A Contrarian view of ENUM

Geoff Huston
Chief Scientist, APNIC

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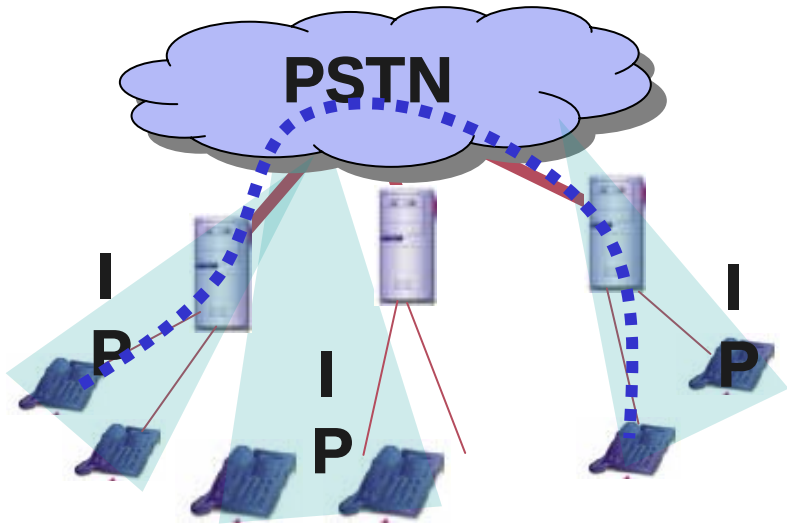
  - Robert Schischka
  - Richard Stasny
  - Richard Schockey

  Whose ideas (and some slides) are contained in this presentation. I'd like to claim full credit for all the errors and mis-interpretations of their efforts!

  Geoff

VOIP without ENUM

- Every VOIP is an island (apologies to John Donne)
  - Enterprise or carrier VOIP dial plans cannot be remotely accessed by other VOIP gateways
- The PSTN is used as the inter-VOIP “default” network
  - Obvious implications of revenue protection for PSTN operators
  - More subtle implications for extended private VOIP networks



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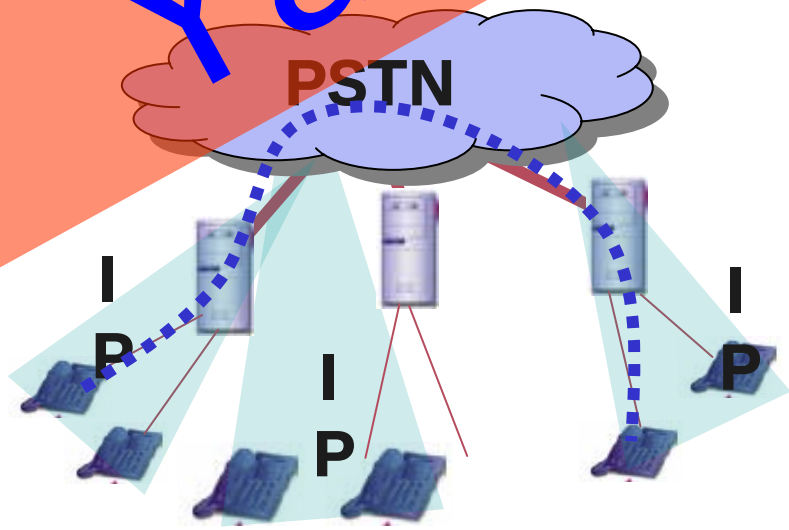
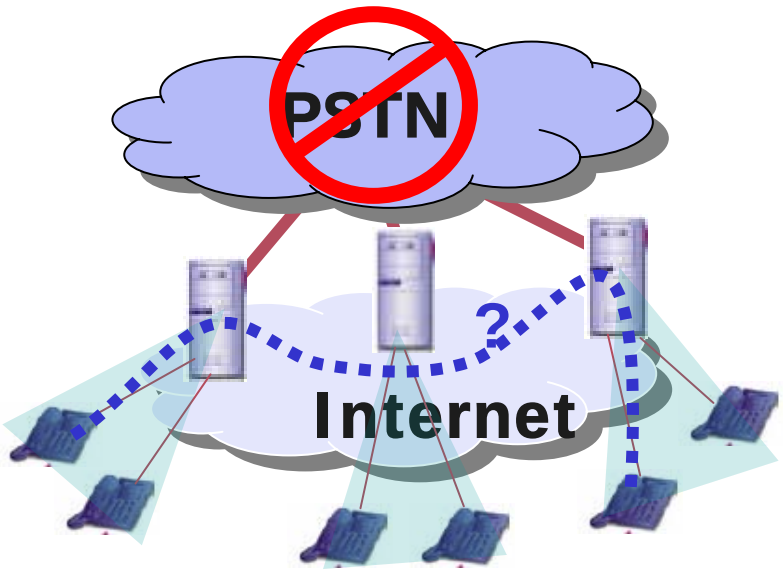
I've Seen this before!
Yawn!



