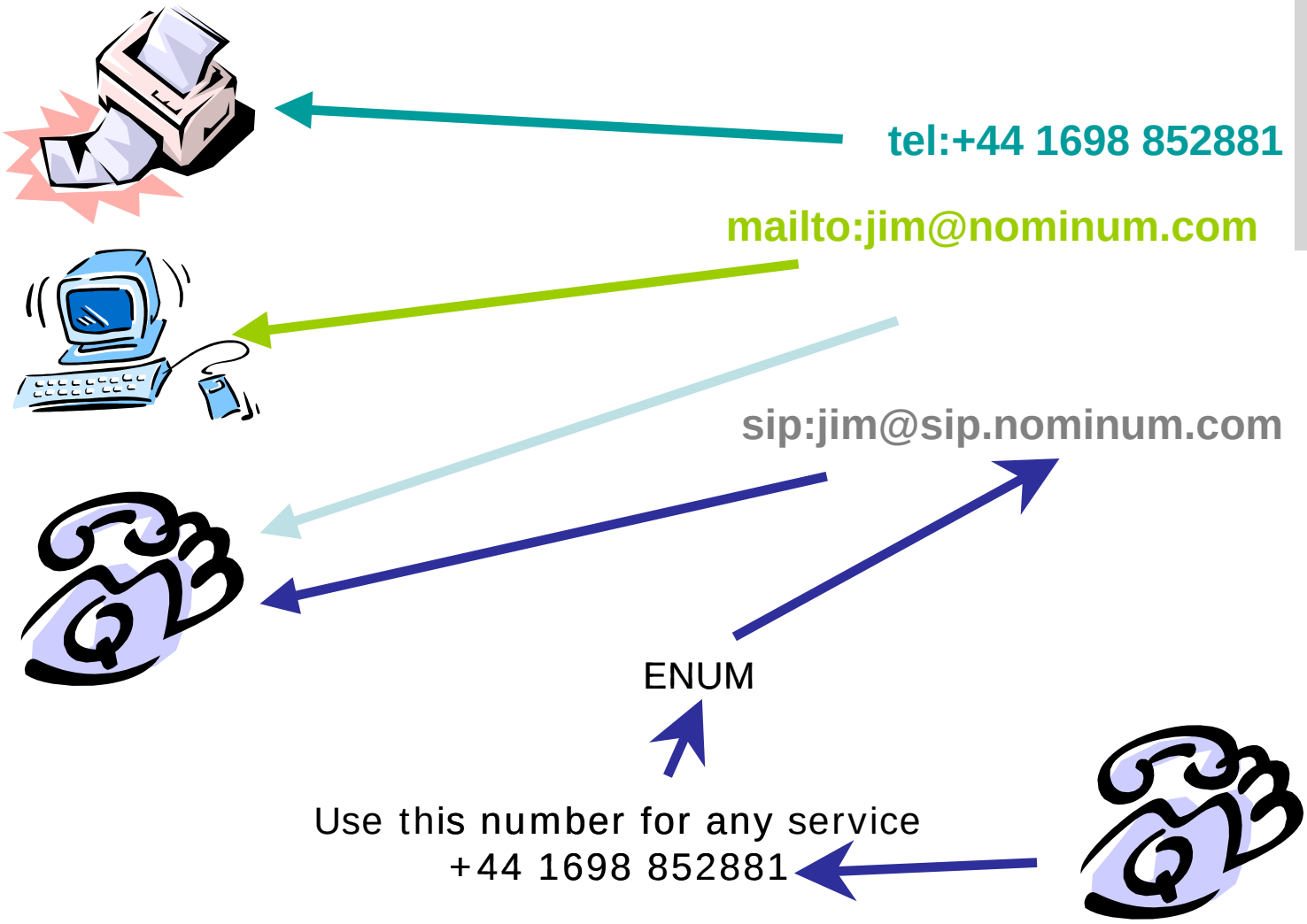
ENUM

Use this number for any service
+44 1698 852881

