ENUM

Numbering and VoIP

ISPA

SIP Info Event

21. May 2003

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ÖFEG

What is ENUM?

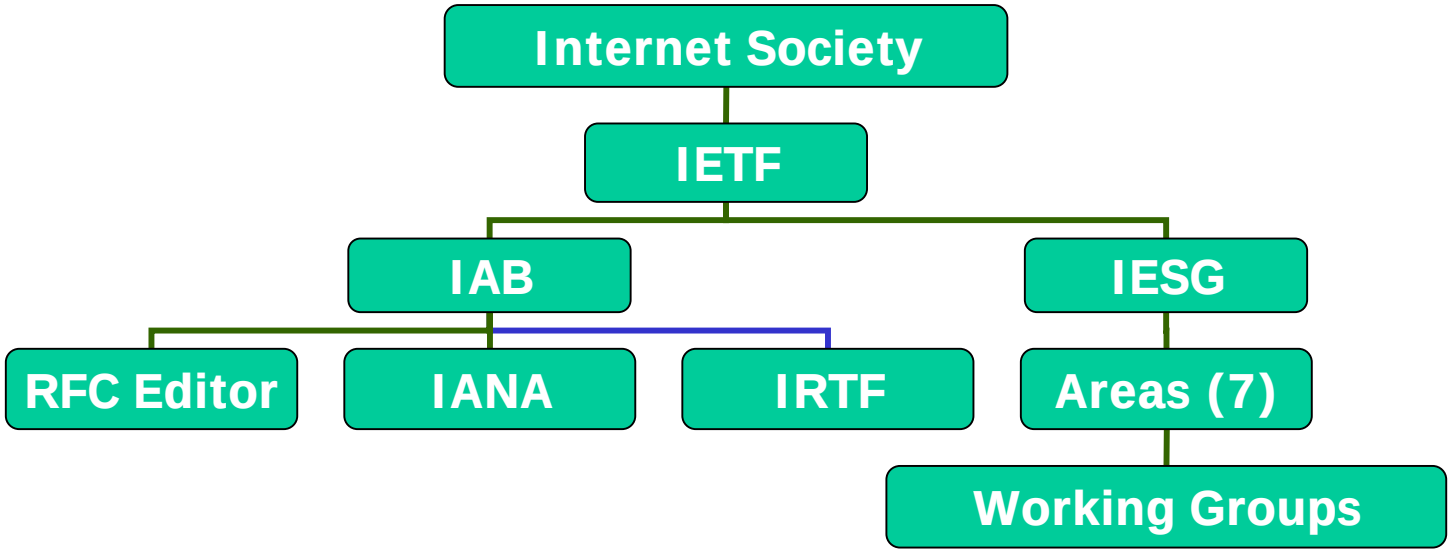
- ENUM is part of the convergence of Circuit Switched and Packet Networks
  - ENUM is defined by the Internet Engineering Task Force (IETF) and translates an E164 phone number into Internet Domain Names; RFC 2916 - September 2000; RFC2816bis – June 2003
- ENUM is about new service creation
  - Allows the use of a traditional telephone number in the context of different communication media, e.g., e-mail, VoIP, etc. and therefore could facilitate the penetration of new applications into the mass market easily
- Defines the use of Domain Name System (DNS) resource records to find:
  - E-mail addresses
  - Voice over IP SIP / H.323 servers
  - Voice Mail servers
  - Fax Machines
  - etc.

Content

- The Protocol Part - IETF
- The International Part – ITU-T, IAB and RIPE-NCC
- The European Part – ETSI and the ENUM Trials
- The National Part – The Austrian ENUM Trial
- VoIP, UPT and ENUM Scenarios
- Voice on the Net (VON) ENUM Demo

Who is the IETF?

- Internet Engineering Task Force
- The organization that oversees the standards process for Internet protocols and technologies
- Industry-based standards body with broad participation from vendors, operators and researchers



IETF ENUM Workgroup

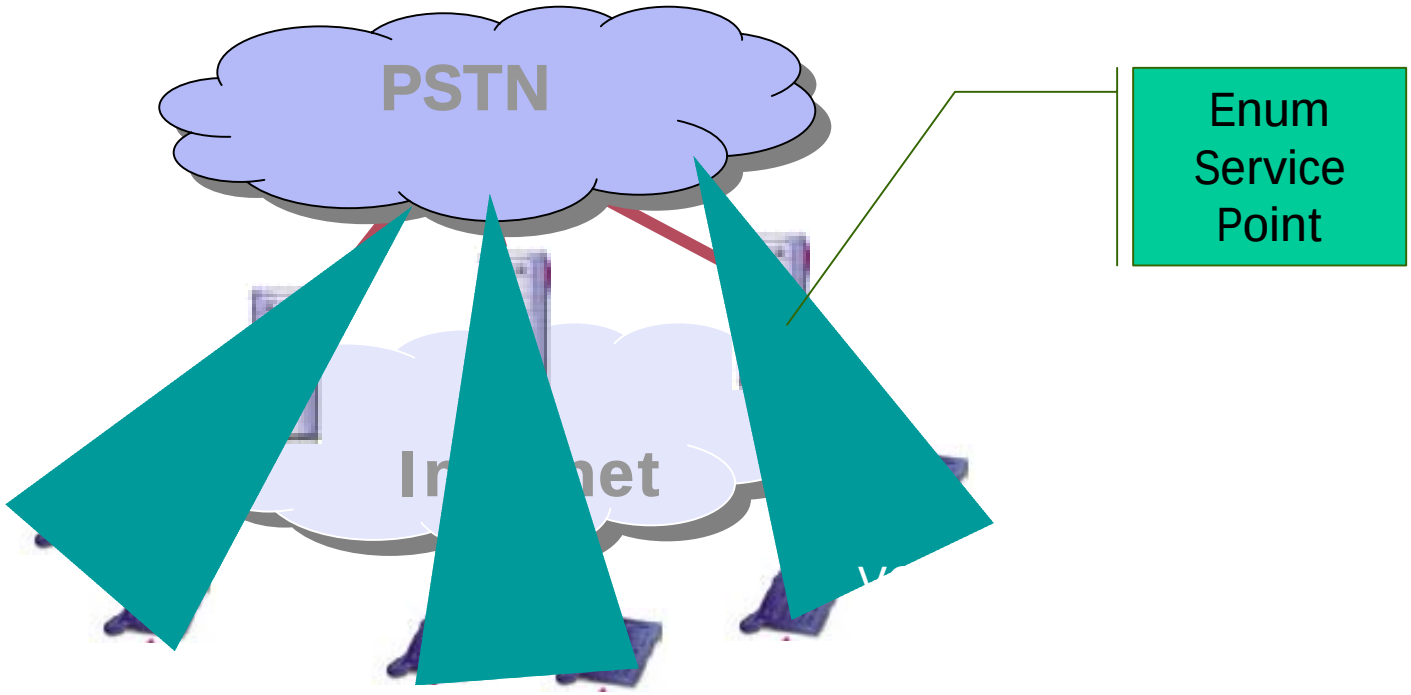
- tElephone NUMber Mapping; E.164 NUMber Mapping; ...
- ENUM is a working group within the IETF Transport Area
- Established in 1999
- Work done sofar: RFC2916 proposed standard
  - Defines a DNS-based architecture and protocol by which an E.164 number can be expressed as a Fully Qualified Domain Name in a specific Internet Infrastructure domain defined for this purpose (e164.arpa).
  - The result of the ENUM query is a series of DNS NAPTR resource records [RFC3403] which can be used to contact a resource (e.g.URI) associated with that number.
- Work in Progress:
  - Update RFC2916 to Draft Standard (rfc2916bis)
  - Define ENUM Services (various ietf-drafts)
  - Security and Privacy Issues

Why ENUM?

- Because tpc.int did not work!
  - tpc.int (c 1992) mapped E.164 numbers to A records (IP addresses) to emulate fax delivery
  - Each new service required a new E.164 -> IP address mapping
  - Did not scale to multiple services using a single mapping
- ENUM is part of a broader IETF approach of splitting out the components of VoIP / PSTN interaction into discrete efforts and addressing each component as a discrete technology standardization effort
- ENUM is not an end in itself

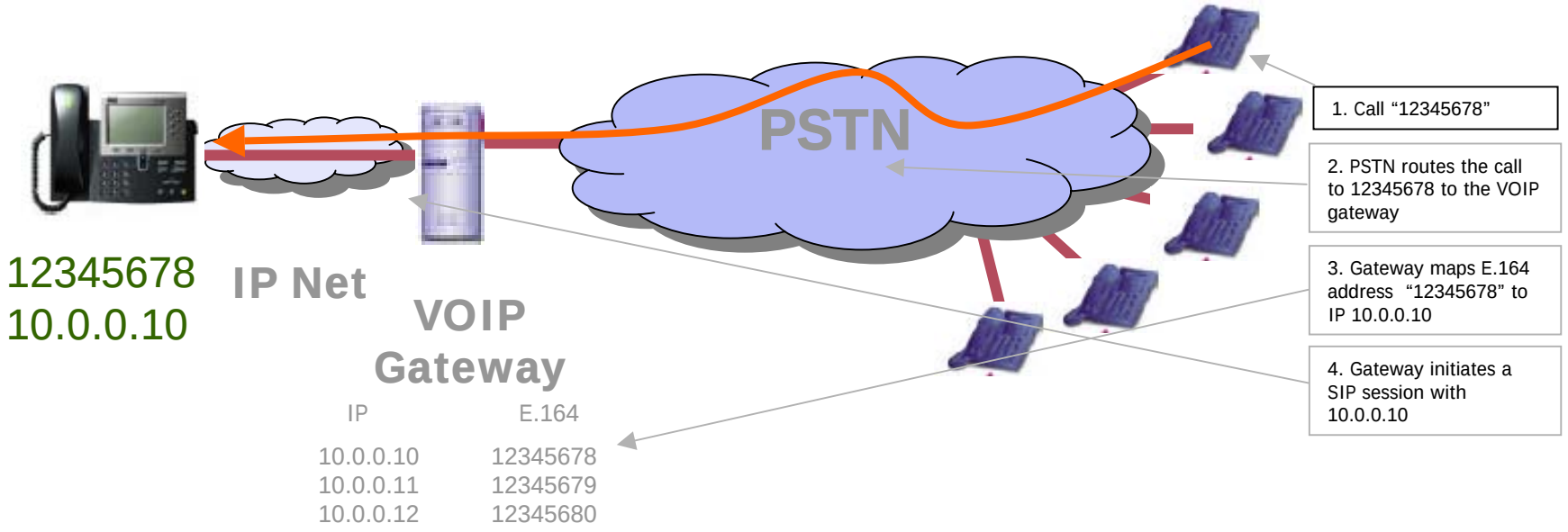
The VOIP Gateway Model for ENUM

- Most IETF work these days assumes a ‘reference architecture’
- ENUM’s core reference architecture is VoIP-to-VoIP