The Core ENUM Problem

- PSTN Carrier Bypass
- 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?



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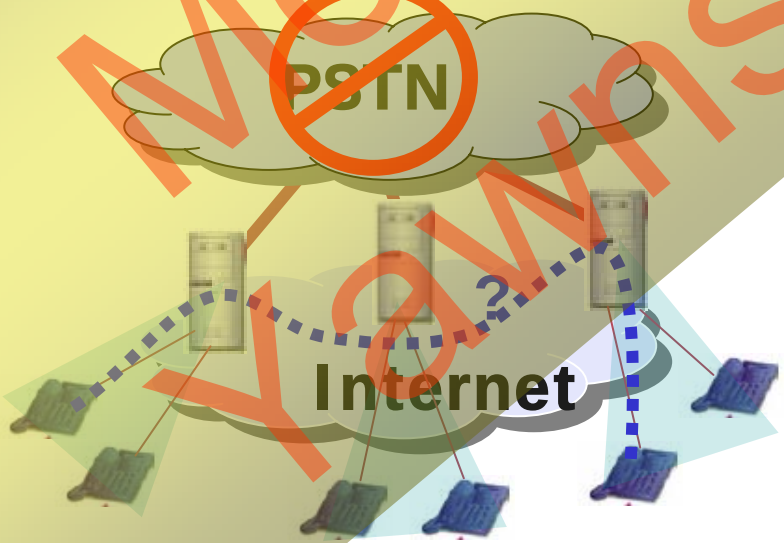
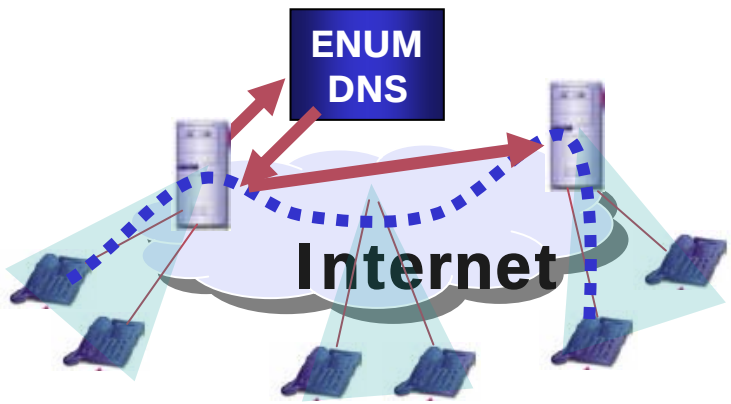


This too More Yawns!

The ENUM Approach

- Use the DNS Luke!
- It's a PSTN carrier default route bypass operation for VOIP-to-VOIP calls:
  - Identify the calling service
  - Lookup the ENUM DNS using the called number
  - Find a compatible terminating service URI
  - Connect directly to the URI over IP
- The DNS as a service rendezvous mechanism



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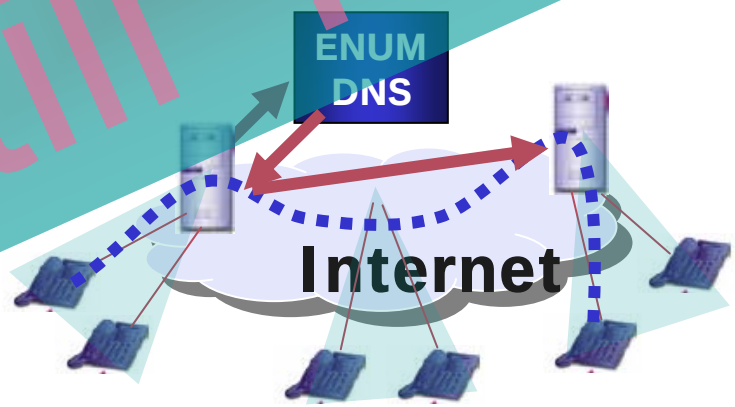


User ENUM

- It's a User-centric approach
- Its all about the end user's services and the end user's call termination type preferences
  - Opt-in model into the DNS
  - Contains end-user preferences for rendezvous services
  - Potential for multiple service providers to be referenced in a single DNS zone file
- It was intended to be useable technology, solving a real problem

Lets face it - User ENUM has been a dud!

