On ENUM:
introduction, usage forms and rollout

Michael Haberler

Internet Foundation Austria

Moscow June 2004

outline

- a one-page introduction to ENUM
- example: call flows & crossing PSTN/Internet boundaries
- the user ENUM concept
- how the e164.arpa tree is supposed to grow
- the +43 trial and service rollout
- carrier ENUM, iENUM
- observations & some speculations

The technical one-page story on ENUM

- ENUM is legacy support for PSTN addressing (E.164) and 0-9 dialkeypad terminals - until numbers go away.
- It maps a telephone number on to a set of URI‘s by means of the DNS (but not backwards).

```
sh# host -t NAPTR 6.6.6.6.9.2.7.5.2.1.2.4.e164.arpa
6.6.6.6.9.2.7.5.2.1.2.4.e164.arpa NAPTR 100 10 "u" "E2U+sip"
"!^\\+421257296(.*)$!sip:2\\1@stuba.sk!"
```

- surprise, surprise : trials showed - it works as well as the DNS
- DNS usually maps names to (mostly) IP addresses – an alias
- ENUM DNS maps numbers to URI – an alias, too: both IP addresses and URI‘s are assumed to exist, and interpretation context is the Internet
- this aliasing enables:
  - common addressing - Internet/PSTN – and thus routing of calls
  - together with number allocation - enabler for Internet-side telephone service
  - and beyond – IM, Video, HiFi calls..
  - NB: DNS becomes call-critical infrastructure