The VoIP Gateway Model

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

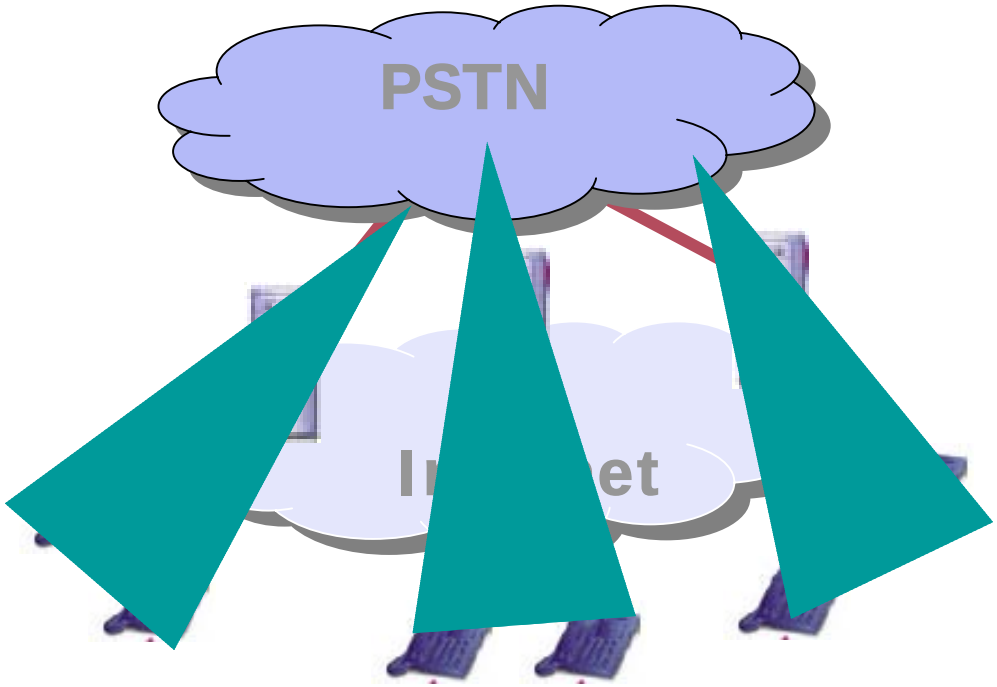


The multi-Gateway VoIP World

- 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

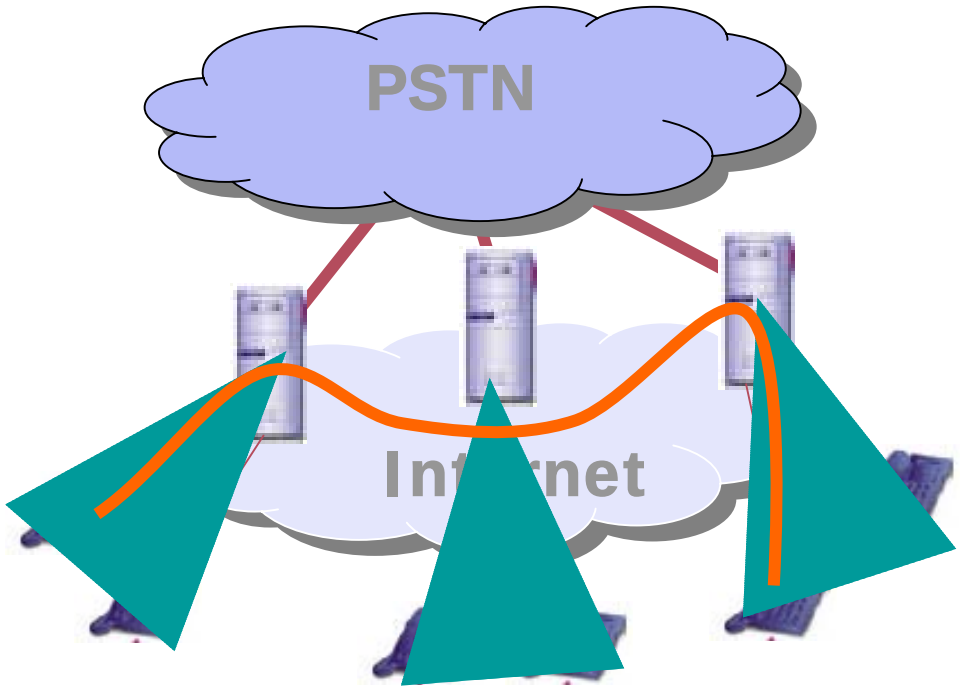
The multi-Gateway VOIP World

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



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?



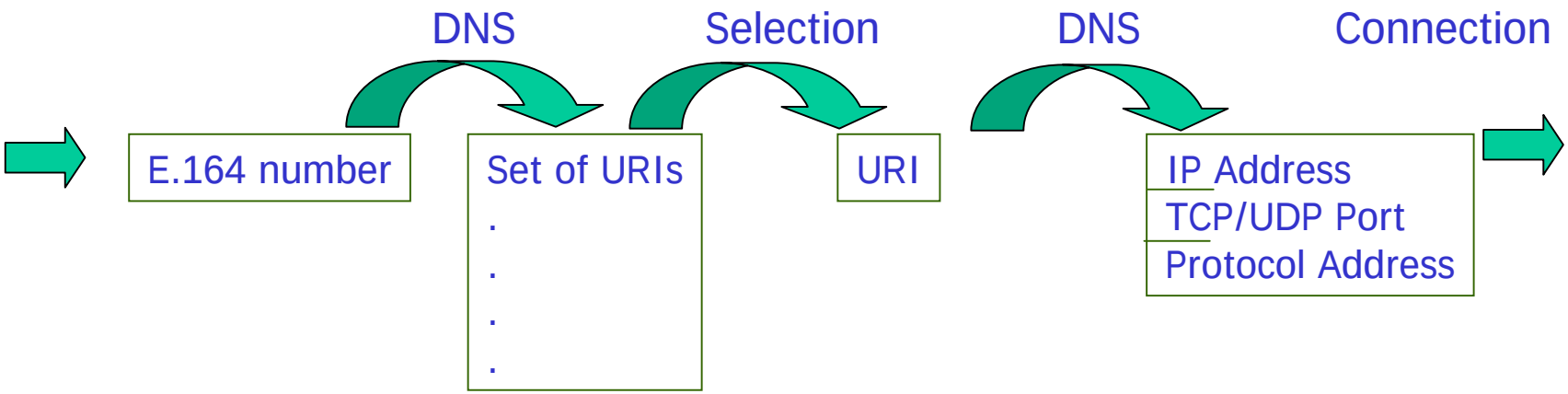
Problem statements for ENUM

1. How do network elements (gateways, SIP servers, etc.) find services on the Internet if you only have an E.164 telephone number?
2. How can subscribers define their preferences for nominating particular services and servers to respond to incoming communication requests?
3. How can this be generalized to be open for all future applications?

The ENUM Objective

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

ENUM Resolution



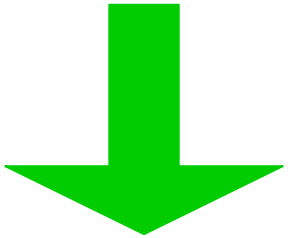
- The PSTN is a multi-service platform
- To emulate this in IP, IP services associated with a single E.164 may be provided on a collection of different IP service points
- An ENUM DNS request should return the entire set of service points and the associated service.

ENUM Resolution (RFC2916bis)

- The "Dynamic Delegation Discovery System (DDDS) (RFC 3403) specifies DNS as Database that uses the NAPTR DNS resource record to contain the rewrite rules. The Keys for this database are encoded as domain-names.
- The output of the First Well Known Rule for the ENUM Application is the E.164 number minus all non-digit characters except for the +. In order to convert this to a unique key in this Database the string is converted into a domain-name according to this algorithm:
- Remove all characters with the exception of the digits. For example, the First Well Known Rule produced the Key "+4319793321". This step would simply remove the leading "+", producing "4319793321".
- Put dots (".") between each digit. Example: 4.3.1.9.7.9.3.3.2.1
- Reverse the order of the digits. Example: 1.2.3.3.9.7.9.1.3.4
- Append the string ".e164.arpa" to the end. Example: 1.2.3.3.9.7.9.1.3.4.e164.arpa
- This domain-name is used to request NAPTR records which may contain the end result or, if the flags field is blank, produces new keys in the form of domain-names from the DNS.