- ENUM's initial impetus was fuelled from the DNS industry, not the VOIP industry
  - The dreams of ENUM becoming the universal identity token were maybe another instance of just incredibly wishful thinking on the part of a rabidly insane DNS industry
  - Just think – up to 1 billion domain name registrations to a captive market ☺
- Effective use of ENUM as a PSTN bypass has been limited by the lack of general admission of geo numbers into the ENUM framework
  - Making ENUM about as useful as VOIP walkie-talkies!

But Carrier VOIP is emerging

- IP represents a cheaper platform than TDM
- VOIP-based carriers are price agile in the market
- Legacy PSTN Voice providers are losing control of voice pricing
- Flat Rate Pricing beginning to dominate
  - Variable costs unacceptable
- VOIP Carriers beginning to demand bill and keep vs inter carrier compensation
  - Current inter-carrier accounting costs outrageous
  - The Internet model of transit and peering is about to be applied to voice traffic accounting

The VOIP Carrier's Perspective on ENUM ...

- Its not really about the end user's preferences
- Its about
  - call termination mechanisms that bypass the imposed inter-carrier SS7 paths and the PSTN
  - re-defining call accounting settlements to bypass traditional paths
  - number blocks, not individual numbers
  - inter-provider dynamics, not the end-user

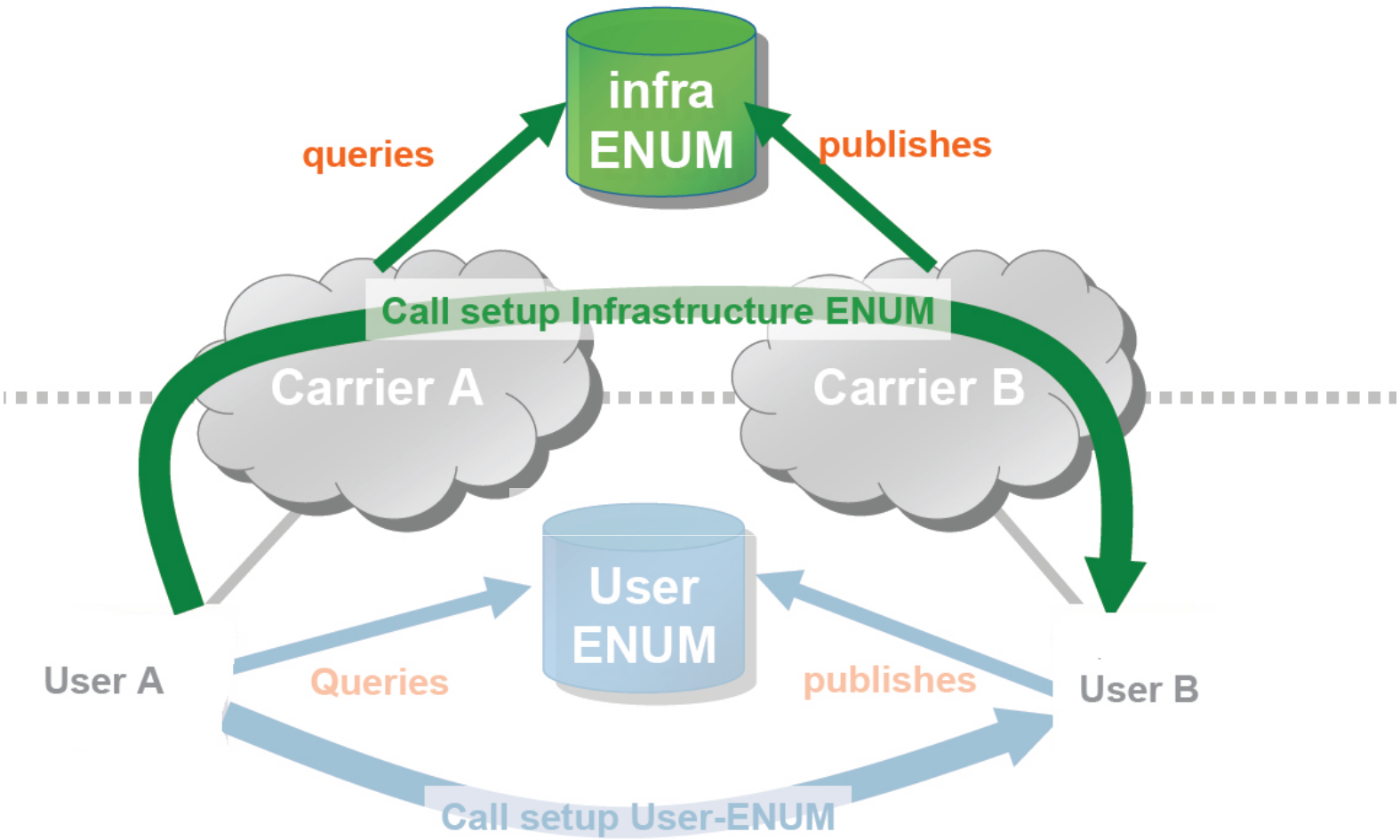
What's "Infrastructure" ENUM?