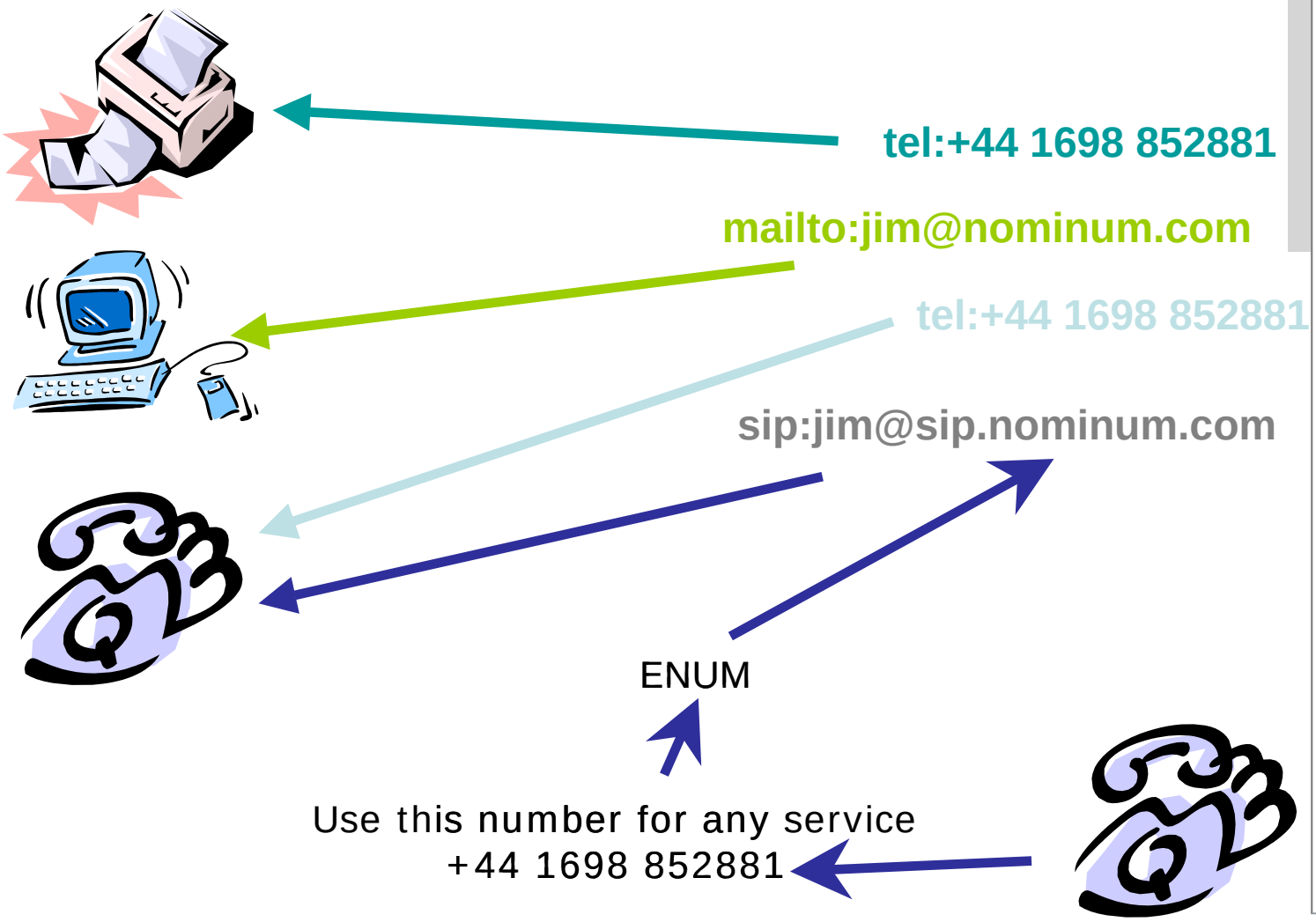
E.164 as a common address substrate ?



