

# ENUM

## Convergence of Numbering

---

**11<sup>th</sup> CEPT Conference, Nice**  
**Technological & Regulatory Enablers**  
**23. October 2003**

### Richard STASTNY

ÖFEG/TELEKOM AUSTRIA, Postbox 147, 1103-Vienna

enum:+43 664 420 4100

E-Mail: [richard.stastny@oefeg.at](mailto:richard.stastny@oefeg.at)  
[richard@stastny.com](http://richard@stastny.com)



## Warm-up: The ENUM Problem Statement

---

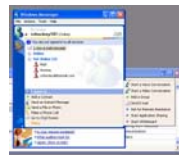
- How do you find a service on the Internet?  
Why not use Telephone Numbers ?
- How can you find "islands of connectivity" across domain boundaries?



**Voice**



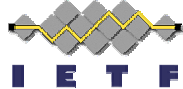
**Video**



**Text**



## ENUM in a nutshell



- take phone number

+43 1 979 33 21

- turn it into a FQDN

1.2.3.3.9.7.9.1.3.4.e164.arpa.

- ask the DNS

mailto:richard@stastny.com

- return list of URI's

sip:richard@iphone.at



## How does ENUM work ?

Telephone Number (TN): +43 1 979 33 21 translates to:

1.2.3.3.9.7.9.1.3.4.e164.arpa

Tier 1 resolution to NS of authority ( pointer only)

1.2.3.3.9.7.9.1.3.4.e164.arpa. IN NS ns1.iphone.at

Tier 2 resolution to NAPTR record and SIP URL controlled at the end office

IN NAPTR 10 10 "u" "E2U+sip" !^.\*\$!SIP:richard@iphone.at" !

set up call



## (Very short) ENUM Trial History

---

- Sept. 2000 – IETF ENUM WG – RFC2916
- 2001 – Various Workshops (ITU-T, Europe, US, ...)
- 2002 – ITU-T Interim Procedures (IAB, RIPE-NCC)
  - ETSI SPAN11 TS "ENUM Administration in Europe"
  - Austrian ENUM Trial in operation (Sept. 2002)
- 2003 – ETSI SPAN11 TS "Minimum Requirements for Interoperability of European ENUM Trials"
  - IETF RFC2916bis WGLC
  - Various national and international ENUM Trials
  - using different scenarios and numbering resources
  - and using different ENUM-enabled products
- 2004 – ENUM ready for production



## ENUM Delegations

---

### Delegations in e164.arpa as of 7. October 2003

- |                  |                     |
|------------------|---------------------|
| ➤ 31 Netherlands | ➤ 55 Brazil         |
| ➤ 33 France      | ➤ 86 China          |
| ➤ 358 Finland    | ➤ 246 Diego Garcia  |
| ➤ 36 Hungary     | ➤ 247 Ascension     |
| ➤ 374 Armenia    | ➤ 290 Saint Helena  |
| ➤ 40 Romania     | ➤ 971 UAE           |
| ➤ 41 Switzerland | ➤ 87810 VISIONg UPT |
| ➤ 420 Czech      |                     |
| ➤ 421 Slovakia   |                     |
| ➤ 43 Austria     |                     |
| ➤ 44 UK          |                     |
| ➤ 46 Sweden      |                     |
| ➤ 48 Poland      |                     |
| ➤ 49 Germany     |                     |

<http://www.ripe.net/enum/request-archives/>



## Lessons learnt in the ENUM Trials

---

- Basic issues solved
  - ENUM technology works,
  - ENUM policy and administration: most problems solved,
  - but shift in focus for the business models.
- The original business model has problems:
  - ENUM for residential subscribers with opt-in for existing numbers
    - second line service,
    - privacy problem with multiple services (e-mail spam)
    - Validation and re-validation problem, ...
  - but the major problem is: How to overcome Metcalfe's Law?
  - *The usefulness, or utility, of a network equals the square of the number of users*
- so new approaches are needed.

## New approaches to ENUM needed

---

- New approaches for IP Communications:
  - ENUM for IP-based private networks ("PBX") with direct dial in
  - Numbers "ported" to IP-based networks (using ENUM for routing)
  - non-geographic number ranges for IP Communications, using ENUM
- and then re-launch of the original ENUM model starting with teleworkers and road warriors to overcome Metcalfe's Law
  - Note: IP Communications is not IP Telephony
    - it is VoIP
    - PLUS
    - Instant Messaging, Presence, Video, Chat, and, ...