- Its for carriers to announce to other carriers a set of rendezvous points for terminating services
  - (International) PSTN Accounting Settlement Bypass
- Announce in some DNS tree the E.164 number set for which the announcer is the carrier-of-record
  - populate this I-ENUM DNS with the services that the carrier is willing to terminate for incoming IP-based service requests
  - Resolve carrier I-ENUM DNS queries to the IP rendezvous URIs that perform service termination in the terminating carrier's network

What's "Infrastructure" ENUM?

- Use the same ENUM technology, but now it's the carrier attempting to perform call completion with the terminating carrier:
  - Identify service
  - Lookup called number in the I-ENUM DNS domain
  - Find the terminating carrier's URI for a compatible terminating service for an enclosing number block entry
  - Pass the call to the other carrier's URI (via IP)

I-ENUM – the logical view



I-ENUM Requirements

- Carriers want:
  - Map called numbers (E.164 numbers) to rendezvous points as specified by the terminating carrier
    - IP or PSTN termination capabilities
  - Under the full control of the terminating carrier
  - Carrier is in the call flow for call termination
  - Number blocks as well as individual numbers to be mapped into I-ENUM
  - Minimal provisioning overhead
  - Minimal opex
  - Terminating Carrier has full control of I-ENUM entries
  - Both Originating and Terminating Carriers have full control of interconnection policies
  - Neither the number blocks, nor the services, nor the rendezvous points are necessarily public