... or simply

+43 1 979 33 21



1.2.3.3.9.7.9.1.3.4.e164.arpa

ENUM Resolution (RFC2916bis)

This domain-name is used to request NAPTR records from the DNS Database which may contain the end result or, if the flags field is blank, produces new keys in the form of domain-names from the DNS.

```
$ORIGIN 1.2.3.3.9.7.9.1.3.4.e164.arpa.
;       type order pref flag      enumservice     regular expression                  replacement
IN NAPTR 10 100 "u" "E2U+voice:sip" "!^.*$!sip:richard@sip.stastny.com!"       .
```

e.g.: voice:h323
voice:tel
sms:tel
email:mailto
web:http
sip

Defined in
ETSI TS 102 172

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
  - transport protocol (TCP/UDP) selection
  - IP address
  - Port address
  - Address selector within the application session

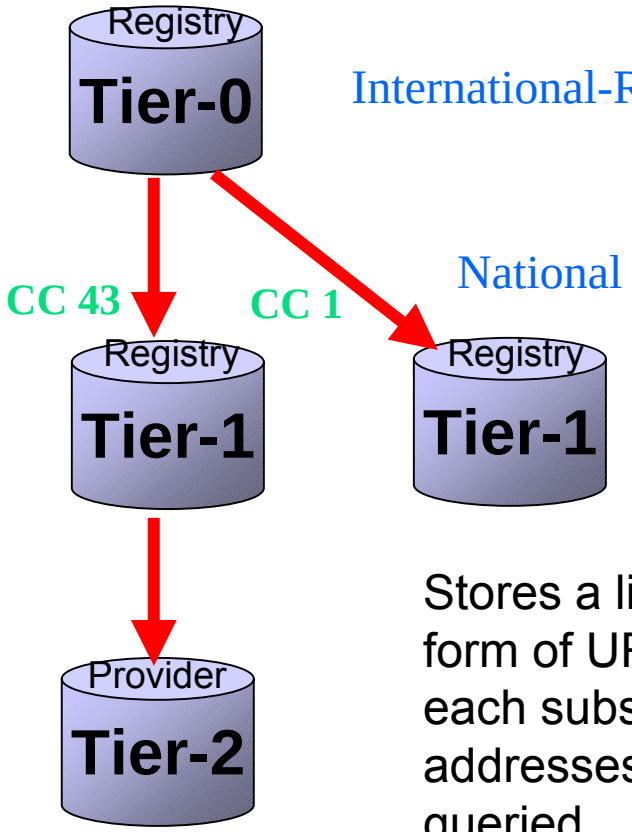
ITU-T, ISOC and IAB

- The ITU-T and the Internet Society (ISOC) are working on a ‘global-tree’ implementation of ENUM using a tiered architecture with a unique top level domain (TLD) that will provide for a competitive implementation
- The ITU/ISOC ‘Global-Tree’ will be a top rooted, global DNS ENUM implementation
- Member States would have the choice of opting in or out of this implementation
- Each ITU Member State may administer their portion of E.164 resources mapped into DNS as they see fit
- There may be other private and perhaps global competitive-tree implementations

International Administration

- The ‘Global-Tree’ domain name space will be organized in three tiers
- Tier-0 is managed internationally
  - The ITU-TSB would have administrative responsibility
  - RIPE-NCC would have operational responsibility
  - Countries would opt-in or opt-out at the Tier-0 level
  - The Tier-0 name server would have ‘NS’ records for the Tier-1 name servers of the opted-in countries
- Tier 1 is to be managed nationally, and is the entity that that operates the Tier-1 ENUM service within a country or Region and has a pointer to the Tier 2 Entity for each served TN
- Tier 2 is the entity that stores a list of service specific internet addresses in the form of URI’s in a DNS resource record called NAPTR for each subscriber

The ENUM "Tiers"



Directs the DNS query to the customer's Tier-2 providers. An NS* record is provided for each subscriber's telephone number

Stores a list of service specific internet addresses in the form of URI's in a DNS resource record called NAPTR for each subscriber. Returns the full list of Internet addresses associated with the E.164 number being queried.

*An NS record is an authoritative Name Server DNS record used to delegate to subordinates

Structure of E.164 Numbers

- International Public Telecommunications Number
- CC N(S)N Country Code - National (Significant) Number
- 43 31680031170
- CC GSN Country Code - Global Subscriber Number
- 878 108781087810

- CC NDC SN CC - National Destination Code - Subscriber Nr.
- 43 1 9793321
- 43 316 8003 1170
- ↑ Partial Number (Private Numbering Plan)

- "global number": +43316800311 70 e.g.: tel:+43316800311 70
- "local number": 1170 e.g.: tel:1170;phone-context=+433168003

ENUM in ITU-T History

- ISOC requested ITU TSB involvement to authenticate that the legitimate representative of the Member State (Country) applied for delegation of its E.164 Country Code into e164.arpa
- ITU-T SG2 began developing a Recommendation that would govern the procedures for the Tier 0 administrative aspects of populating E.164 numbers into the common designated domain
- But, it wasn't that easy:
  - Germany – Governance of the ENUM root zone should be international and politically and commercially neutral
  - China - Opposed the use of the TLD ".arpa" for ENUM implementation and proposed that another TLD that is under the unique responsibility of the ITU would be more suitable
  - France and Syria- Proposed that the TLD for the whole ENUM DNS be a TLD delegated to the ITU itself as the administrative responsible entity
- During the September 2001 meeting it was agreed to separate administrative control from operational control
  - The ITU would have "administrative" control
  - The IAB would have operational control – at present via RIPE NCC

ITU-T Interim Procedures

- At a February 2002 meeting of experts a draft set of interim procedures for the delegation of geographic E.164 Country Codes were conditionally approved by the participants but needed to be formally approved at the May meeting of SG2
- Therefore, there were no formal ITU procedures in place from the February 2002 meeting until the May meeting of SG2
- At the May meeting of SG2, the participants reviewed the draft set of initial interim procedures developed by the experts group in February, made some editorial revisions, and then unanimously approved the procedures
- Consequently, with the approval of these interim procedures countries that now apply to RIPE-NCC for the delegation of their country code, will have that application authenticated by the ITU-TSB
- A copy of the Interim Procedures can be obtained at:
  http://www.itu.int/ITU-T/inr/enum/index.html

ITU-T Current Work

- The Interim Procedures are only for the delegation of E.164 geographic country codes, but explicitly not for CC for networks, group of countries and global services
  - Note: The code 878-10 for global UPT services had been delegated to VISIONng on a special interim basis at the May 2002 SG2 meeting
- At an experts meeting in September 2002 a draft set of Interim Procedures for CC + ICs/GoC was proposed
- And the December 2002 meeting of SG2 approved.
- At the April 2003 meeting work was progressed with the Recommendations and Supplements. Also an update of Rec. E.164 was started to reflect ENUM numbers.

ENUM Delegations

Delegations in e164.arpa as of 19. May 2003

- 31 Netherlands
- 33 France
- 358 Finland
- 36 Hungary
- 40 Romania
- 420 Czech requested
- 43 Austria
- 44 UK
- 46 Sweden
- 48 Poland
- 49 Germany
- 55 Brazil
- 82 Korea requested
- 86 China
- 246 Diego Garcia
- 247 Ascension
- 290 Saint Helena
- 971 UAE
- 87810 VISIONng UPT

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

ENUM in Europe - ETSI

- ETSI (SPAN11_NAR)
  - ETSI TS 102 051 “ENUM Administration in Europe”
  - ETSI TS 102 172 “Minimum Requirements for the Interoperability of European ENUM Trials”
    - ev. update in 3Q 2003 (IETF changes, trial feedback)
  - ETSI TS “ENUM for Network Routing” - Work in Progress - SPAN11 NAR
- Last Meeting April 2003 in Vienna
- Next Meeting June 2003 in Budapest
  - VISIONng, ETSI SPAN/TIPHON
- The Austrian ENUM Trial is fully compatible with IETF, ITU-T and ETSI (especially with TS 102 172)

Other European Activities

- ENUM is discussed in nearly every European body:
  - EC, ETSI, ONP, ETO, ETNO, ECMA, ...
  - different views, depending on background
  - Involvement of RIPE NCC
- National Activities
  - Procedure normally: consultations, workshops, platforms, trials
  - Platforms and Trials in: AT, UK, SE, DE, FR (closed trial)
  - Consultations and Workshops in: NL, CH, Portugal, Hungary, Poland, Rumania, ...
  - Mailing lists on trials: RIPE, Germany, Austria
- Non European Activities:
  - US ENUM Forum, Canada, Australia, Korea, China, ..

ENUM Background in Austria

2000-09 Start of activities

2001-08 First consulation by Austrian regulator (RTR)

2001-09 Telekom Austria internal ENUM Task Force

2002-02 ENUM Workshop RTR, group of interested partners formed

2002-05 Interim procedures from ITU-T SG2 and TSB available

Delegation request by RTR to RIPE and ITU-TSB

2002-06 Tier 1 Registry in operation by NIC.AT (the Austrian ccTLD)

Tier 1 Registry in operation by Infonova (VISIONng)

Delegations for 3.4.e164.arpa and 0.1.8.7.8.e164.arpa

Start of development and deployment

2002-07 First draft of policy framework for MoU by RTR

2002-09 Austrian ENUM Trial Platform established

2002-11 Policy Framework and MoU ready

Austrian ENUM Trial Platform

- Mission:
  - Co-ordination of activities for the Austrian ENUM trial between the trial partners
- Tasks:
  - develop and approve documents beside the regulatory framework compulsory during the trial
  - enable communication between the trial partners
  - monitor trial activities
  - monitor international ENUM standards and trial activities
  - gather results and experiences
  - serve as a basis for an Austrian ENUM Forum required for commercial implementation
- Members:
  - RTR, nic.at, Telekom Austria, Infonova, AOSA, Kapsch, ÖFEG, Telcordia

