



A Contrarian view of ENUM

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Acknowledgements

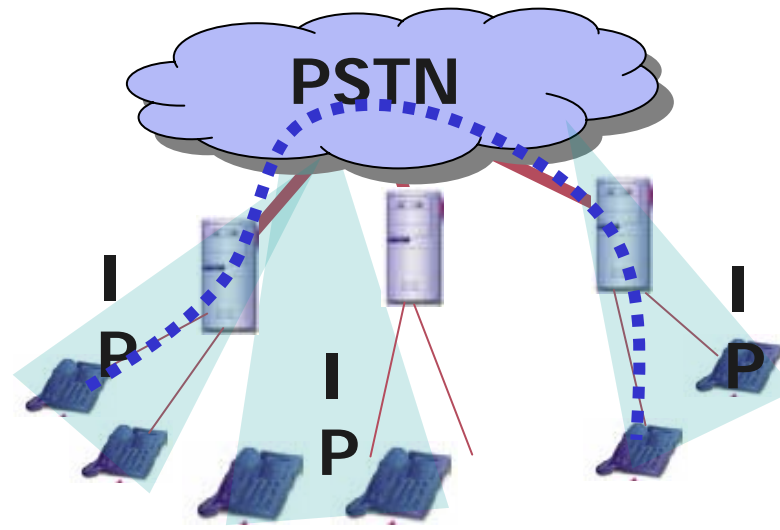
- Thanks to
 - Patrik Fältström
 - Olaf Kolkman
 - Robert Schischka
 - Richard Stasny
 - Richard Schockey

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

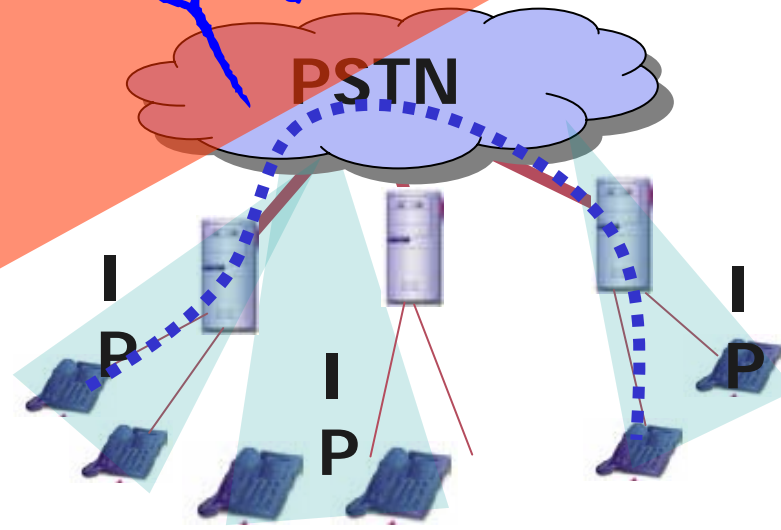
VOIP without ENUM

- 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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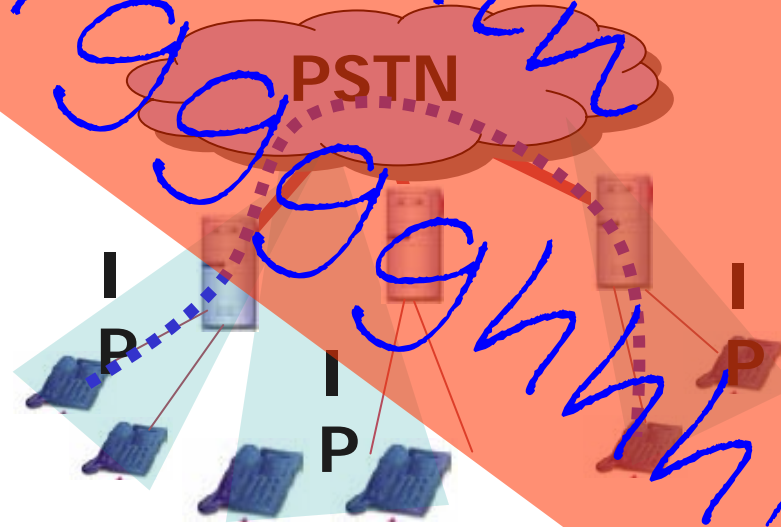


I've seen this before!