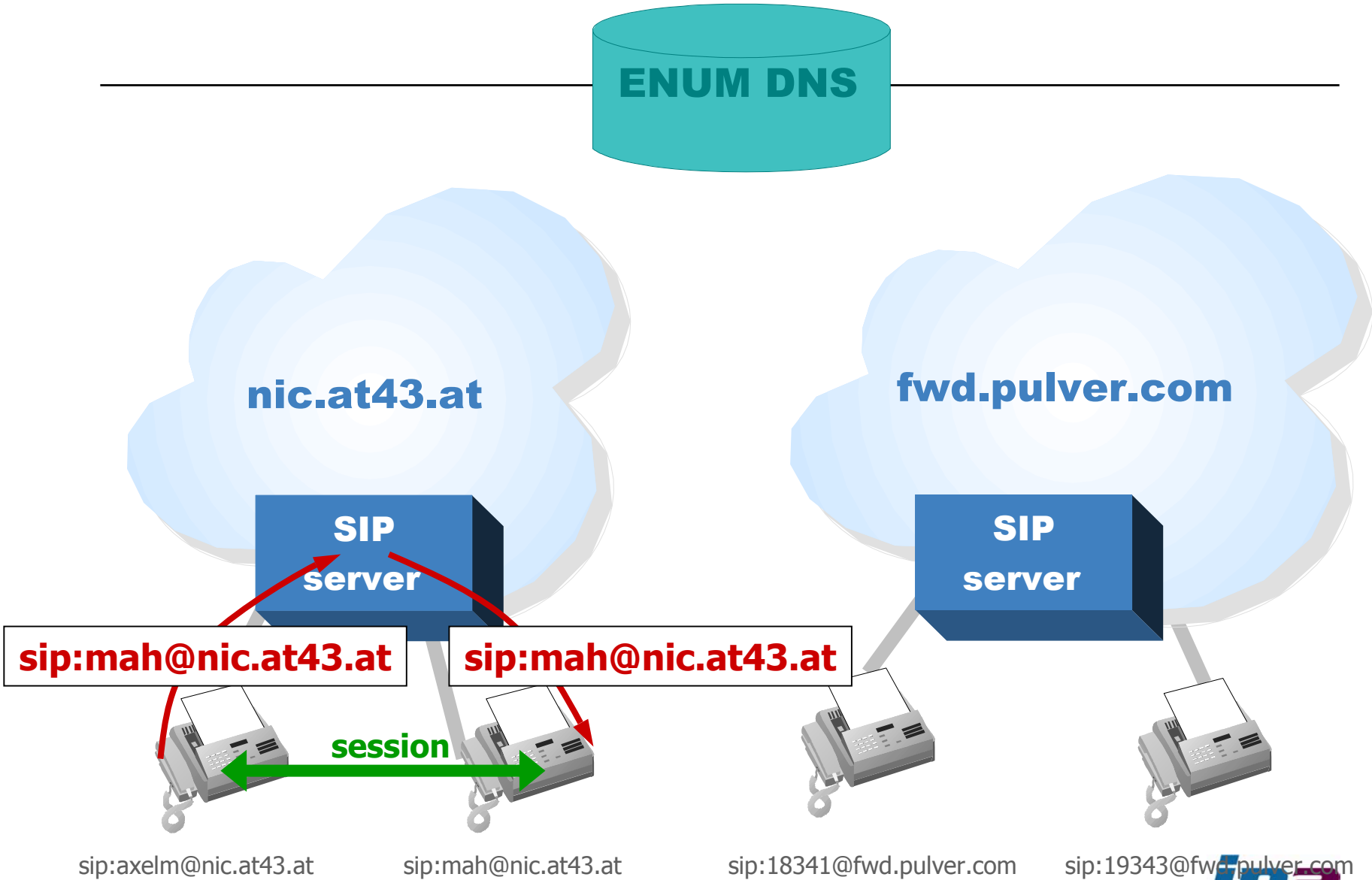
call flow examples

- „single user ENUM“
  - recap: calls based on SIP address-of-record adressing
  - calls with ENUM resolution
  - intra-domain and cross-domain