## Scenarios for IP Communications

---

- The following end-to-end scenarios exist:
  - PSTN/ISDN via IP to PSTN/ISDN
    - good ol' voice bypass, IP trunking, not discussed here
  - IP Communications to IP Communications
    - e.g. hotmail, aol, FWD, sipphone, skype, ...
    - all including IM, presence, chat, etc.
  - VoIP to PSTN/ISDN
    - e.g. Vonage
  - PSTN/ISDN to VoIP
    - e.g. libretel with 2-stage dialing
- How can the last three scenarios be merged?
- What are the impacts of this merger on naming, addressing and numbering?

## IP Communication to IP C.

---

- Naming and Addressing is done by Internet means:
  - usage of IP addresses, URIs and alphanumeric UserIDs
  - if you stay within an Administrative Domain (AD), you use a name (UserID) e.g. richard, marc or frank
  - if you access another AD, you use an URI (Address-of-Records) e.g. richard@aol.com
- SIP Servers translate URIs to Contact Addresses and the DNS finally to IP addresses
- The problem:
  - you soon run out of UserIDs like richard, marc and frank

## VoIP to PSTN/ISDN

---

- This is easy
- Provided you have an outbound VoIP gateway
- you just enter a phone number
  - either in a mutually agreed dialing plan or
  - in the international format +4317978032
- The PSTN is doing the rest
- The problem:
  - The call may not be routed as long as possible on the Internet, incurring long distance charges
  - If the call finally terminates on the Internet, you may also not have an optimal routing (cost, QoS)

## PSTN/ISDN to IP

---

- This is a problem
  - 2-stage dialing is not very elegant
- Internet names and addresses are not recognized by the PSTN/ISDN
  - So you need a phone number attached to an Internet Name (AoR)
- The phone number needs to be recognized by the PSTN/ISDN to be routed to a VoIP Gateway
- The phone number needs to be translated to an Internet name (URI – AoR) e.g. with ENUM

## Interlude

---

- What happened in the meantime in the administrative domains featuring UserIDs like richard, marc and frank?
  - The second and all other Richards got e.g. RichS, SRich and Rich1234
- in addition, IP phones, "ATAs" and "WiSIP" phones got popular featuring numeric keypads
  - so numeric UserIDs appeared: e.g. 8781@iptel.org, 16421@fwd.pulver.com
  - this "phone" numbers can be dialed directly (private numbers)
  - Note also: private networks (PBX) migrating to IP use numeric UserIDs as aliases for user convenience in any case
- What about dialing the host part iptel.org on IP phones?
  - Surprise, surprise, cross trunking as used in private networks was re-invented
  - you now dial e.g. \*\*478 8781 to reach 8781@iptel.org from FWD
- The problem:
  - more then 10 to 20 cross connections in one domain are not feasible
- conventional private networks use the PSTN/ISDN in addition with E.164 numbers

## ENUM as problem solver

---

- An URI (AoR) entered in an ENUM domain related to an E.164 number allows you:
  - to reach any destination on IP from the PSTN/ISDN
    - requirements on the PSTN/ISDN see next slide
  - to reach any destination on IP directly from IP
    - by dialing the full E.164 number as default
    - dialing local numbers and cross connections is still possible
    - if a proper numbering and dialing plan is used
- and reach any destination existing only on the PSTN/ISDN
  - but only calls to numbers not found in ENUM are routed via the PSTN

## What is required on the PSTN/ISDN?

---

1. Numbers both on the PSTN/ISDN and in ENUM (opt-in)
  - Calls originating on IP are routed directly on IP
  - Calls originating on the PSTN are routed and terminated on the PSTN
2. Numbers ported out (locally) to VoIP providers
  - Calls originating on IP are routed directly on IP
  - Calls originating on the PSTN are routed on the PSTN and terminated on IP
3. Numbers routed directly to IP via ENUM
  - "Personal Mobile Number" ranges are assigned for this purpose
  - If significant enough (max 7 digits), they may be recognized early
  - and routed to the nearest VoIP ENUM-enable gateway
  - e.g. +87810, +43723, ...