Scope of the ENUM Trials

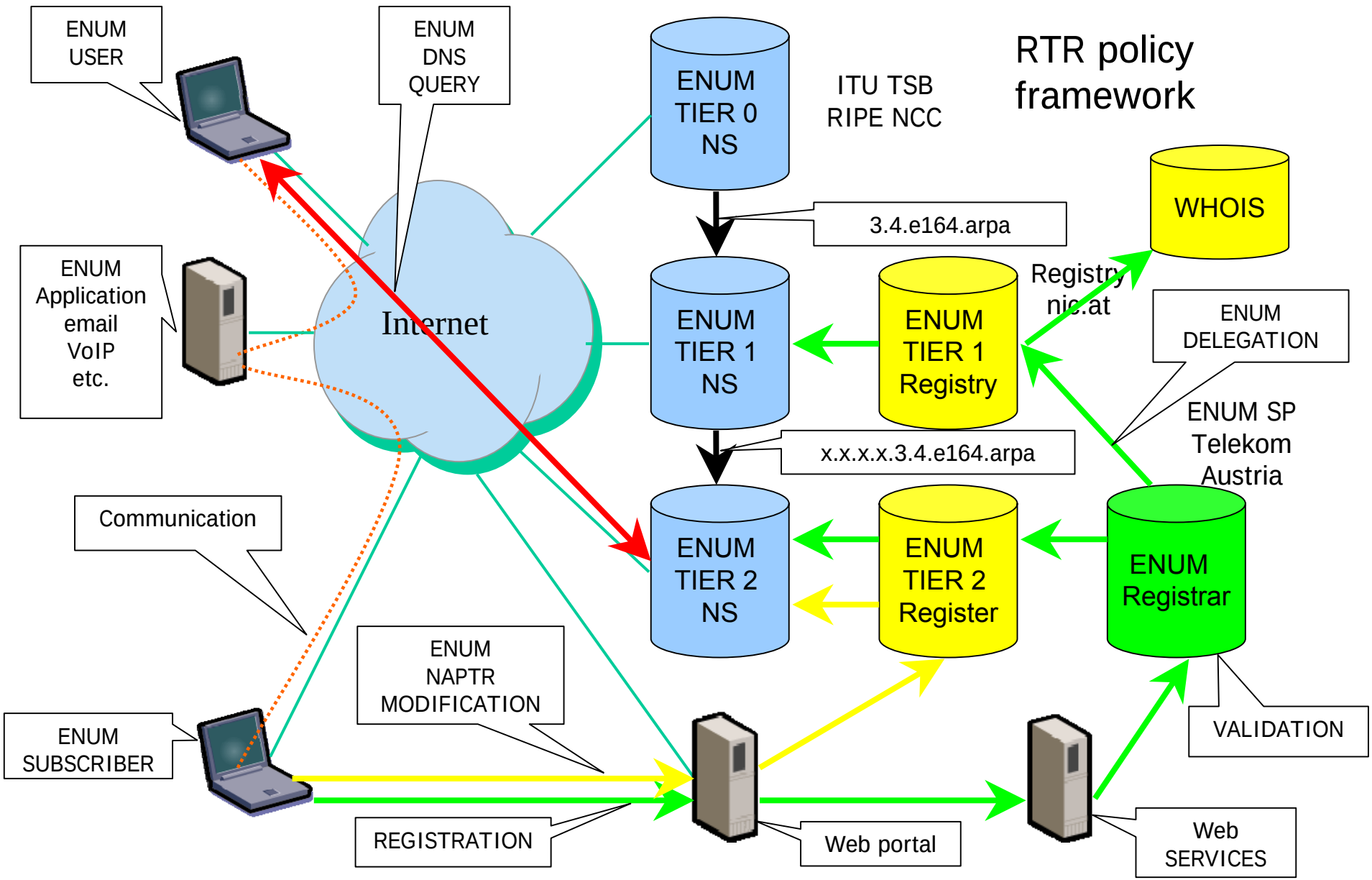
- Provide a DNS based infrastructure in ENUM Tier 1 and Tier 2
- Basic administration and validation by ENUM Registrar (ENUM Service Provider) and an ENUM Tier 1 Registry including the necessary provisioning processes
- Web-Portal for registration of ENUM Subscribers and for simple manipulations of the DNS records in Tier 2
- ENUM Client-SW for ENUM Users to query the ENUM database
- VoIP Applications for ENUM Subscribers and Users (sip and h323)
- Evaluation of the services provided and of the user feedback
- Monitoring of and interworking with other trials
- Evaluation of standards and feedback to the relevant bodies
- The Austrian and VISIONng Trials are Feasability Studies
  - Purpose: find out first Products and then Markets

Tasks of the Trial Partners

- Inner circle (must sign MoU):
  - RTR responsible for policy framework (MoU holder)
  - Tier 1 Registry (nic.at)
  - Registrar + Tier 2 Nameserver provider = ENUM SP
    - e.g. Telekom Austria
  - Must sign MoU to get registrar (admin-c) and nameserver handle (tech-c)
- Outer circle:
  - Client SW Suppliers - Infonova, AOSA (Siemens, Alcatel), Kapsch, Telcordia
  - Provisioning SW Suppliers – Infonova
  - Application Provider - Telekom Austria (VoIP), any others
  - Consulting, standards - OeFEG

ENUM Trial: Application Aspects

ENUM Trial: Administrative Aspects



Validation within the trial

- Basic requirements for commercial deployment:
  - ENUM subscriber shall be the assignee of an E.164 number valid for the ENUM trial and the number shall be in operation with a TSP.
  - It has to be verified that the ENUM subscriber is the named entity
  - Registration shall cease if first item is no longer valid.
- Interim solution for trial:
  - Only known subscribers
    - later identification via billing address possible
  - Currently only geographic and mobile numbers
  - Number shall be listed in phone directory, data need to be the same
  - Validation done by Registrar
  - Personal Numbers for ENUM use under discussion
- De-validation with periodic check (will be automated)
- Evaluation of improved validation methods ongoing (e.g. RADIUS)
- Current issue: corporate ENUM subscribers, private numbering plans

WHOIS

- ENUM is DNS
- Processes have to be similar to normal domain name administration
- For operation of DNS the storage of e.g.:
  - Domain Name Holder
  - Administrative Contact
  - Technical Contact
- in a database is necessary (WHOIS-DB)
- Currently there is still a discussion, which data are stored in the WHOIS-DB and which data are publicly available.
- Regarding the Austrian ENUM Trial it has been decided temporarily that all data are stored and are public available.
  - Domain Name Holder: ENUM Subscriber
  - admin-c: Registrar
  - tech-c: Nameserver Provider

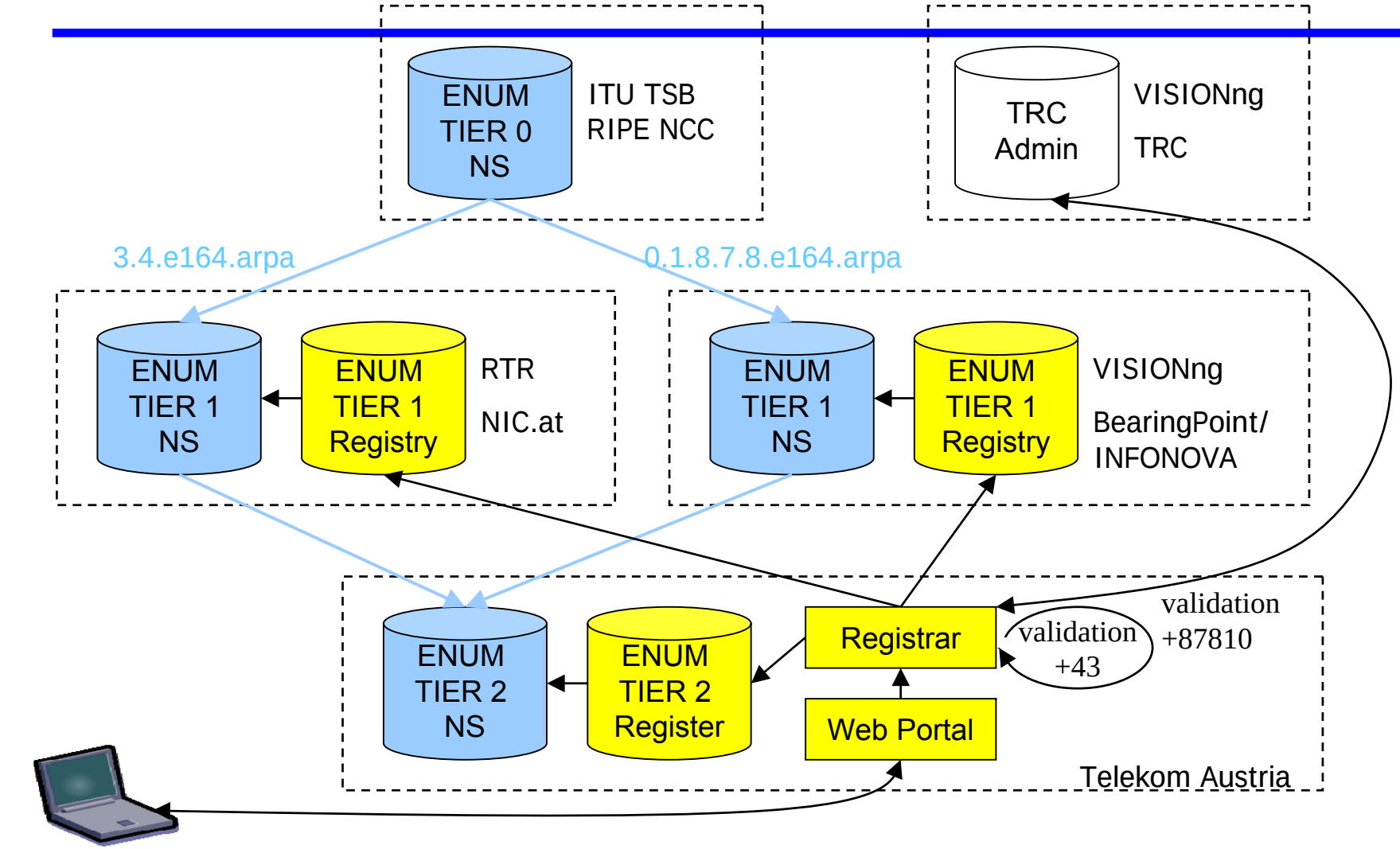
ENUM Trial for UPT

- Telekom Austria is Member of the VISIONng Association
- The mission of VISIONng is to provide a framework for the deployment of worldwide inter-domain and multi-vendor IP Telephony services based primarily on ETSI TIPHON specifications
- ITU-T has assigned part of the country code for UPT to VISIONng for deployment of a Universal Personal Telecommunication Service:

  +878 10 (URU10)

- In May 2002 VISIONng (as assignee of the numbering range +87810) requested an ENUM Delegation from RIPE NCC and got approval from ITU-TSB
- Telekom Austria is therefore implementing in parallel to the Austrian ENUM Trial within +43 also an VISIONng ENUM Trial within +87810
- In October 2002 it was decided by VISIONng, to use +87810 within ENUM for routing on IP
- This decision caused the joining of Free World Dialup (FWD) to VISIONng in January 2003 and Earthlink after the Spring VON 2003