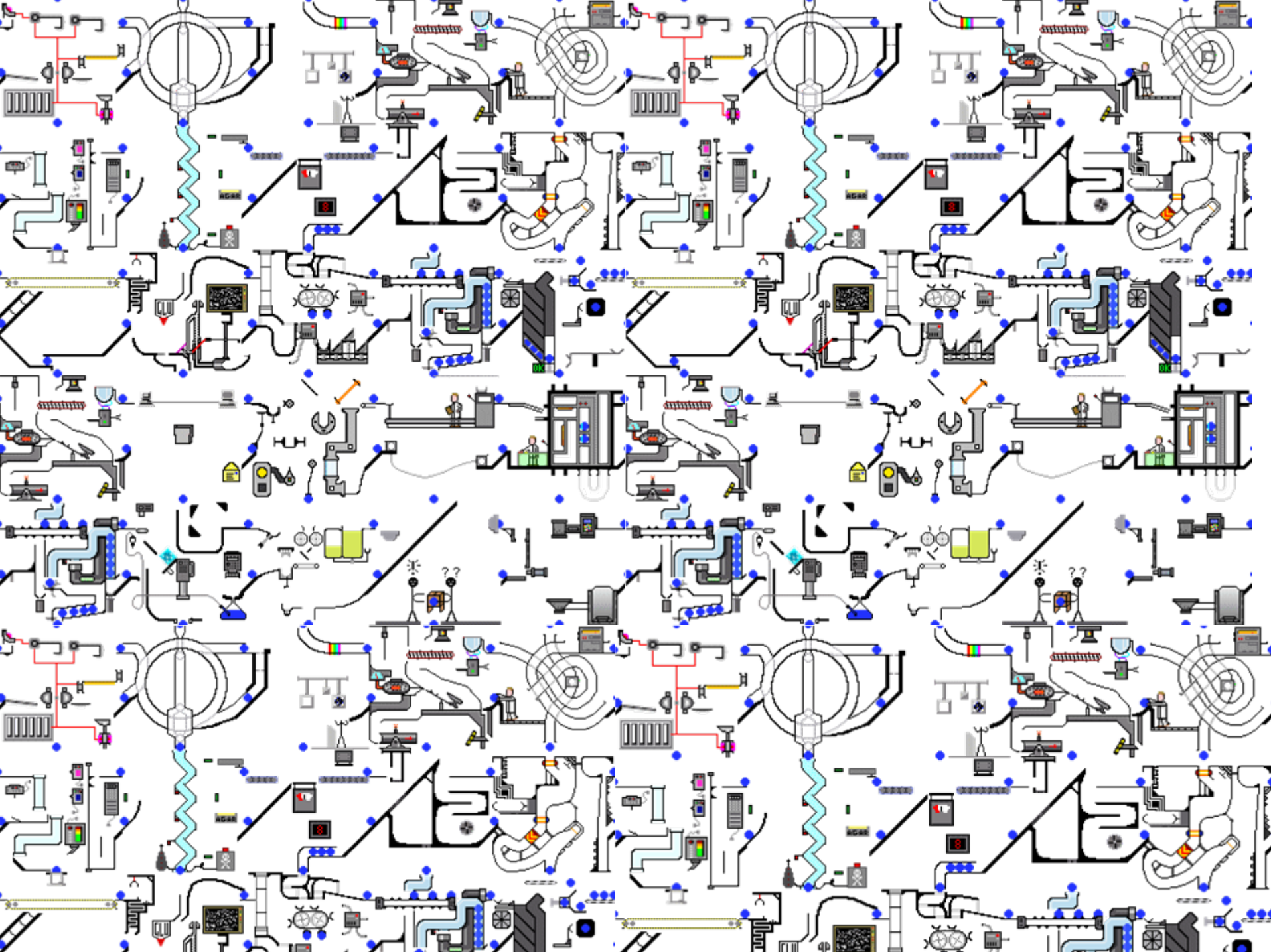
Status of I-ENUM

- Right now:
  - The VOIP industry thinks it knows what it wants
  - But we don’t yet agree on how to achieve it!

Approach A

- Leave it to the telco's to figure this out

Of course, don't forget that you are asking the Masters of Complexity to solve a simple problem – beware of what you ask for...



Approach B

- Leave it to the IETF to figure it out:
  - Generate Requirements documents
    (*wait*)
  - Generate Framework documents
    (*wait*)
  - Generate Solutions documents
    (*wait*)
  - Publish RFCs

    Is there anyone alive who can remember what was the original problem again?

Approach C

- Have everyone just do something
  - Or anything!
  - Because sometimes, if you are lucky, you can get away with labeling any form of activity as “progress”

百花齊放，百家爭鳴 *

- Split the DNS domains

  or

- Play even more games in the DNS with Resource Records and query sequences

  or

- Use private ENUM contexts

* *Let a hundred flowers bloom: let a hundred schools of thought contend*
Mao Zedong, 1956

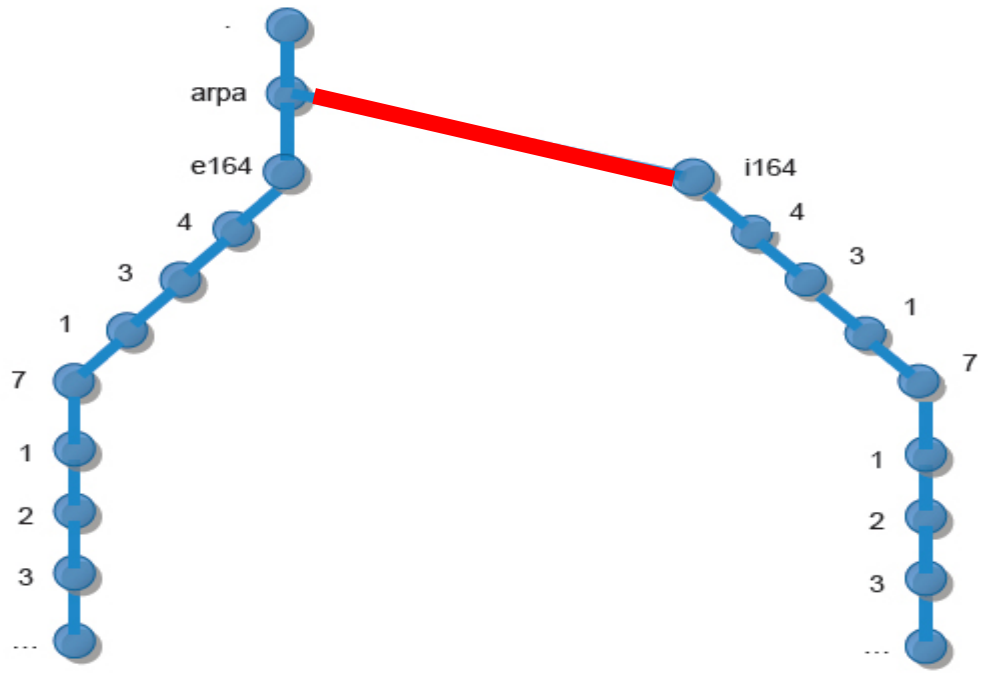
1. I-ENUM as a DNS hierarchy

- Use the same NAPTR DNS RR entries
- Use the same lookup mechanism to resolve a called number to a URI set
- Use the regular expression substitution capabilities of NAPTRs to use a general NAPTR RR to generate called-number-specific rendezvous URIs

- No change to ENUM RR records
- No change to NAPTR capabilities

I-ENUM – a possible approach

- Split I-ENUM into a new DNS tree
  - Use <number>.i164.arpa for i-enum



What's wrong with this picture?