Yawn!

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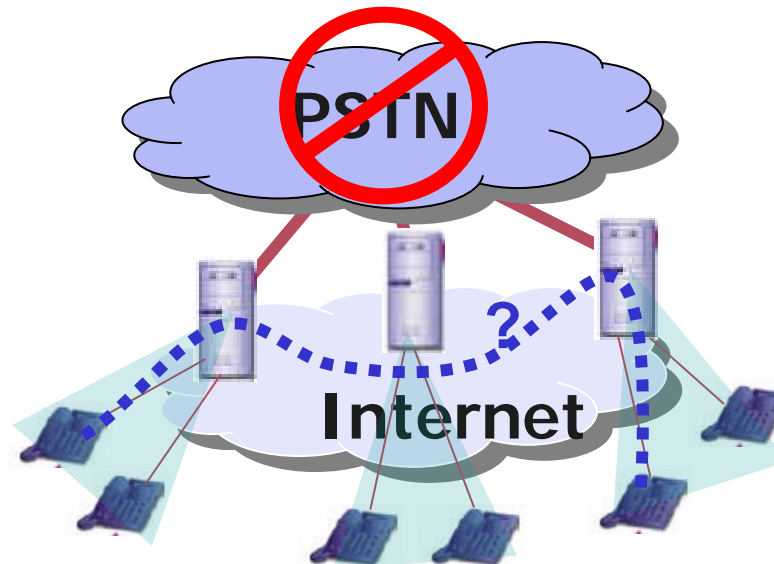


And I'll probably see

As a way to gain

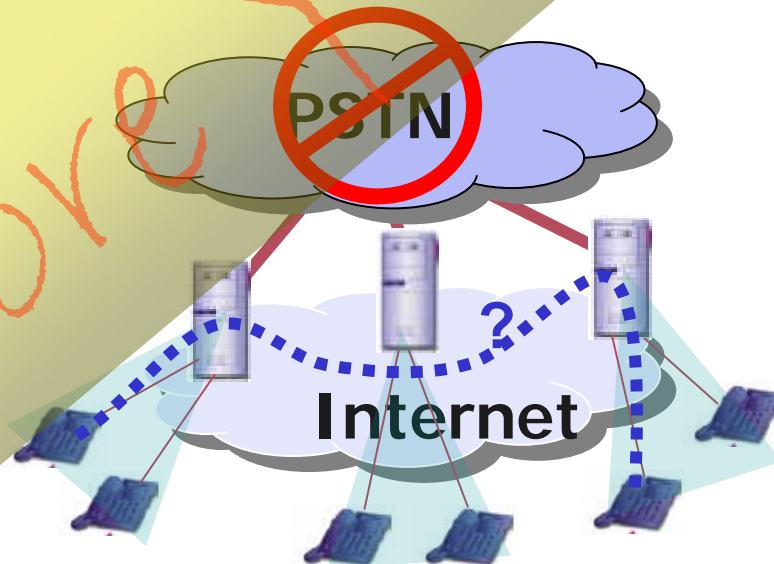
The Core ENUM Problem

- 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?



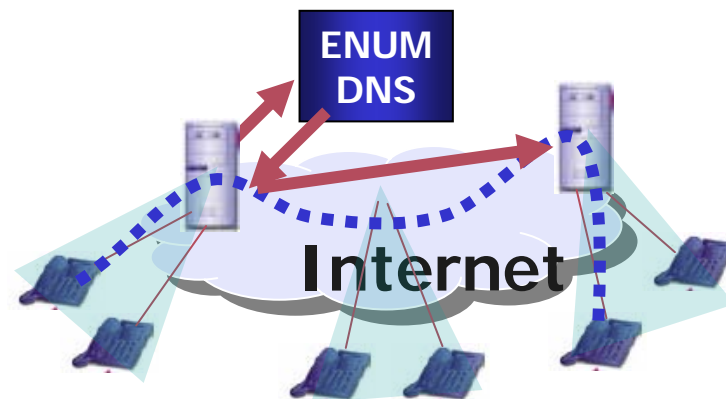
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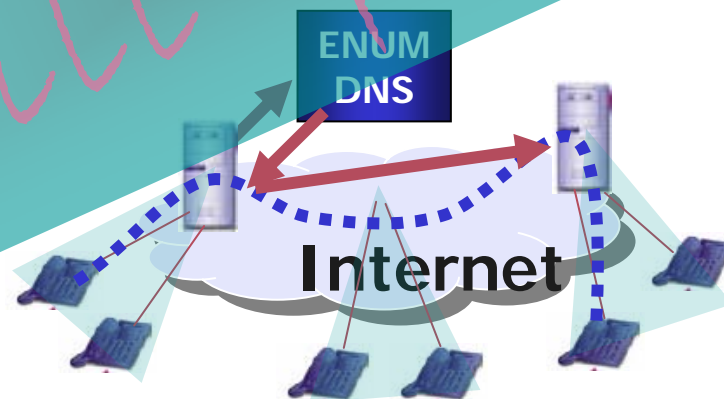
The ENUM Approach