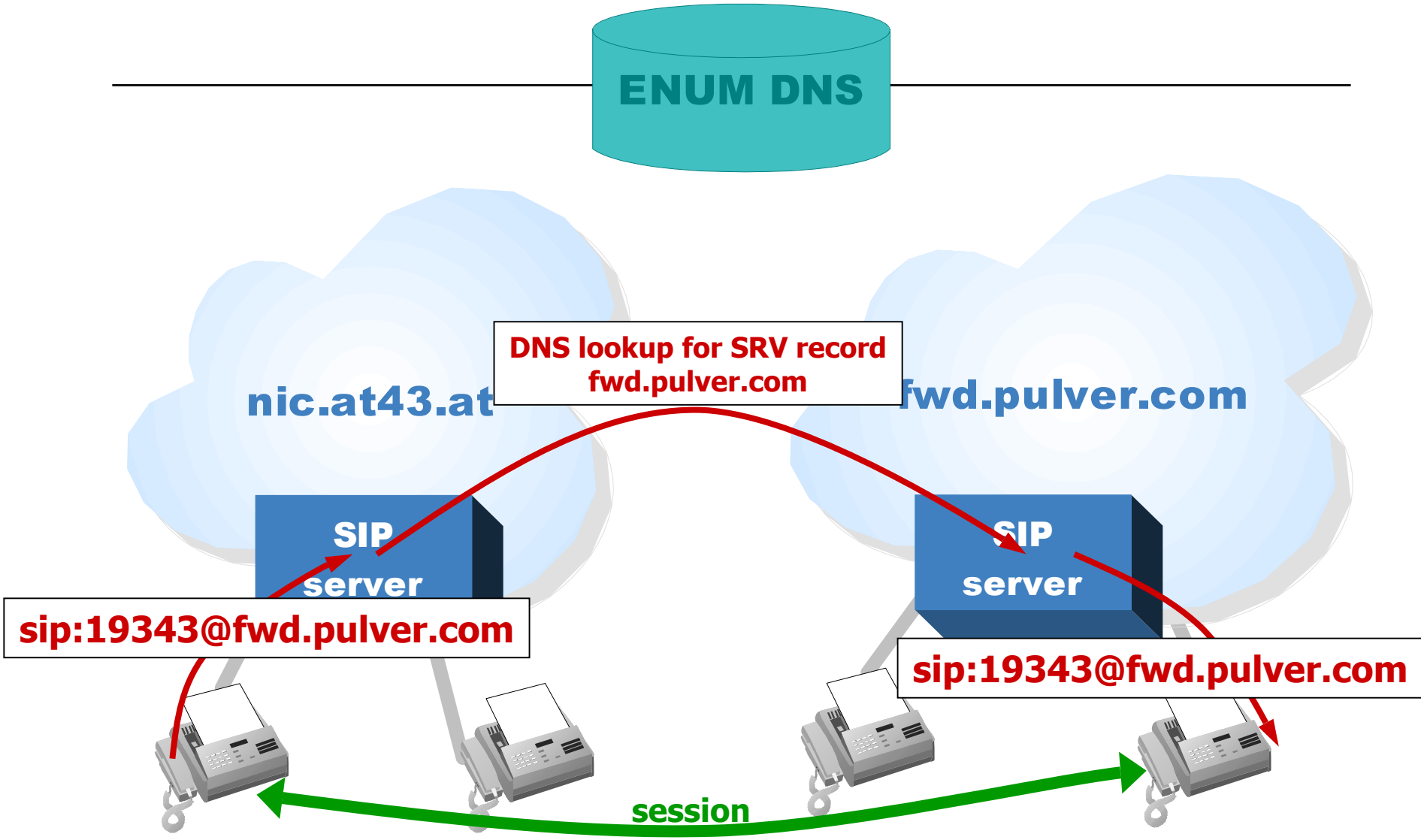
- crossing the Internet/PSTN boundary
  - where is the user of a number? (the PSTN rarely cares...)
    - routing of on-net numbers to a gateway
    - context resolution with ENUM on Internet side