- e164.arpa was hard
  - The split control between the ITU-T and the IETF was tough to set up and contentious to operate
  - The e164 number space is a political nightmare
    - Oddly enough, "countries" are a pain to deal with:
      - China, Taiwan and +886
      - North American Number Plan
  - The line data base is often in the hands of the ex-monopoly telco
    - These telcos see ENUM as a diabolical invention of a evil revenue-stripping deity that must be resisted

- So why would i164.arpa be any easier to pull off?
  - Why would any service provider ASK for more government intervention and regulation in the critical signaling infrastructure?
    - Choice of i164.arpa requires Govt approval and delegation
    - Isn't the telecom industry moving to deregulation?

But what's the real issue here?

- Each service provider wants to maintain the record entry for the services where they offer call termination to other service providers
  - We need to be careful about biasing I-ENUM for a single vertically integrated service provider world
    - How do you publish routing information in the DNS?
    - How do you offer different routing views to different parties?
  - How do you solve the problem for multiple service providers to maintain their service record within the same delegation zone in the DNS?
  - With I-ENUM how do you know that 2 DNS ENUM trees are enough? Is 4 a better number? or 42?
- If 1 ENUM tree is not enough, how many is 'enough'?

We've been here before...

- This is not a new concept:
  - **tpc.int** (1993) used A records in a DNS tree to create a fax service that bypassed the truck PSTN
  - A messaging pager service was added, using A records in a new subtree: **pager.tpc.int**
  - More services added to tpc.int implied the need to create more **<service>.tpc.int** DNS trees and new service deployment networks
  - Ergo, ENUM
    - Combine **all** services associated with a number endpoint into a single zone, and "neutralize" the DNS tree

Back to the Future

- So I-ENUM via a new DNS hierarchy wants to do this again, using <service>164.arpa trees
  - But this was precisely the “problem” with tpc.int that ENUM was intended to solve!
  - So can we do the same ENUM approach at the leaves of the DNS tree rather than reverting to service-specific tree replication?
  - i.e. is the service embedded in the DNS name, or is the service a RR entry at the leaf of the DNS?

2. Games with DNS NAPTR RRs

- The user has the ability to delegate service records for individual services
- Add NAPTR records with the ‘d’ flag
  - The replacement DNS string is used as a lookup the URI record for this string
  - Take the replacement field, not the regular expression, prefix the replacement field with the service field content, which is prefixed with an underscore (just like SRV records)
- This is another level of DNS indirection
  - Allow delegations per service
  - Or allow for other service delegations
- Provide the distinction in the DNS between the queries:
  - What services exist for this domain?
  - What URI should I use for this service?