- 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



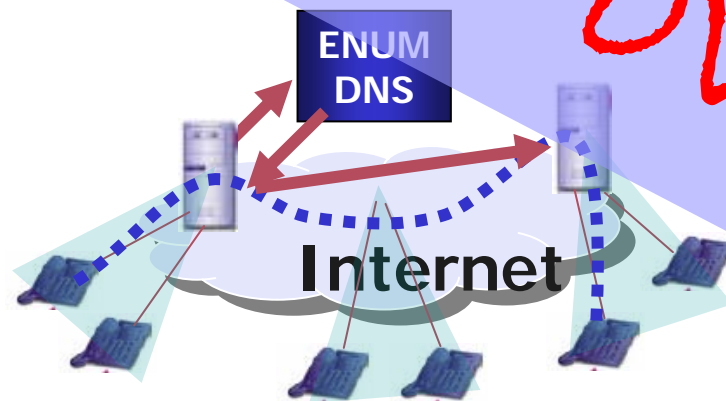
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Wake me up
When it's over!



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?

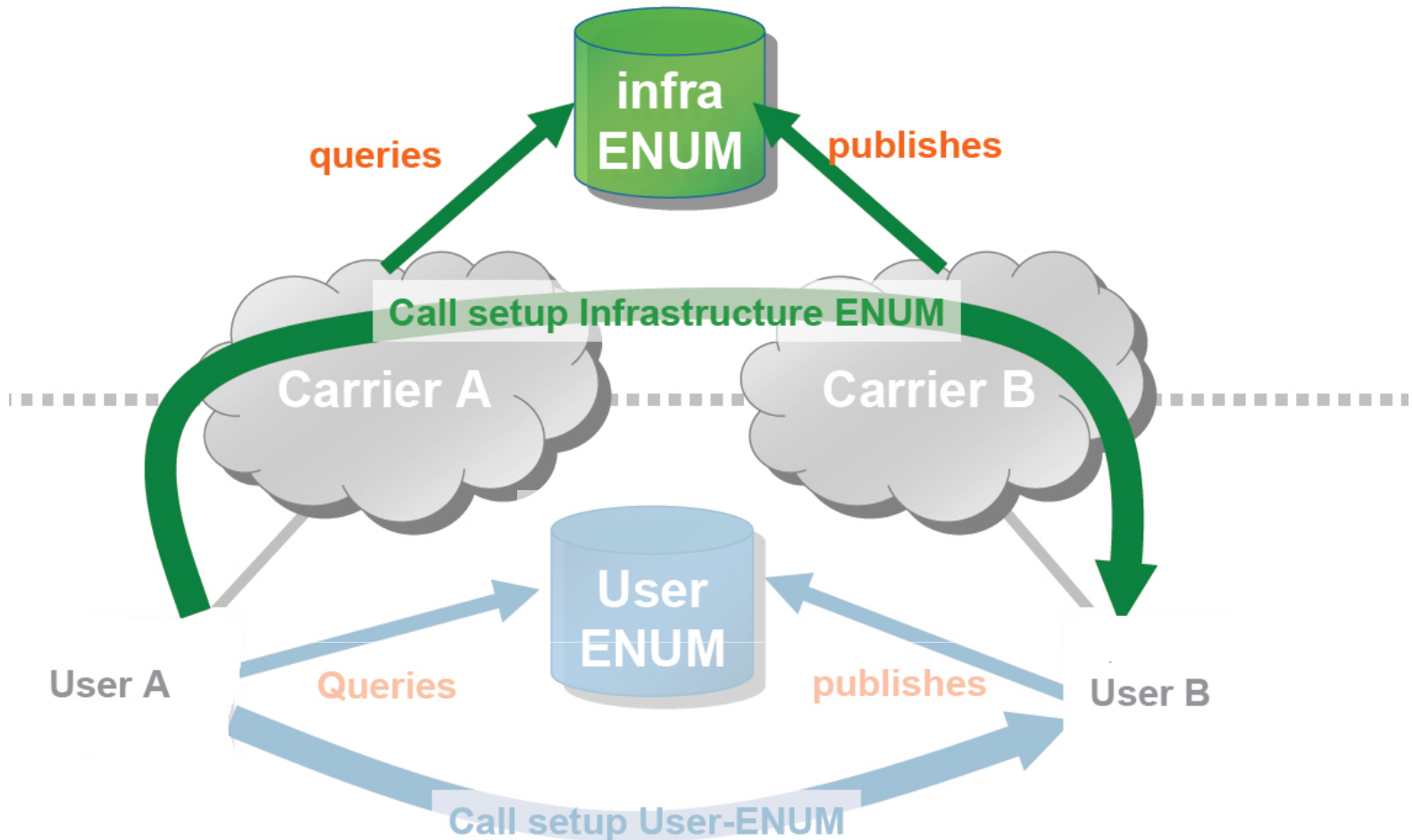
- Its for carriers to announce to other carriers a set of rendezvous points for terminating services
 - (International) PSTN Accounting Settlement Bypass
- Announce in some DNS tree the E.164 number set for which the announcer is the carrier-of-record
 - populate this I-ENUM DNS with the services that 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