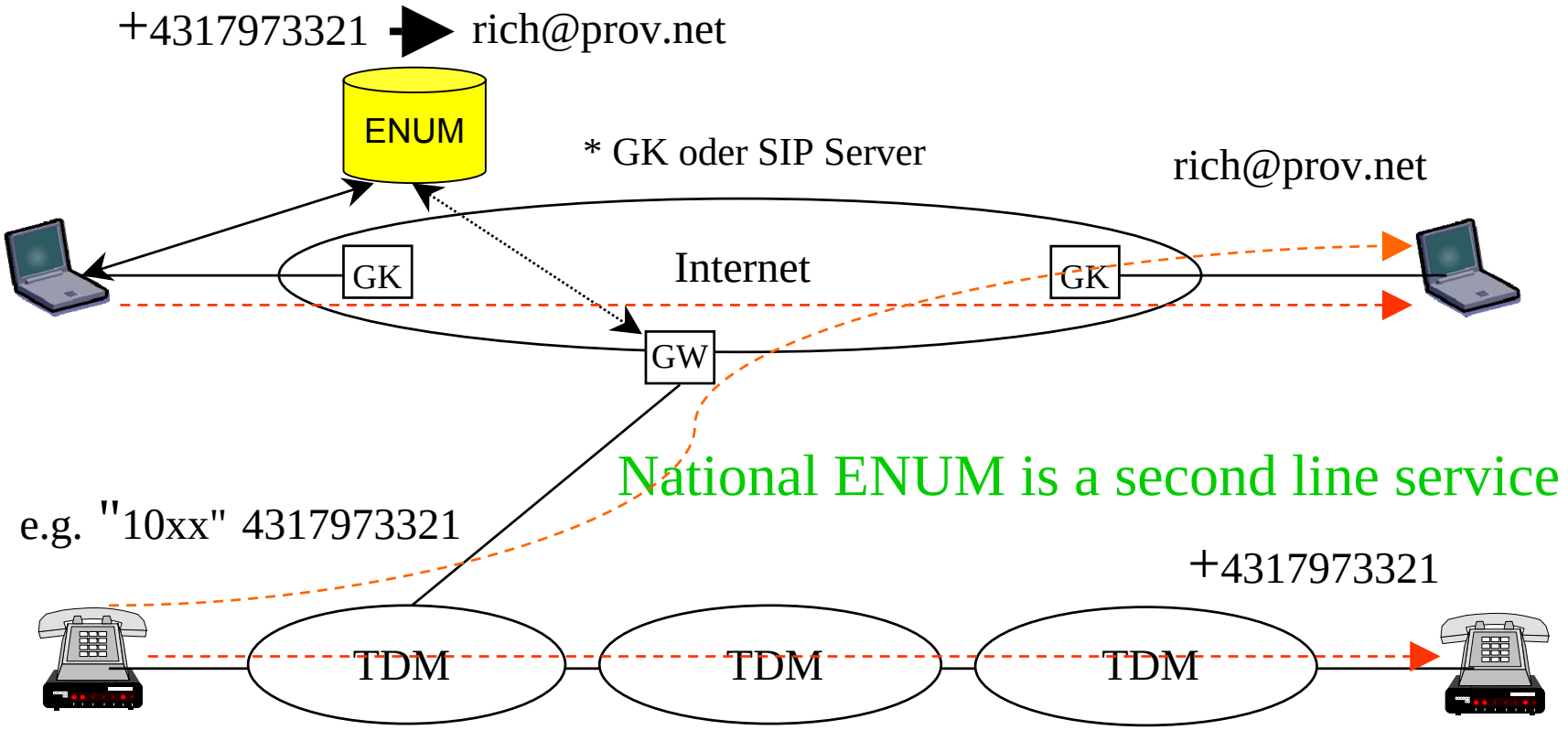
Austrian ENUM and UPT ENUM



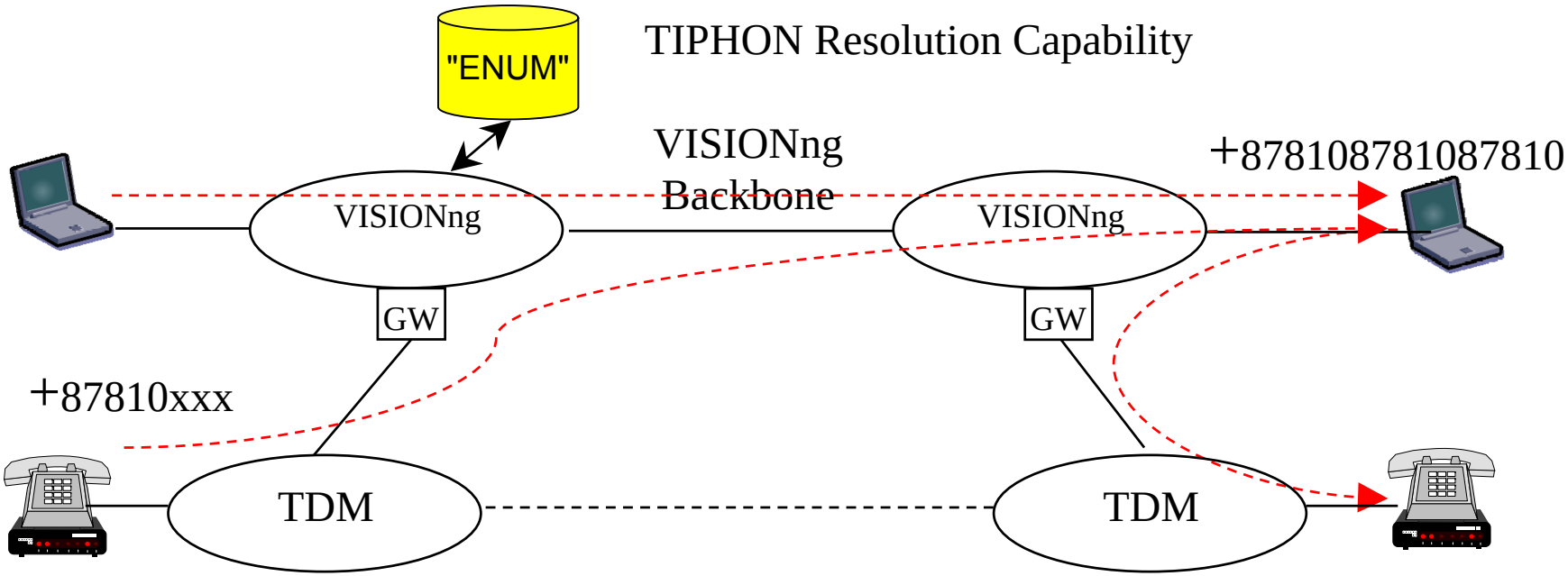
Austrian ENUM Trials - Rollout

2002-03 Start of planning activities
2001-06 ENUM Tier 1 Registry (nic.at and Infonova) in operation
Start of development
2002-09 ENUM Tier 2 Nameserver (Telekom Austria) in operation
First clients available (ENUM queries on public Internet)
2002-10 Web-Portal for registration and modification in operation
SIP and H.323 VoIP applications available
First Live Demo in Atlanta, GA (VISIONng/VON/TIPHON)
Set-up of Call Center and Registrar (Telekom Austria)
2002-11 ENUM Tier 1 Registry processes fully automated (nic.at)
Test of provisioning processes with selected subscribers
2002-12 Ready to invite real ENUM subscribers and users
Live demo of all functions at the ITU-T SG-2 meeting in Geneva
2003-01 Free World Dialup (pulver.com) is joining VISIONng as Registrar
2003-02 Conversion to ETSI TS 102 172 compliance
2003-03 Demos in Australia (ACA), IETF, ICANN and Spring VON 2003
2003-04 Earthlink is joining VISIONng
2003-06 Demo at 2003 VON Europe London