E.164 as a common address substrate ?



E.164 as a common address substrate ?



ENUM Potential

- Convergence between telephony and Internet worlds
  - i.e. one network for everything
- Smarter devices
  - Routing & diverting telephone calls
- Integrated Messaging Services & multi-media
- E.164 number becomes the only thing to remember
  - An ENUM DNS lookup could return the user's email address(es), web site, IRC identifier, SIP gateway, etc
- ENUM also being considered by telephone companies to simplify call routing and number portability
  - One phone number for life?

ENUM Jargon - 1

- Most of this originates from the work by ETSI
  - European Telephone Standardisation Institute
- Tier-0
  - The registry operator for **e164.arpa** and its name servers
- Tier-1
  - Registry for a “country”: e.g. **4.4.e164.arpa**
  - Codes are not just for countries: satellite operators, multinational telcos, international free phone numbers
- Tier-2
  - Registrars who process registration requests
  - Not area code level delegations as the terminology might suggest

ENUM Jargon - 2

- What happens at Tier-1 becomes a “national matter”
  - It’s up to each country to decide:
    - How its registry is chosen and operated
    - How any sub-delegations (if necessary) are done
    - What rules and policies apply nationally
    - Whether it participates in ENUM or not

The Golden Tree

- Simply follows the Tier-0, Tier-1 & national numbering hierarchy under **e164.arpa**
  - Widely accepted by the industry & regulators
  - Regulators need to control their national telephone numbering plans and how they are used
  - Telephone companies won't stray from E.164 and ITU recommendations
- Golden tree is sparsely populated today
- Various efforts to set up rival trees
  - Currently not credible, but could be significant
  - Typically attempts to gain commercial advantage by pre-empting the market
  - Unlikely to succeed unless a major vendor forces a universal, de-facto solution

Alternate ENUM Trees

- Other ENUM-like trees exist
  - Far worse than “Alternate Roots” in the DNS
  - Don’t just fragment the name space
    - Jeopardises the integrity of E.164 numbering
    - Causes user confusion: which tree is someone’s number registered?
    - Creates serious impersonation and domain name disputes
      - What if your number is registered in another tree by someone else?
      - What if that tree is owned by a company that doesn’t operate in your country?
      - Or that company ignores your national telco regulator?
      - What about national privacy, data protection or consumer protection considerations?
- Can’t be ENUM if it’s not anchored under **e164.arpa**

Integrated Numbering Plans

- Essentially only a problem for North America:
  - Many countries use +1: USA, Canada, Jamaica, etc
  - Also +7 for the former Soviet Union
- In DNS this implies one delegation for **`1.e164.arpa`**
  - Obvious sovereignty considerations
  - Different legislation and regulation in each country
- Current thinking is to delegate every “area code” for each country to the recognised national authority
  - Technically clumsy and messy
  - But far easier to solve than the political problems

Legal Considerations

- Data privacy & protection
  - ENUM names (numbers) usually identify people
  - Restrictions on how that data is stored and processed
  - Generally implies ENUM has to be “opt-in”
- What about unlisted phone numbers?
- What about a household with 1 phone number?
- Competition legislation
  - Is there fair and free competition?
  - By definition, domain names are a monopoly
- Potential for telephone by-pass
  - Use SIP gateways and VoIP: where’s the phone call?