Example

```
$ORIGIN 3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.

      NAPTR 10 100 "u" "E2U+sip" "!^.*$!sip:info@example.com!"  .
      NAPTR 10 102 "u" "E2U+msg" "!^.*$!mailto:info@example.com!"   .

      NAPTR 10 100 "d" "E2U+sip" "" 3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.
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$ORIGIN _e2u.3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.
      _sip   NS  sipservice.example.com
      _msg NS  mailservice.example.com

$ORIGIN _sip._e2u.3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.

      . URI 10 10 "sip:info@example.com"
      . URI 10 10 "sip:info@example2.net"

$ORIGIN _msg._e2u.3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.

      . URI 10 10 mailto:info@example.com
```
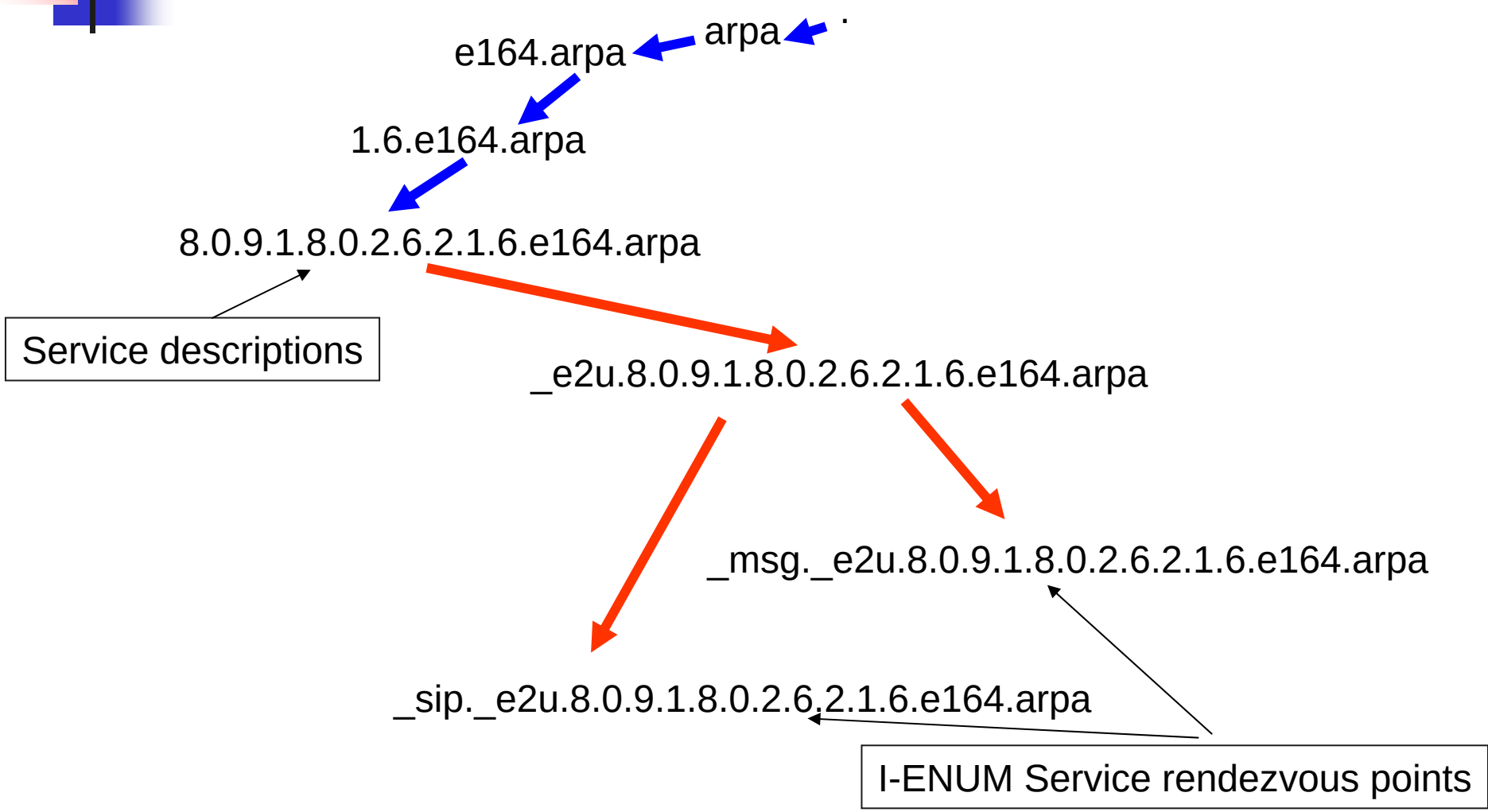

Delegation Structure



The Good, the Bad, and the Ugly

Good

- Does not need endlessly replicating ENUM trees for each service type, sub-service type, meta-service type,...
- Does not require multiple service entities attempting to maintain records in a shared DNS zone

Not so Good

- Another Resource Record in the DNS
- Another layer of indirection in the DNS

Bad

- Exposes inter-carrier service termination points to public view
- Exposes inter-carrier signalling into the public IP network

Ugly!

- Requires carrier delegations at the end-point of the single ENUM delegation tree
  - What happened to number blocks?

What does the Carrier really want out of ENUM?

- Discover the terminating carrier's service capabilities
- Discover the terminating carrier's preference for service rendezvous URIs

- And **not** to disclose this signalling and the signalled information to every hacker/evil party on the planet
  - Can you say "DOS?"
  - And how many ways can you say "DOS"?

- And to disclose different information to different carriers
  - Can you say "bilateral"?

- To execute an SS7 financial bypass
  - Can you say "money"?

3. Private I-ENUM

- Each carrier achieves its numbers, services, and termination points in a private world of contracts and bi-lats:
  - Use private DNS roots
  - Use DNS filters
  - Use DNS selective responses to each carrier
  - Use shielded rendezvous points
- DNS technology is about the cheapest and most efficient distributed database we've managed to figure out
- Use DNS technology, but alter the publication model, to suit the actual business need for fine-grained bilateral control of service and policy interaction

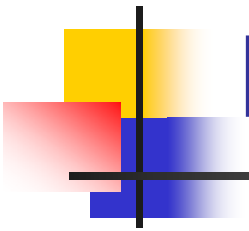
So what is gained, and who gains, by making this carrier interconnection information public through publication in the public DNS?