- blue sky note: PSTN could also resolve ENUM – with SS7 INAP/ENUM

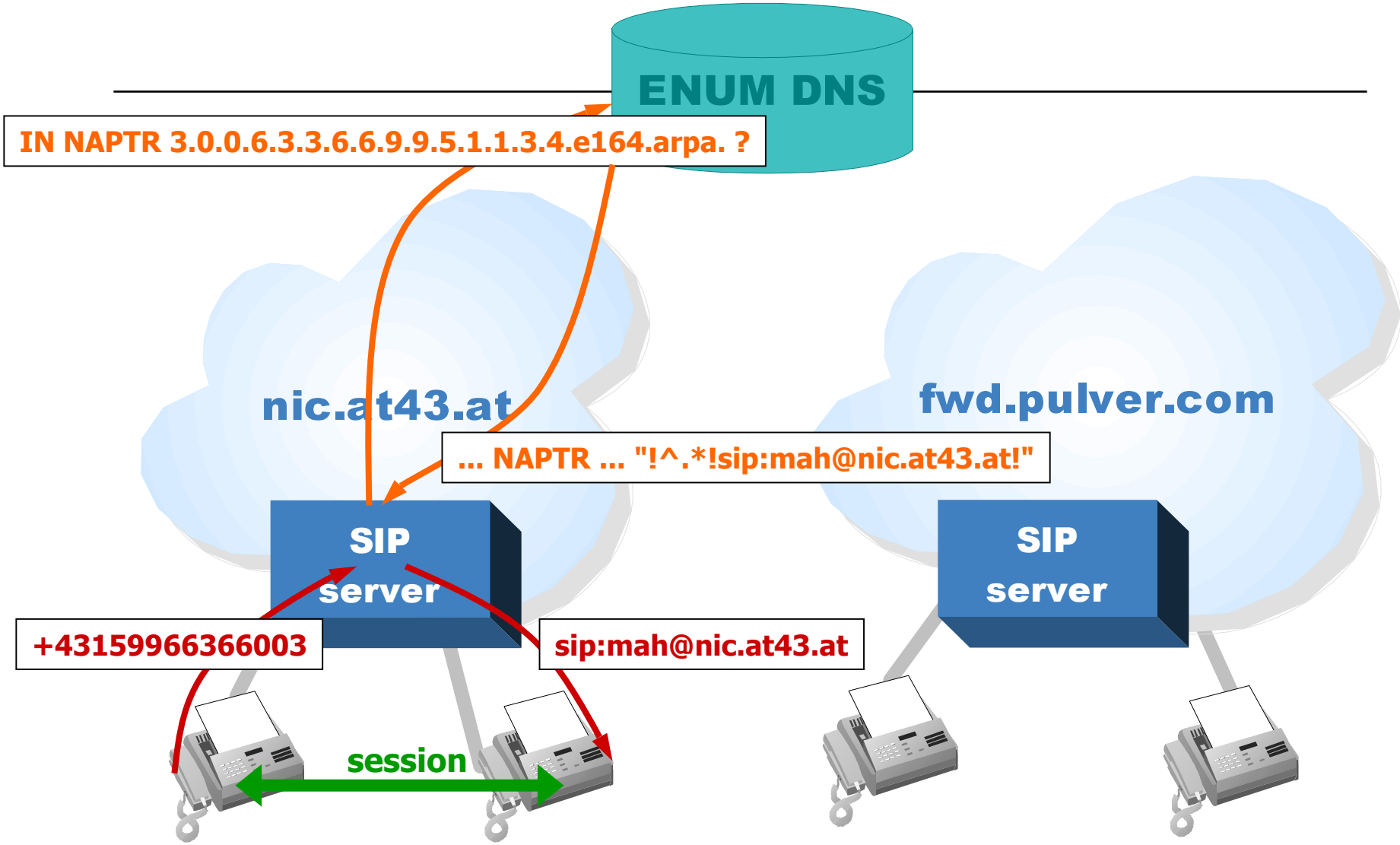
Call within a SIP domain



Call across SIP domains

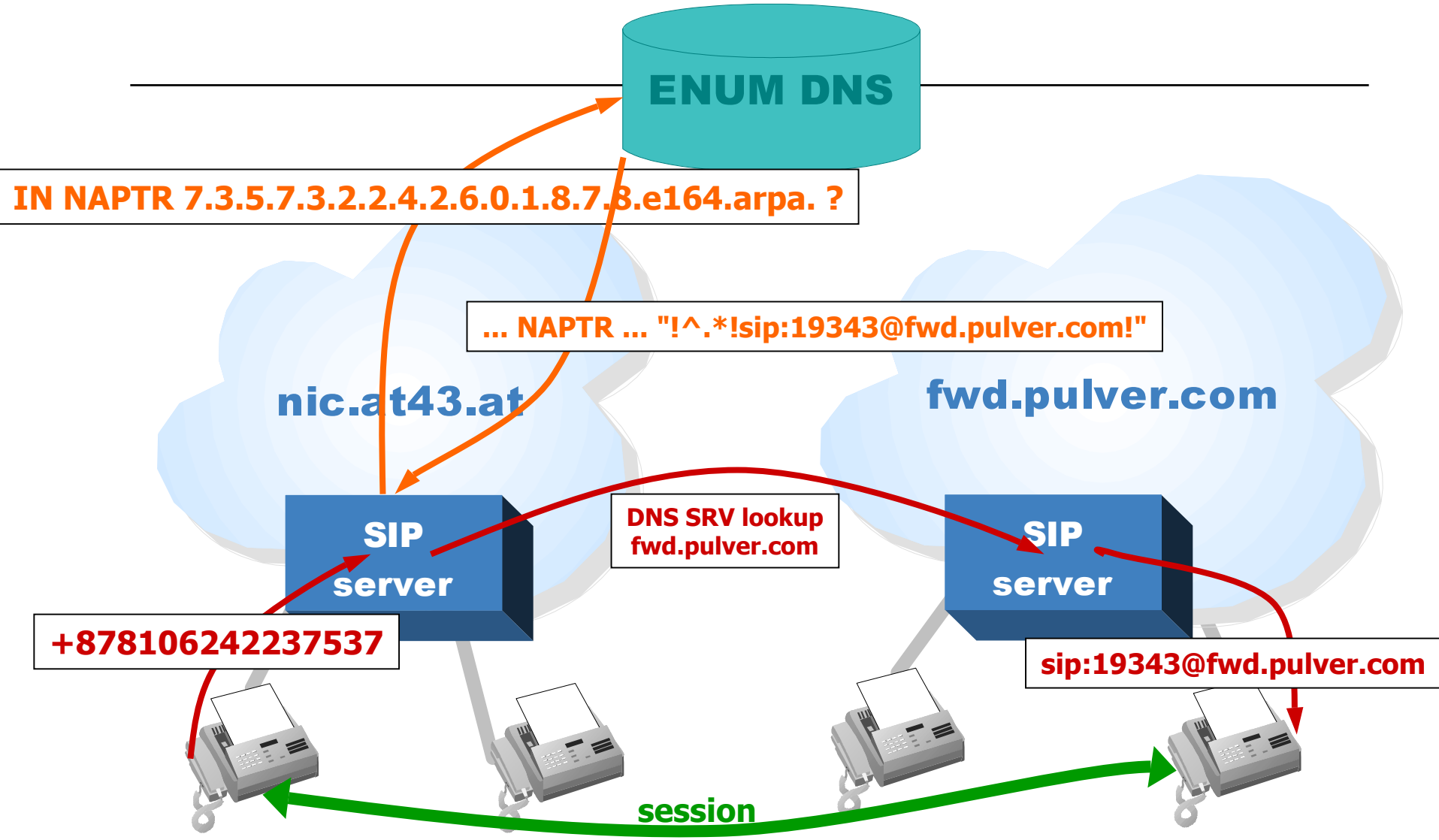


E.164 adressing with ENUM



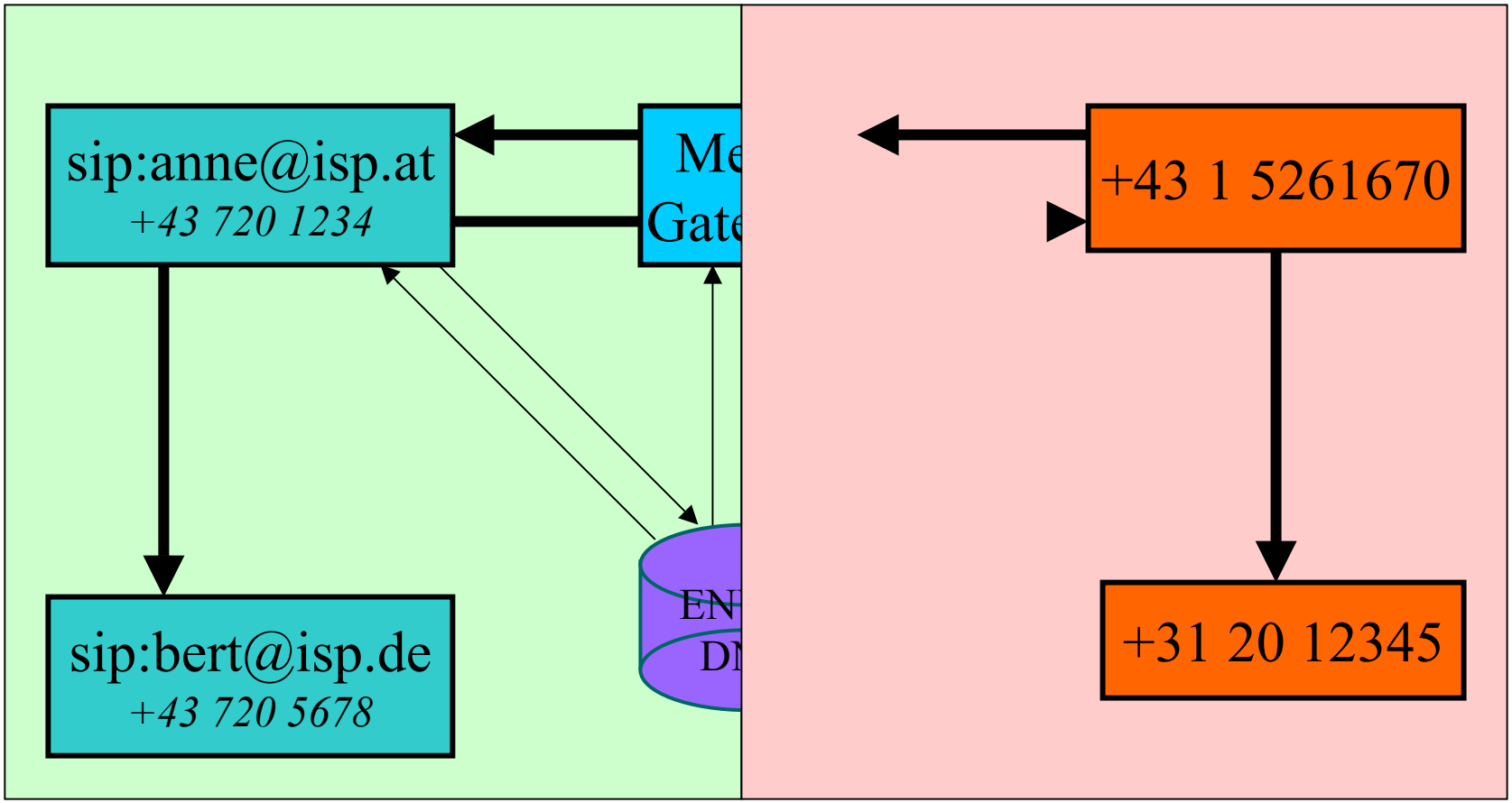
sip:axelm@nic.at43.at sip:mah@nic.at43.at sip:18341@fwd.pulver.com sip:19343@fwd.pulver.com

cross-domain call ENUM



sip:axelm@nic.at43.at sip:mah@nic.at43.at sip:18341@fwd.pulver.com sip:19343@fwd.pulver.com

Internet & PSTN call legs



how to get from Internet to the PSTN & back?