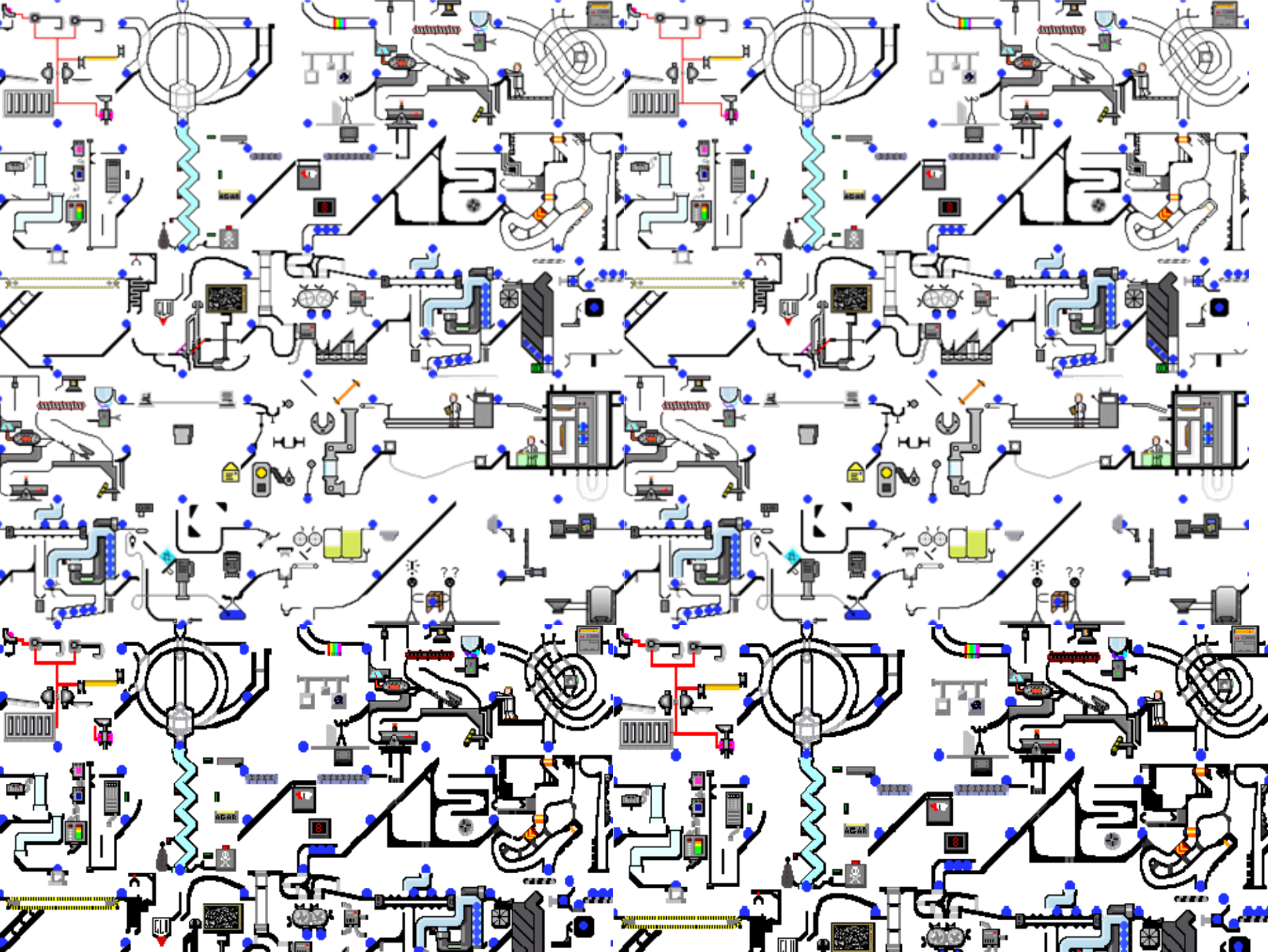
- Right now:
 - The VOIP industry thinks it knows what it wants
 - But we don't yet agree on how to achieve it!