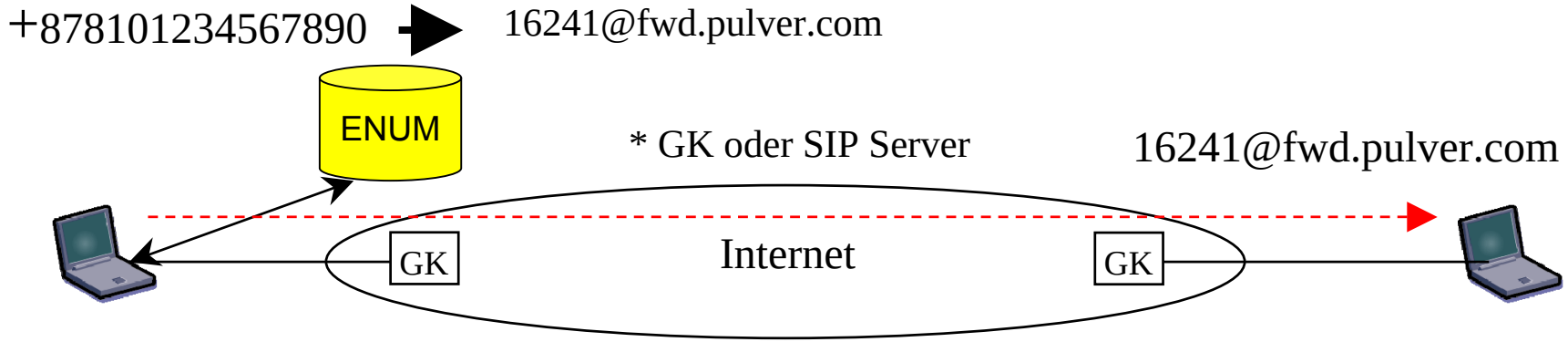
ENUM with national numbers



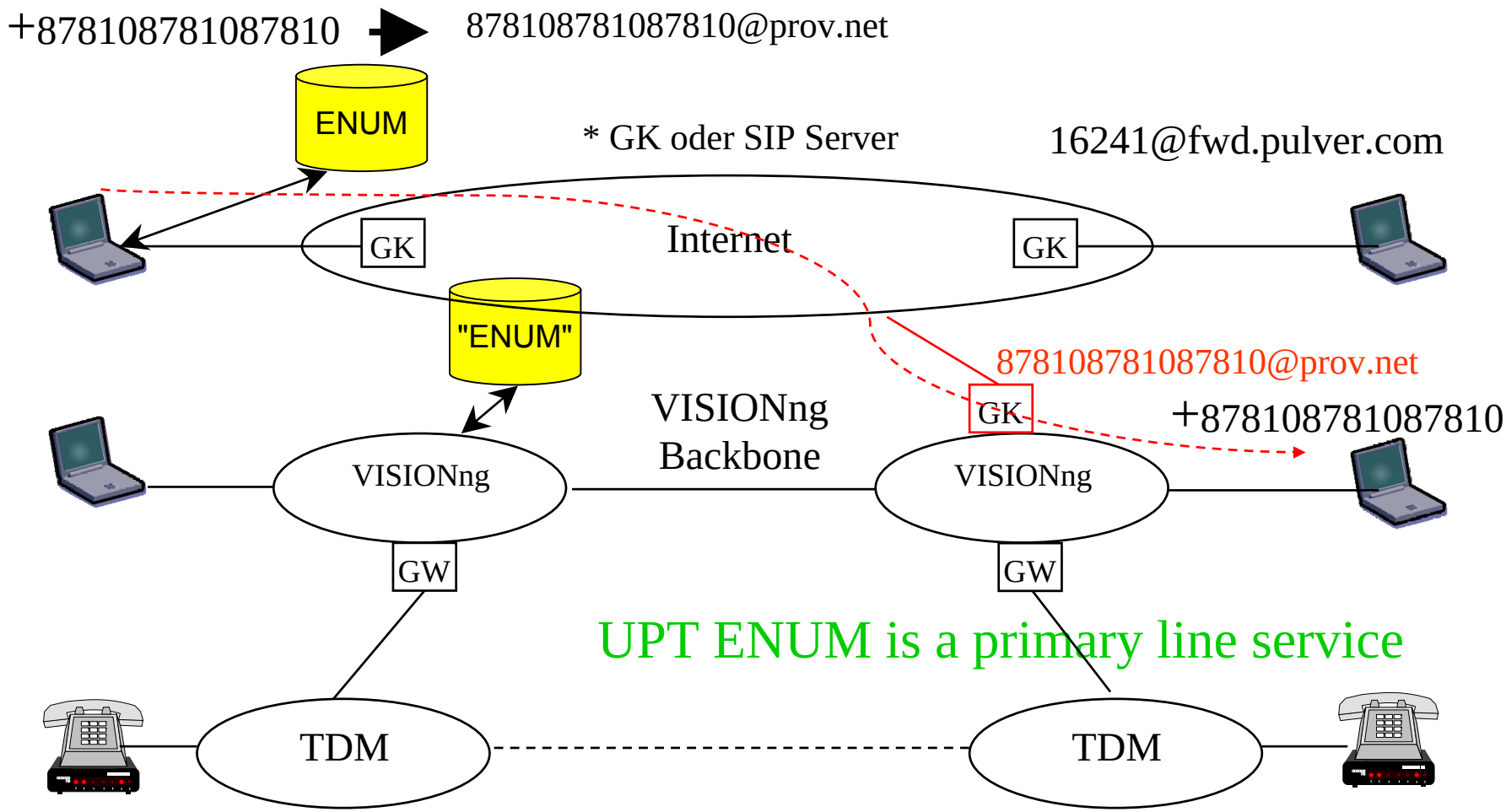
Universal Personal Numbers (UPT)