The Politics of ENUM

- Many players
- Internet Engineering Task Force (IETF)
  - Define the ENUM protocol & NAPTR record format
  - Also define related protocols: SIP, VoIP, etc
- Internet Architecture Board (IAB)
  - Steering body for IETF
  - Tasked with making the Internet work
- International Telecommunications Union (ITU)
  - International institution (part of United Nations)
  - Define telephony & radio standards
  - Owns the E.164 telephone numbering standard

Potential ENUM Political Problems

- Integrity of E.164 numbering plan
  - Critical for world's telephone system
  - Phone companies need this for billing, routing, etc
- National Identity
  - What is and isn't a country?
  - Who is authorised to represent that country?
- National Sovereignty
  - Who controls what happens to a country's national resources? i.e. its E.164 numbers?
- E.164 "national" codes
  - What codes are valid and who owns them?

Pragmatic Solution

- IAB selected RIPE NCC to operate Tier-0 registry
- Delegation requests checked by ITU
  - ITU determines what is and isn't a country
  - ... and what is and isn't a valid E.164 country code
  - ITU has diplomatic immunity
  - Also used to dealing with sovereign states, national telco regulators, governments, etc
  - ITU also knows the official government contacts and representatives on telephony matters
- Delegations only proceed if ITU says so
  - ITU has effective administrative control over the contents of **e164.arpa**

ITU Interim Procedure

- Anyone can submit a delegation request
  - To ITU or RIPE NCC or both
- ITU sends request to official government contact for the country concerned
- Government says yes or no
- Response is relayed to RIPE NCC
  - Delegation made or rejected as appropriate
- Result is no delegations get made without government approval
  - National interests safeguarded
  - E.164 integrity protected

ENUM at ITU - 1

- IAB/IETF Tier-0 domain name is not endorsed by ITU
  - Other TLDs under consideration
  - Some countries perceive **.arpa** to be controlled by the US Government
  - Can't have an international resource under the control of one state as a matter of principle
- On-going discussion within ITU
  - ITU documents on ENUM deliberately do not mention the name of the ENUM root domain
    - Will do so once consensus is reached inside ITU
    - Hopefully that will be **e164.arpa**, but this can't be assumed
- Some member states want Tier-0 to be totally under the control of ITU

ENUM at ITU - 2

- General acceptance of a golden tree
  - Some ITU member states just don't want that golden tree to be under **e164.arpa**
- Current ITU process is an interim procedure
  - Allow ITU more time to reach consensus
  - Enables those countries wanting to carry out trials
  - Pragmatic approach:
    - Trials can proceed for those who want them
    - Final decision from ITU can be deferred until consensus is reached

Getting an ENUM Delegation

- Follow the advice on the RIPE web site:
  - **http://www.ripe.net/enum/instructions.html**
- Submit the request to RIPE NCC
  - Published on their web site and mailing list
  - Forwarded to ITU for checking and government approval
  - Response from ITU also published by RIPE NCC
  - If approved, submit required templates to get the delegation from **e164.arpa**

DNS Considerations - 1

- Scaling
  - If ENUM is successful, every phone number will be in the DNS, each with 5-10 NAPTR records
  - Orders of magnitude increase in DNS data
    - More zones, more RRs, more name servers, bigger registry & registrar systems
  - Example: UK
    - Currently 3-4M delegations under .co.uk
    - Approx. 100M phone numbers in use today
  - Editing BIND zone files and **`named.conf`** won't work
    - RDBMS for zone & customer data
    - Integrate with telco provisioning & billing systems?

DNS Considerations - 2

- Performance
  - Need to guarantee service levels & response times by name servers
    - How long after “dialling” before a phone rings?
  - Existing DNS infrastructure in many countries is not yet good enough
    - Many broken ccTLDs
  - Software like BIND may not be good enough
    - Zone loading, zone management, query throughput
    - Fine-grained access controls

DNS Considerations - 3

- Robustness
  - No single points of failure
  - Placement of name servers
  - Diversity of DNS software
  - Multiple network providers & carriers
  - Name server configuration
    - Usual considerations, should be no surprises