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

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- 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



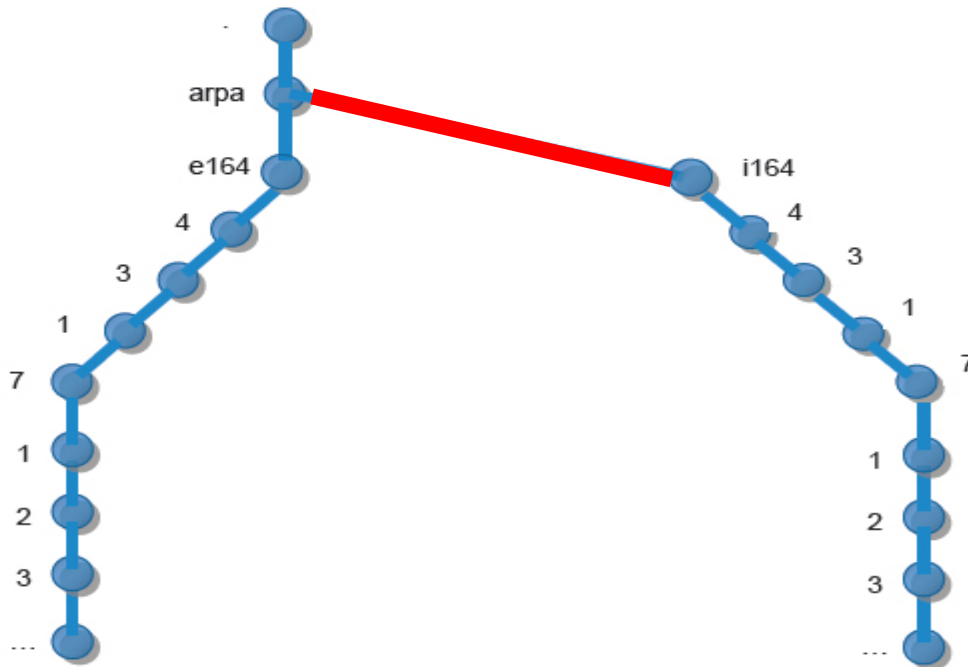
1. I-ENUM as a DNS hierarchy

- 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.
```

```
NAPTR 10 102 "d" "E2U+msg" "" 3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa.
```