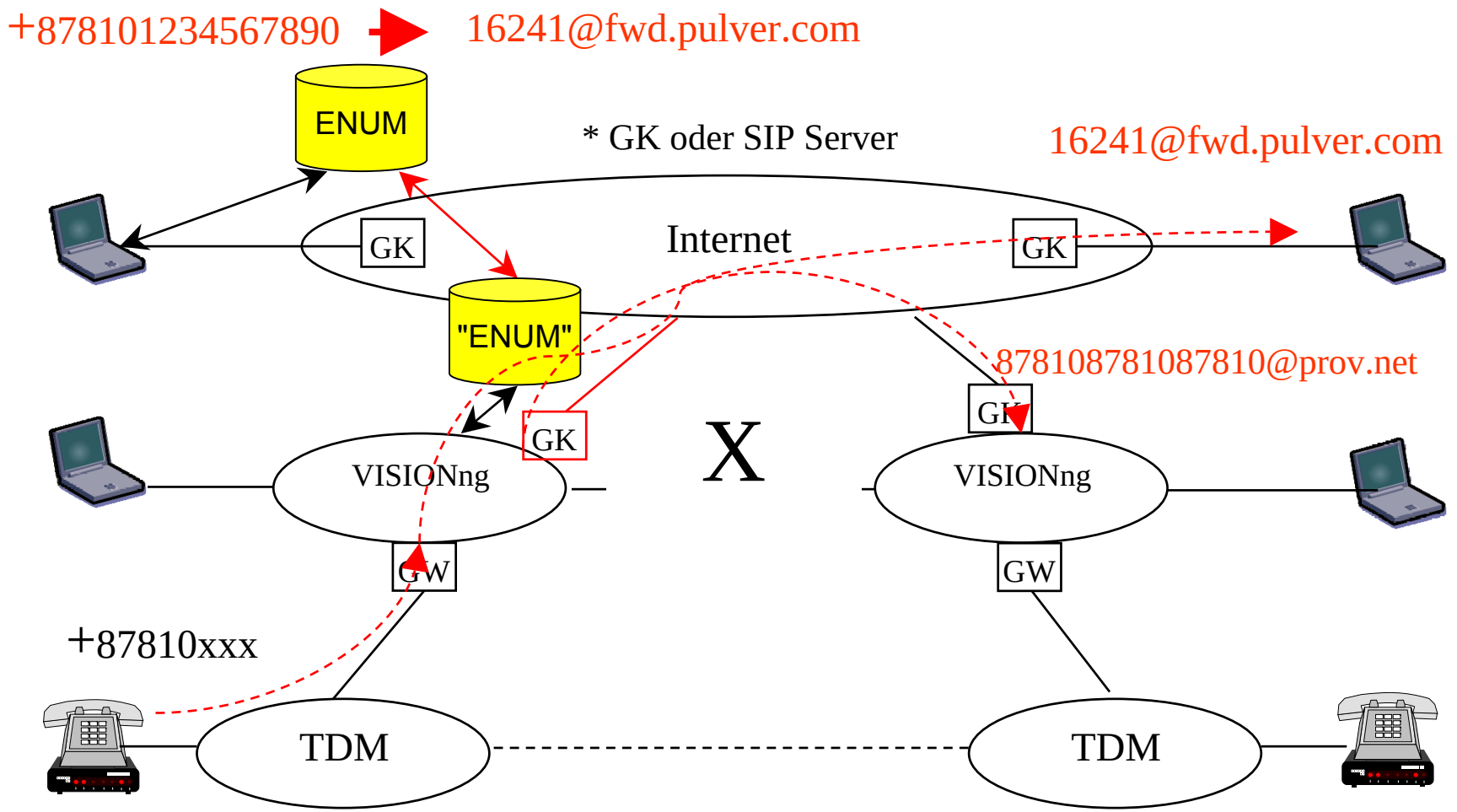
Personal Numbers on ENUM



ENUM + UPT Combined



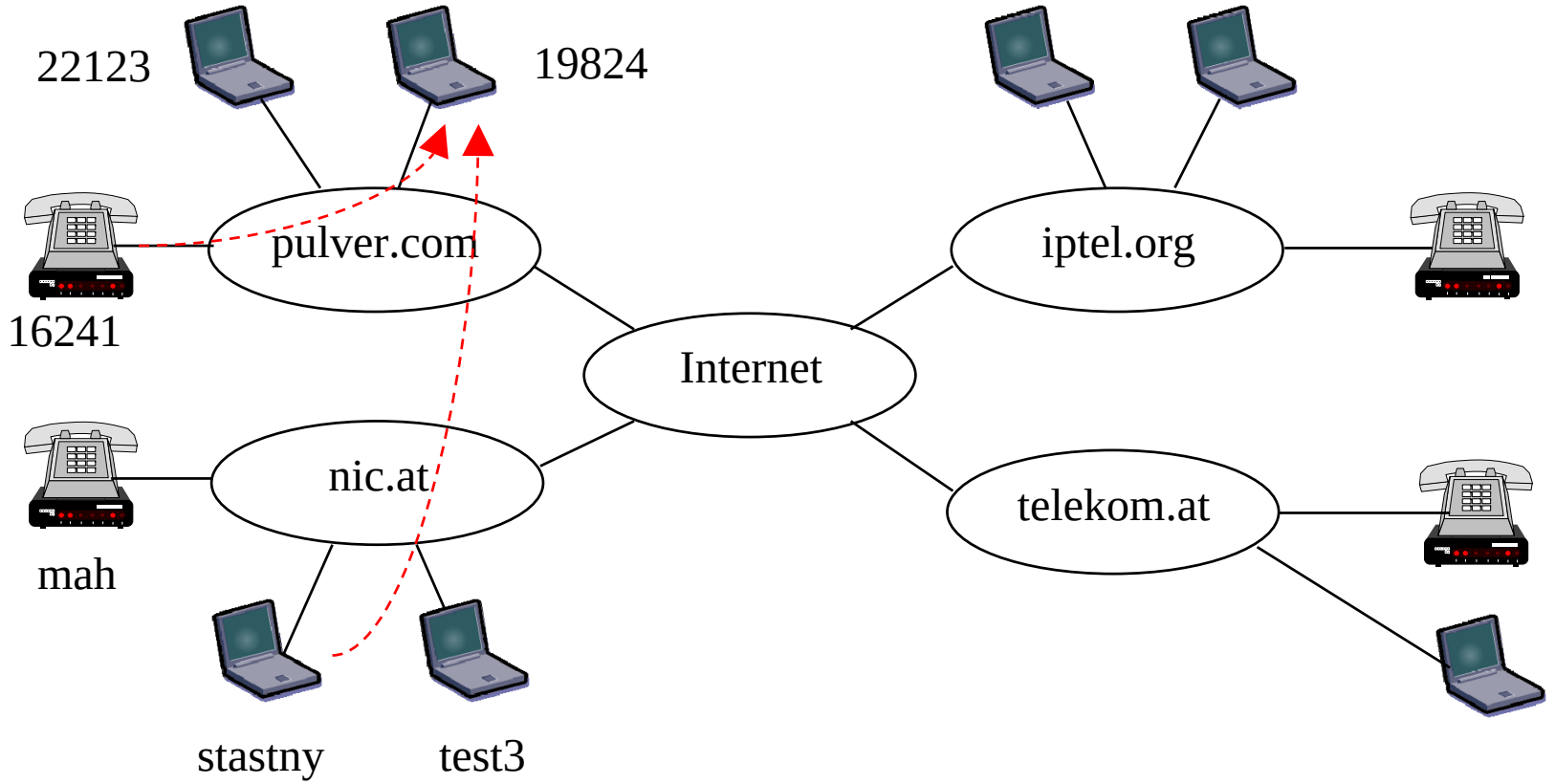
ENUM UPT Numbers from PSTN



Live Demo of ENUM Trials

- The following demos have been shown at the Spring VON 2003 in San Jose 1.-3. April 2003:
  - ENUM Webpage http://enum.nic.at
  - ENUM query via UK Siemens Roke Manor
  - Registration of an E.164 number by an ENUM subscriber via the web-interface
  - Query of ENUM entries via the web-interface by ENUM subscriber
  - Modification of ENUM entries via the web-interface by ENUM subscriber
  - DNS-query of ENUM entries by ENUM User with ENUM client SW and launch of applications
  - Query of WHOIS data related to an E.164 number
  - ENUM at work in the different VoIP scenarios
- These demos and additional interworking functionality will be shown at the upcoming VON Europe 2003 Expo in London 10.-12. June 2003 (see http://pulver.com/europe2003/)
- Participants: Telekom Austria, nic.at, Kapsch CarrierCom, BearingPoint (Infonova), Siemens München, Iptel.org/GMD Fokus Berlin