一花独放，一家主鸣 *

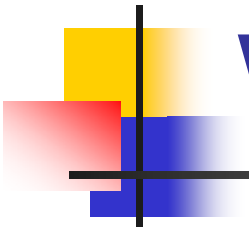
- I suspect that there is no clear agreement about the merits of I-ENUM beyond Private ENUM bilats
  - Private bilats have a long and respected history in this industry
    - Private contracts, private interconnects, private rendezvous points
  - And no carrier is really willing to disclose their number blocks and service rendezvous points to the great unwashed masses
  - And private ENUM is now replete with vendors, products, customers and carrier users

** Let one flower bloom; let one school of thought prevail*

But Wait – There's More!



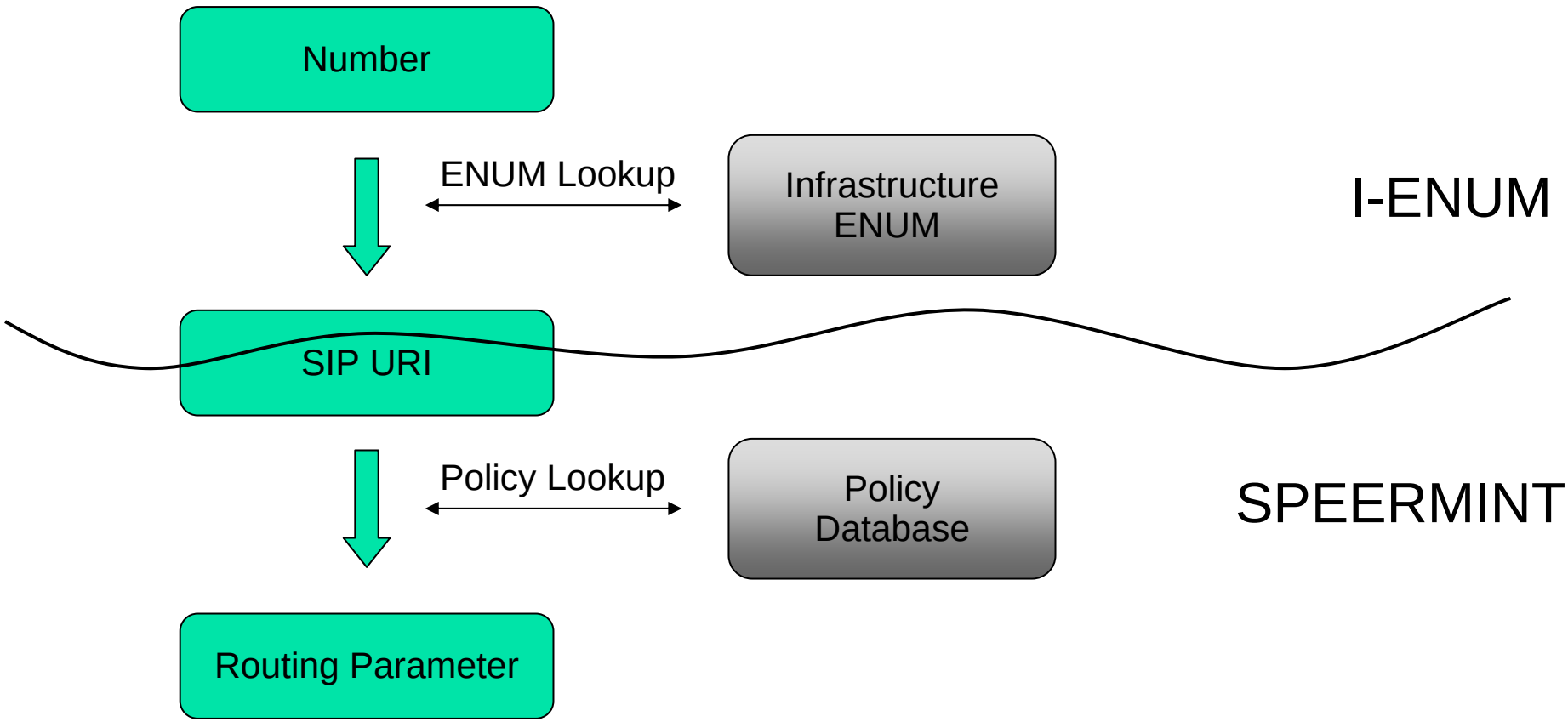
- You can't let those precious VOIP packets be passed around just anywhere
- Obviously, you need to hand-craft special policy-based routes here, don't you!



Which leads to…

- VOIPEER and SPEERMINT
  - Technology frameworks that attempt to paste QoS and policy-based forwarding elements into the IP forwarding plane

Scope: ENUM and SPEERMINT



CAUTION: You've just entered the NGN twilight zone!

There are so many curious (or bizarre!) aspects to this form of policy-based traffic and service management overlays that this is best left for someone else, as another topic !

Thanks

Questions?