```
$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.
```

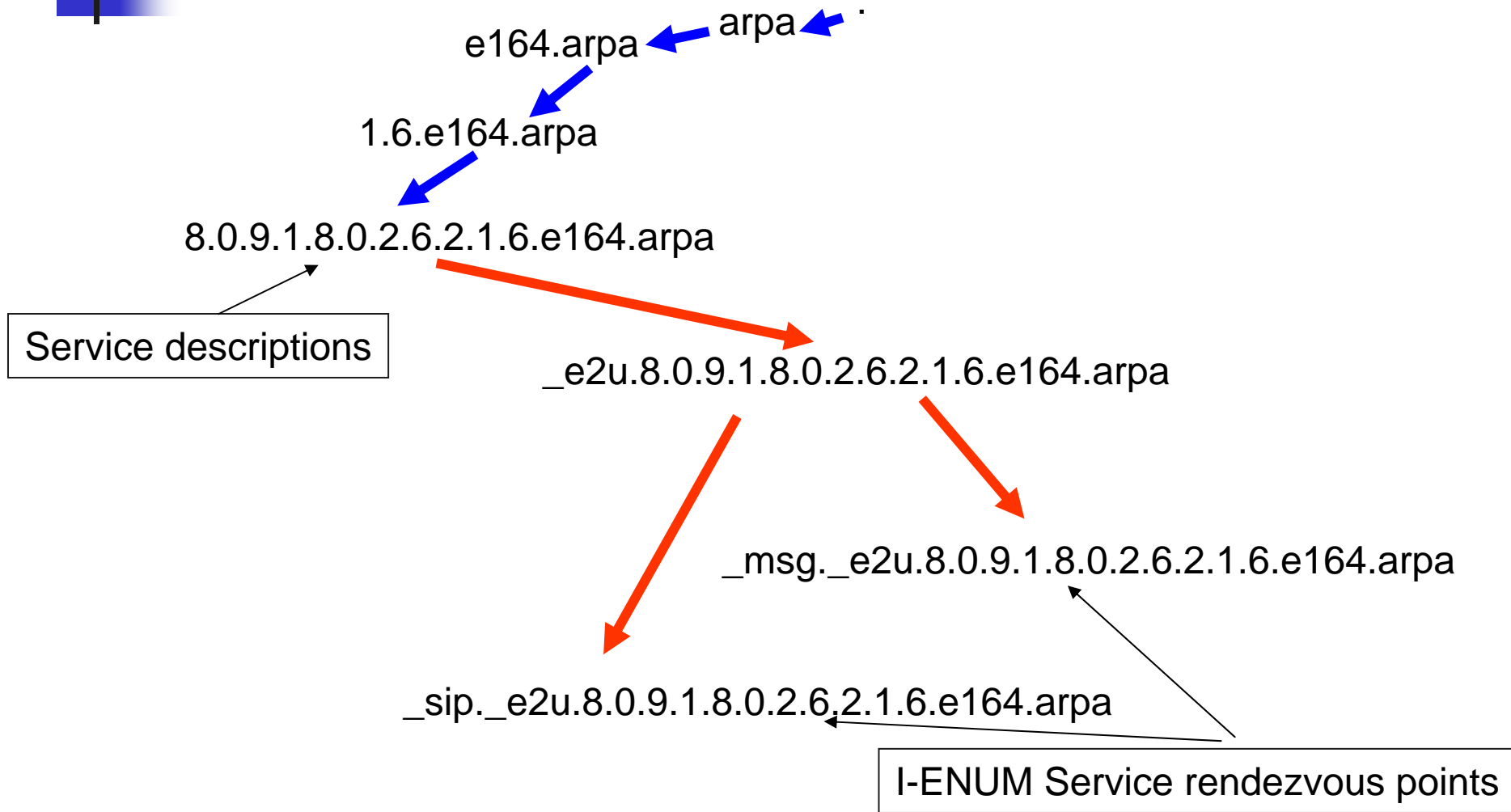
```
. URI 10 10 "sip:info@example.com"
```

```
. 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



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!

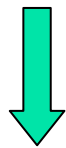


Which leads to...

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

Scope: ENUM and SPEERMINT

Number

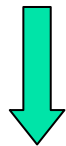


ENUM Lookup

Infrastructure
ENUM

I-ENUM

SIP URI



Policy Lookup

Policy
Database

SPEERMINT

Routing Parameter



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?