## What is required on IP?

---

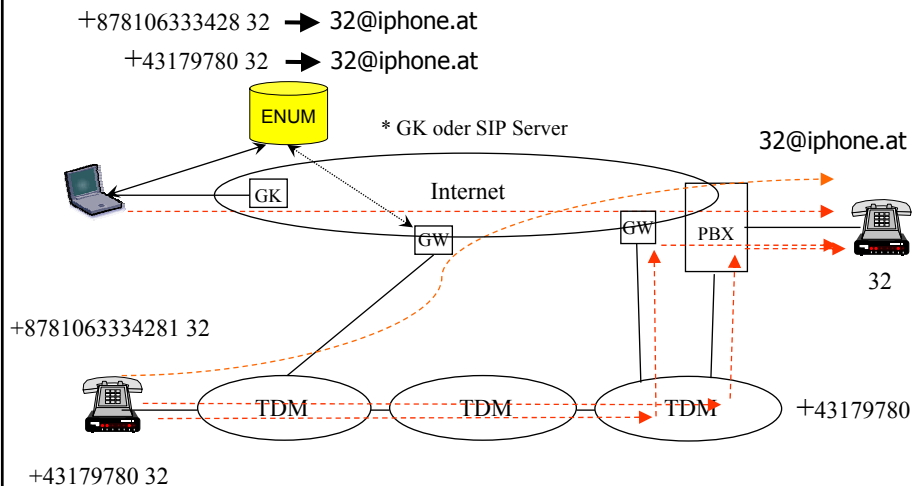
- ENUM enabled VoIP Gateways (exist)
- ENUM enabled IP-PBX (exist)
- ENUM enabled SIP proxies and H.323 gatekeeper (exist)
  - and/or
- ENUM enabled IP phones and soft clients (exist)
  
- Number ranges for residential users (in progress)
- Number ranges for corporate users (exists partially)
  - see next slide for the options

## Options for corporate users

- Assumptions:
  - the company has already an E.164 number, a private numbering plan and a mapping of this private numbering plan to the E.164 number with DDI
  - The company migrates to IP Communications, connects to the Internet, but keeps the PSTN/ISDN connection
- Step1: Opt-in in ENUM with existing number
  - e.g. ÖFEG +43179780-32 (2 digit DDI)
  - calls from IP use ENUM, calls from PSTN use PSTN access
- Step2: Use in addition an ENUM-enabled number
  - e.g. ÖFEG +8781063334281-32 (2-digit DDI) or +437212345-32
  - calls to this number from the PSTN are routed to IP directly
- Step3: Port out the geographic number to IP
  - dump the PSTN access, use common VoIP gateway from provider
  - calls from IP may use any number, calls from the PSTN may prefer +87810 but may still use +43179780-32



## Call flows



# Large Scale IPC Trial at43

- Large Scale Trial on IP Communications using ENUM
- University of Vienna ~100.000 Students
  - re-use of existing student account credentials via RADIUS
  - iptel.org SIP Express Router SIP proxy with call routing, ENUM processing, PSTN interworking
  - some functions based on Asterisk open-source IP-PBX:
    - voice-mail, conference bridge, IVR, SIP-H.323 Gateway
  - PSTN Connection: CISCO 5300 PSTN/ISDN Gateway with PRA
  - Various Soft- and Hard-phones, WiFi-Phones, ...
  - IP Connection to other universities, communities and "IP-PBX"
  - Applications: Crash test for VoIP, Chat, IM, Presence, ...
- IP calls free, PSTN->IP calls by caller; IP->PSTN with call-by-call accounting
- Naming, Numbering and Addressing with ENUM
  - Base: sip:<student-id>@sip.univie.ac.at
  - Vienna geographic number: +43 1 59966 nnnnnn
  - Austrian number for private networks: +43 59966 nnnnnn
  - global UPT number: +87810 2843 nnnnnn

ORIGIN 6.6.9.9.5.3.4.e164.arpa.

\* NAPTR 100 10 "u" "E2U+sip" "!^\+4359966(.\*)\$!sip:\1@sip.univie.ac.at!" .



# IP Communications global network

1. Phone numbers are now only routable over PSTN network
2. Connect "Friends and Family" Customers and Suppliers to the E.164 numbering plan using ENUM
3. and route this ENUM-enabled calls via the public Internet



**The End**

---

**Thank you for  
your attention**