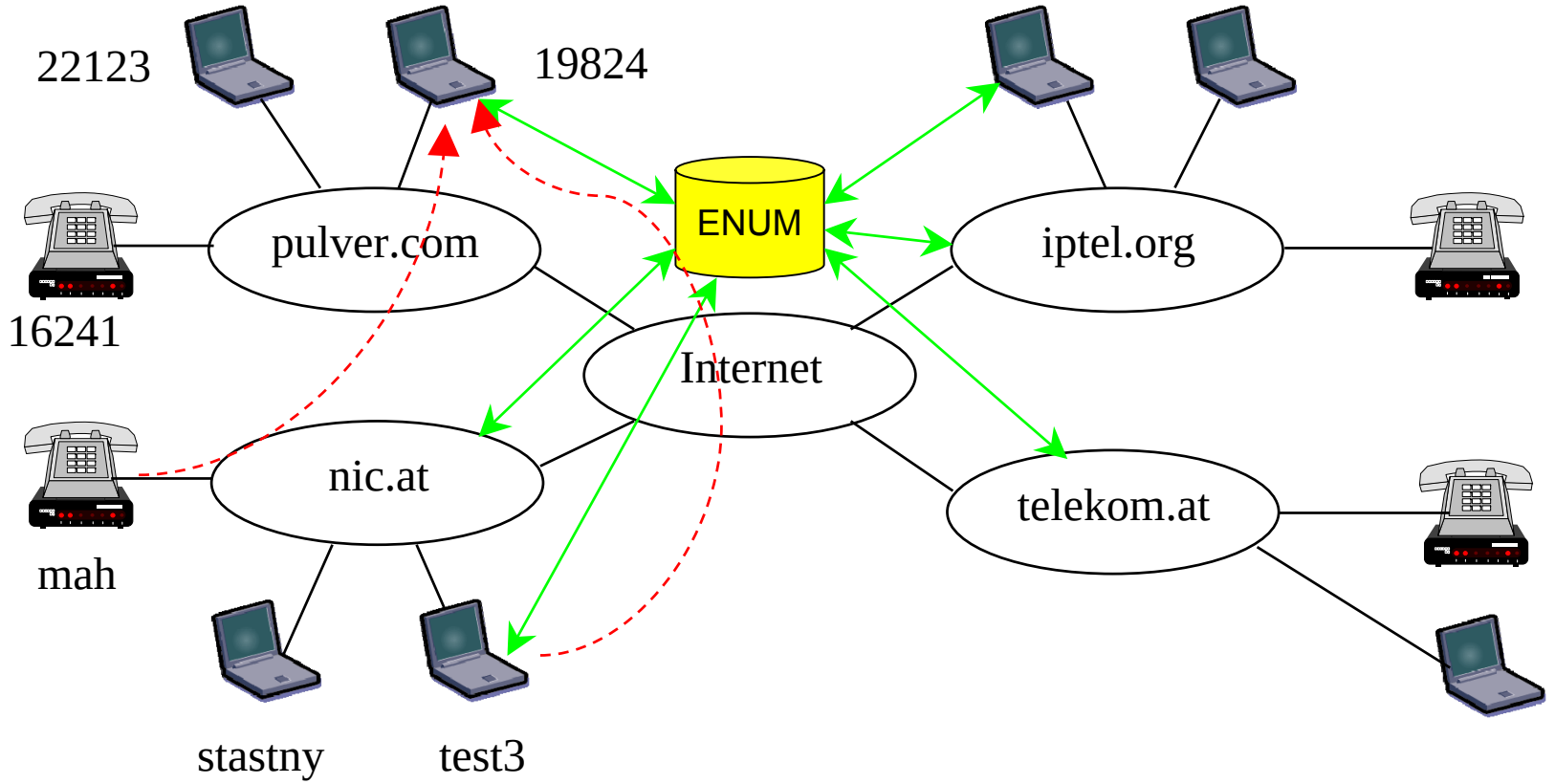
VON Demo Scenario - SIP



FWD - FWD: 16241 dials 19824

nic.at - FWD: stastny dials 19824@fwd.pulver.com

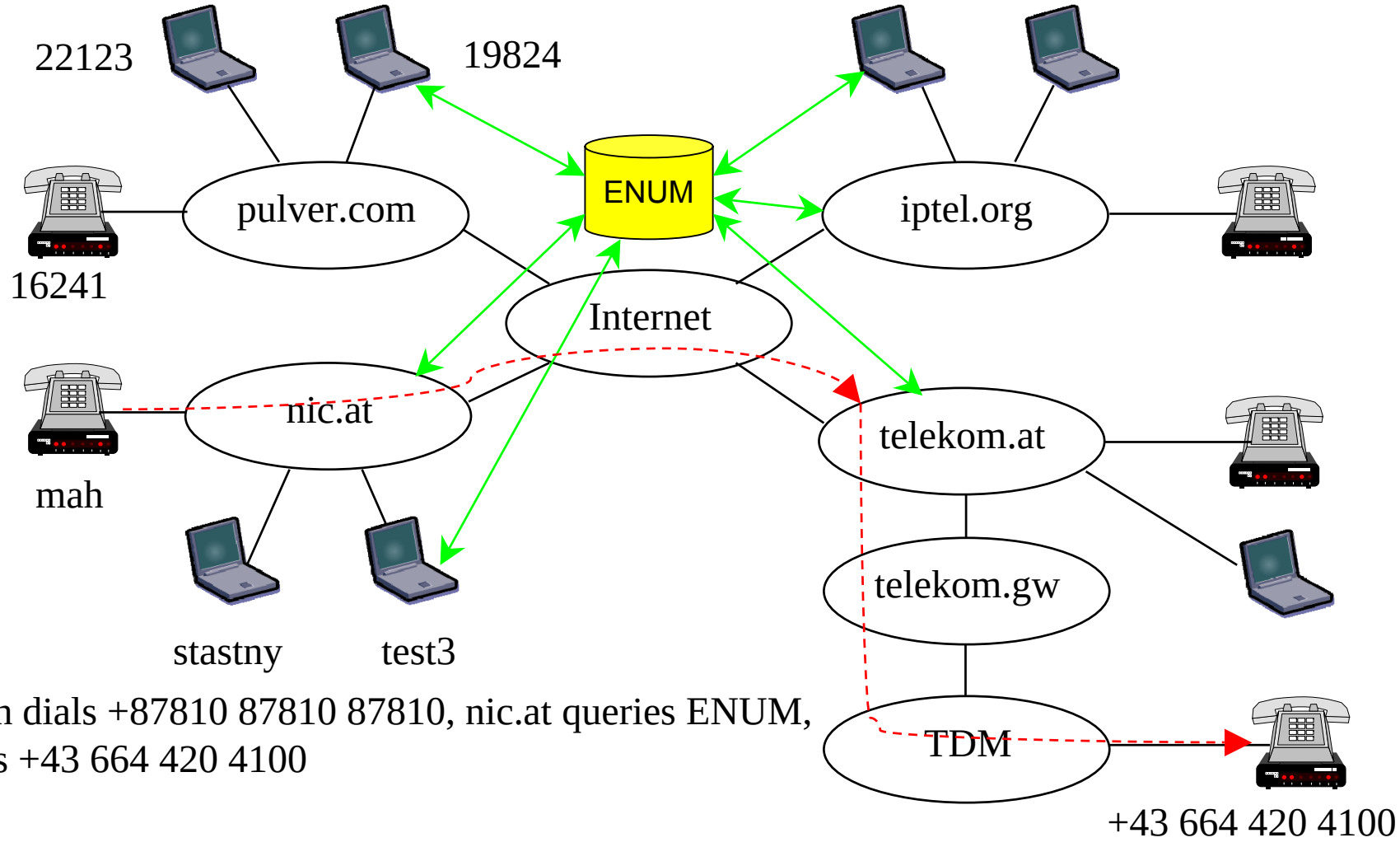
VON Demo Scenario – SIP +ENUM



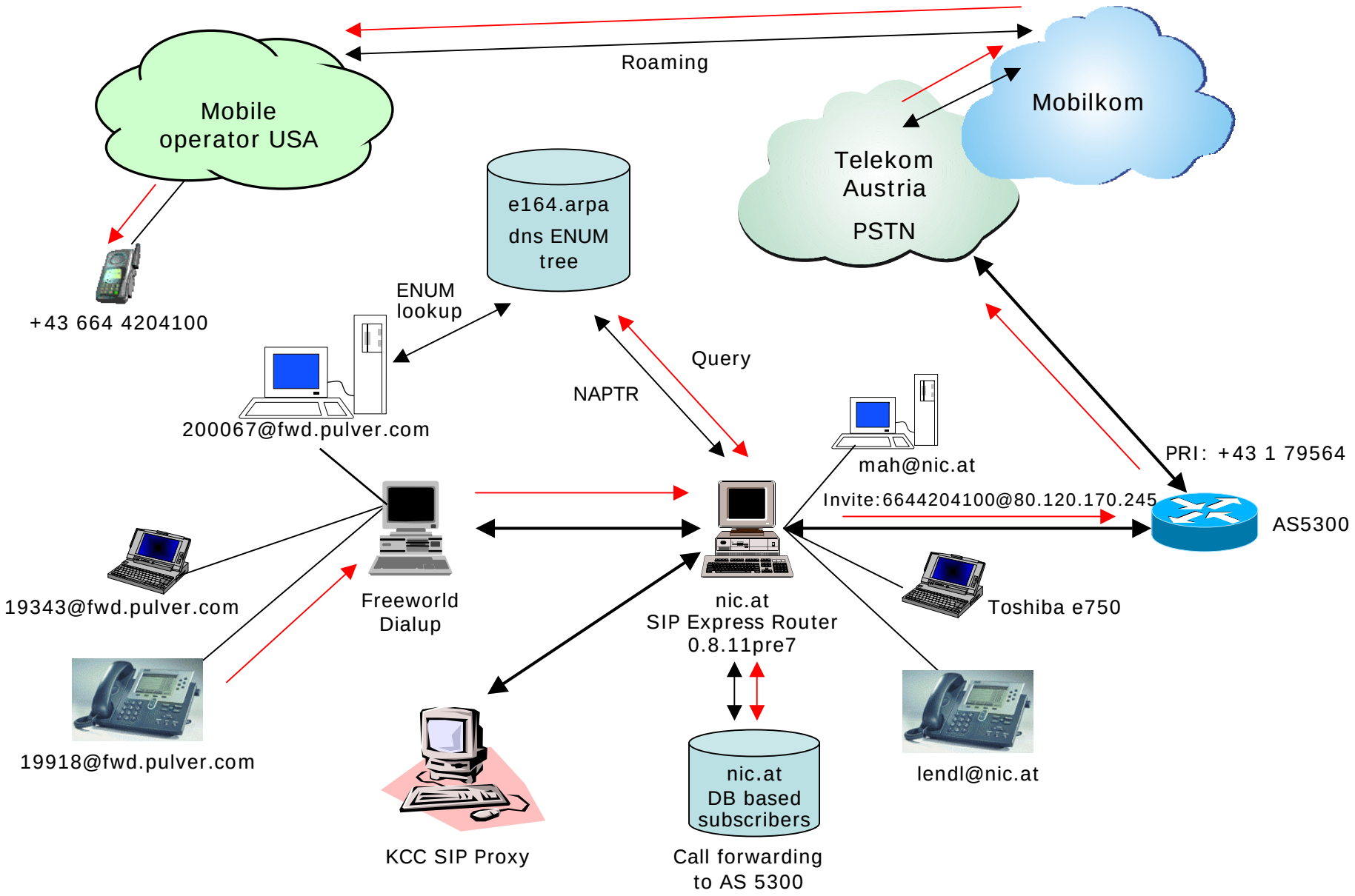
test3 queries ENUM for +87810 87810 87810, gets 19824@fwd.pulver.com

or mah dials +87810 87810 87810, nic.at queries ENUM, gets 19824@fwd.pulver.com

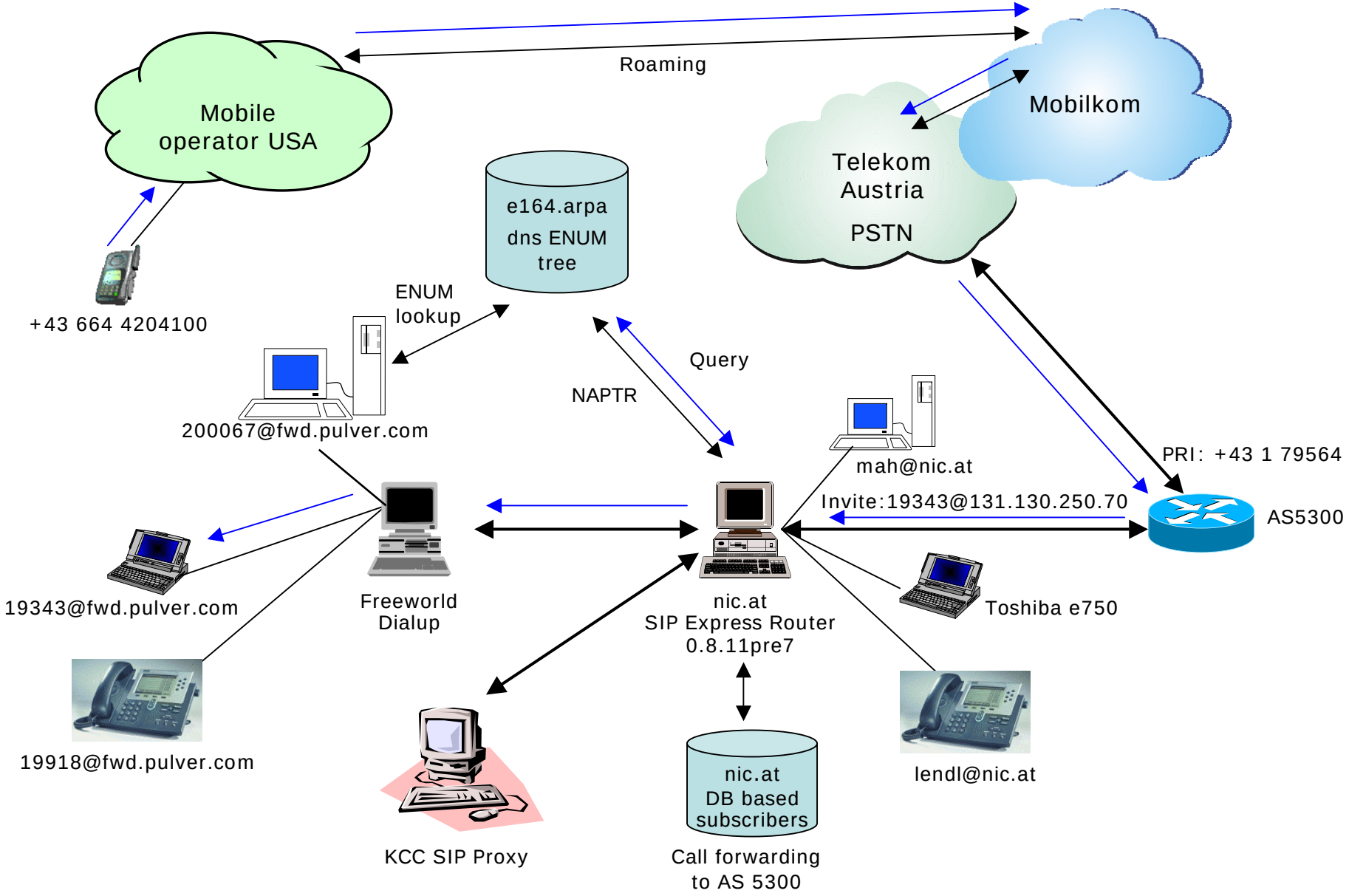
VON Demo Scenario - PSTN



mah dials +87810 87810 87810, nic.at queries ENUM, gets +43 664 420 4100



VON Demo Scenario: Call from FWD to Mobile Phone



VON Demo Scenario: Call from Mobile Phone to FWD

Further Activities

- ENUM Administration
  - ENUM Validation Architecture using RADIUS
  - Network Asserted Identities, E.164 Certificates, Trust Circles
  - Use ENUM for Interconnection of Private Networks
  - Include Private Networks in Public ENUM Architecture
  - Upgrade the Registry and Registrar Functions accordingly
- ENUM Usage, VoIP and other Services
  - Upgrade ENUM Clients
  - ENUM-enabled Applications e.g. Softphones, PDAs, Mobile Phones, Outlook
  - ENUM-enabled Server und IP PBX e.g. SER, Asterisk
  - Linking VoIP Testbeds with ENUM e.g. Kapsch CC, Uni Wien, OeFEG, TA
  - Linking with VISIONng UPT Applications e.g. Earthlink, FWD
  - etc.
- Feedback to Standardisation
  - ETSI (June, September), IETF (July Vienna), RIPE NCC (September)
  - ITU-T (October), CEPT (October),
  - VON (June, September)
  - Other Trials (good contacts with UK, SE, DE, CH, US, AU, KR, ...)

Some Websites

- IETF ENUM www.ietf.org/html.charters/enum-charter.html
- ITU-T www.itu.int/osg/spu/enum/index.html
- ETSI portal.etsi.org
- RIPE/NCC www.ripe.net/enum
- US ENUM Forum www.enumf.org
- Austria enum.nic.at , www.rtr.at/enum
- Germany www.denic.de/enum/index.html
- Switzerland
  www.bakom.ch/de/telekommunikation/nummerierung/enum/index.html
- UK www.dti.gov.uk/cii/regulatory/enum/
- Sweden www.pts.se
- Australia www.aca.gov.au/committee/nsg2/enum.htm
- Portugal www.anacom.pt
- France www.art-telecom.fr
- Pulver www.pulver.com/fwd

The END

Thank you for your attention

Any Questions?