DNS Considerations - 4

- Security & Integrity
  - DNSSEC is almost guaranteed to be mandatory for production ENUM services
  - Only way to validate answers from the DNS
    - Essential for verifying E.164 numbers in the DNS
    - Obvious billing, integrity considerations
  - Introduces obvious key management problems
    - Choosing and changing keys
    - Emergency key revocation
    - Simplicity for end-users

DNS Considerations - 5

- Tooling
  - Far better tools are needed for everyone:
  - End-users should never (need to) see NAPTR records
    - Just too horrid and complicated
    - Could be hidden by smart devices (call forwarding in a mobile phone or personal organiser)
  - Back-end systems
    - Provisioning, hooks to other systems: logging, billing
  - Move away from text-based zone files
    - Need for dynamic updates in real-time
    - Store zone data in RDBMS?
  - DNSSEC
    - Existing tools are primitive and hard to use

International & National Trials

- Trials currently under way in Austria, UK & Sweden
  - Other nations expected to start soon
- Trials have a different focus:
  - Austria - Applications
  - Sweden - Regulatory interfaces & policy
  - UK - Everything
- Intention is to interwork
  - Economies of scale
  - Wider experiences and expertise
  - Avoid unnecessary duplication of effort
  - Information sharing

The UK ENUM Trial

- Under the auspices of an ad-hoc industry body, UKEG, with input from government (DTI) and telco regulator (OfTel)
- Wide participation from telecom and internet companies:
  - Atlas Internet, Bango, BT, Firsthand, ICB, ICC, MCI Worldcom, Neustar, Nominet, Nominum, Roke Manor Research, Telcordia, Univ. of Southampton, Vodafone
  - Not all based in the UK!

UK ENUM Trial Roles

- Tier-1
  - 3 Companies: ICB, Neustar & Nominet
- Tier-2
  - 3 Companies: Afilias, Atlas Internet & BT
- DNS Providers
  - 2 Companies: Atlas Internet & Nominum
- Authentication Agency
  - 1 Company: BT
- Applications:
  - Everyone else! Bango, BT, Firsthand, ICC, MCI Worldcom, Roke Manor, Telcordia, Univ. of Southampton, Vodafone

Choices

- Single Tier-1 for production ENUM service
- Tier-1 is a monopoly
  - Can't do anything else
    - Conflicts of interest
    - UK/EU Competition Law
  - Does minimum role: operates the registry
- Authentication handled by another entity:
  - Effectively UK-Licensed Telephone Operators
    - Compliance with National Telephony regulations
- Other roles can be combined:
  - DNS Hosting or Registrar service with Applications

Authentication Agency

- Proposed solution for the authentication problem:
  - How can we be sure someone “owns” the telephone number they are registering?
  - Complicated because of UK Telephone Numbering Scheme
    - Privacy & commercial confidentiality issues
- Based on UK Number Portability Process
  - Initially a manual process - directory enquiries lookup
  - Will become on-line during the trial
    - Digital “certificate” from AA to Tier-1 & Tier-2

Trial Issues

- Secure DNS (DNSSEC)
- Accreditation
  - Tier-2? Authentication Agencies?
- Tier-1/Tier-2 Interface
  - EPP?
- Continue after the initial trial?
- Selection process & criteria for production Tier-1
  - Auction? License? Franchise?
- Regulatory/legislative framework
  - Stakeholder input
  - Self-regulation with government oversight

Useful Web Sites on ENUM

- ITU
  http://www.itu.int/osg/spu/enum/index.html
- RIPE NCC
  http://www.ripe.net/enum/index.html
- UK ENUM Trial
  http://www.ukenumgroup.org
- US ENUM Forum
  http://www.enum-forum.org

ENUM Mailing lists

- RIPE lists
  - **enum-announce@ripe.net**
    - Announcements
  - **enum-request@ripe.net**
    - Requests for delegations
  - **enum-trials@ripe.net**
    - Information sharing between trials

- IETF list
  - ENUM WG
    - Protocol issues, privacy, provisioning, etc

enum@ietf.org

Questions?