- PSTN to Internet:
  - number range routed to media gateway
    - plain PBX model or interconnection as a telco
  - two stage dialing - LibreTel
  - in both cases ENUM useful on Internet leg
- Internet to PSTN
  - no VoIP ENUM record at all – bounce to PSTN
  - ENUM tel: record – explicit call forward to PSTN

recap: the concept of **user ENUM**

- original idea as per ETSI
  - user **already owns** a service with **a number**
  - thereafter she may have an ENUM domain to go with it (for **THAT** number)
  - „opt-in“ to the service
    - kind of „Internet second line service“
    - needs end-user motivation and action
    - administratively: validate the right-to-use in the number
  - end-to-end visible URI for terminal assumed (not everybody likes the idea)

- an interesting blend of carrier-assigned number and end-user controlled domain
- that‘s a key assumption behind „user ENUM“

now for the politics.. how e164.arpa grows:

- Governments/regulators have control over „their“ number space
- Nations „opt-in“ to deploy ENUM
  - designate a registry (somehow)
  - send ITU TSB a letter to approve delegation to that registry
  - ask RIPE to delegate at the country code level to that registry
  - registry starts allocating ENUM entries to number holders.

- great idea - unfortunately governments have a proven lack of skills in Internet service rollout
  - availability is sketchy at best
  - Metcalfe‘s law applies – to be useful, coverage must improve

ipa

Carrier ENUM and iENUM

- ENUM **technology** is useful in closed and semi-open contexts as well
- private DNS trees support the termination monopoly
- so the largest ENUM app today is MMS routing between US mobile operators
- more of these will appear – between „operators“ – this is „carrier ENUM“

- the new ITSP‘s often supply public URI‘s to their customers
- **a** public ENUM tree(s) enable end-to-end **routing** of calls
- strong demand – but low coverage and fragmentation over many e164.X trees
- public DNS is an issue wrt customer base access and spam

- for end/end ITSP‘s a semi-public tree might do the trick
  - it is becoming clearer that the „national opt-in model“ doesnt scale fast enough
  - a culture-compatible rollout model is needed, and single-tree control isnt it
  - collecting operator private trees might be an option

+43 ENUM trial & rollout

- discovered that using only **existing numbers** is a bad idea – too complex
- the „second line service“ idea is just that
- we built the at43 public SIP service platform (see http://enum.nic.at) based on a „new“ number range
- this is about Internet end/end addressing with **new numbers**

- key result: define new number range which is „ENUM driven“
  - meaning – PSTN number and ENUM domain become **one** step
  - this is now available as +43 780 xxxxxx in Austria!

- enum.at (a nic.at sister company) will be the +43 registry for user ENUM
  - maybe other forms of ENUM too – we need to get this going

ipa

observations

- the economics of DNS based routing is hard to beat
- the end-to-end reachability assumption has key implications for the telco approach and the „termination monopoly“ – on-net URI‘s/DNS it implies the Email SMTP/MX model
- The concept of an „operator“ blurs – is it user, telco, PBX or what? (can we spell „X.400 ADMD‘s“...)
- the drivers will likely not be telcos to start with, but ITSP‘s, just users with their PBXes
- attention turns to number supply issues
  - NB: in the on-net end-to-end case tariffs are not relevant, and so is the number range used

recommendations

- there‘s a lot of homework in e164.arpa ENUM - go kick your regulators to get going fast
  - tell them if they dont act numbering goes offshore – and so does their control
- gather experience with service and a private tree – this is not just about cheap voice but the full gamut: Instant Messenging, Presence, Video...
- gather experience with friends & family I(t)SP‘s about end-to-end viability
- dont be stopped by „E911“ (emergency call), lawful intercept, universal service counterstrategies – those are general VoIP problems, not ENUM problems
  - and then it is unclear wether on-net service is telephony at all – maybe just an ECS (electronic communications service)

ipa

recommended links

- get an account at www.fwdnet.org
- try the Windows X-Lite SIP client – www.xten.com
- try instant messenging with SIP and the Windows Messenger
  - note this is not the same as Microsoft Messenger!
- Linux: try Linux kphone http://www.wirlab.net/kphone/
- SIP terminal adapter: www.sipura.com
- SIP WiFi phone: http://www.zyxel.de/product/model.php?indexcate=1075688089&indexFlagvalue=1075687935

- Ready for your own SIP server?
  - try SIP Express Router – www.iptel.org
  - try the Asterisk IP PBX – www.asterisk.org
  - both are ENUM enabled
- to read up on ENUM, try enum.nic.at