

ENUM Workshop

June 4, 2007

Berlin

May I introduce myself

My name is Adrian Georgescu



- Founder and CEO of AG Projects
- Member of OpenSER management board
- Co-chair of Dutch SIP SIG working group

The audience

Vendors: 1

Fixed line operators: 2

ISPs: 1

Regulatory: 5

DNS Registry: 3

Consultants: 1

My today's workshop agenda

Part 1

- What is ENUM
- Interaction between ENUM and other systems
- Migrating from SS7/IN to SIP/ENUM architectures
- Answering your questions

Coffee break

Part 2


- Business opportunities for ENUM
- Answering your questions

Part 1

What is ENUM

What is ENUM

ENUM maps a telephone number to another address and protocol
Given an E.164 number, ENUM returns one or more mappings

+40317105169  sip:ag@ag-projects.com
mailto:ag@ag-projects.com

ENUM is an addressing and numbering system

What is ENUM

There is a fundamental difference between how addressing and numbering systems work on PSTN as opposed to the Internet.

On PSTN

- the source is responsible for finding a path to the destination network based on a least cost routing logic (provisioning at source)
- name queries are performed while in the middle of a call setup

On INTERNET

- the destination is responsible for managing its own name space and how it is reachable
- name queries are performed before doing the actual call setup

What is ENUM

Existing mechanisms for realizing number portability on SS7:

- ONWARD ROUTING (OR)
- CALL DROPBACK(CDB)
- QUERY ON RELEASE (QoR)
- ALL CALL QUERY (ACQ)

ENUM is an “All call query” mechanism on IP networks for the originating network or device to determine the final destination prior establishing the call. ENUM is **a solution for implementing number portability on IP networks.**

What is ENUM

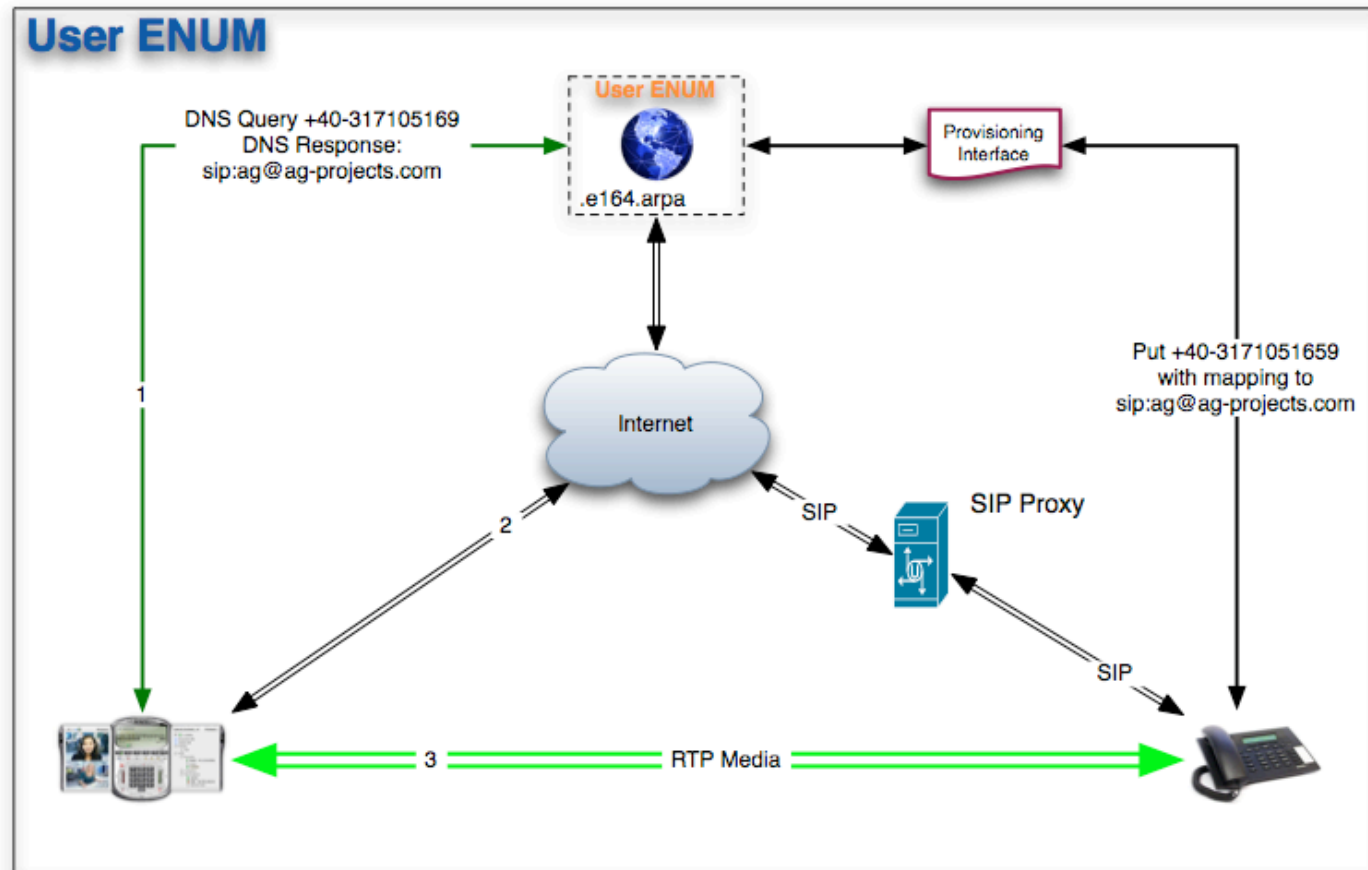
ENUM was originally intended for end-users:

- to add their existing telephone number (opt-in)
- to subscribe to an IP telephony service from a third-party
- to manage their own subscription
- numbers are visible on the Internet (in e164.arpa domain)

This is called **User ENUM**

What is ENUM

This is now called **User ENUM**



What is ENUM

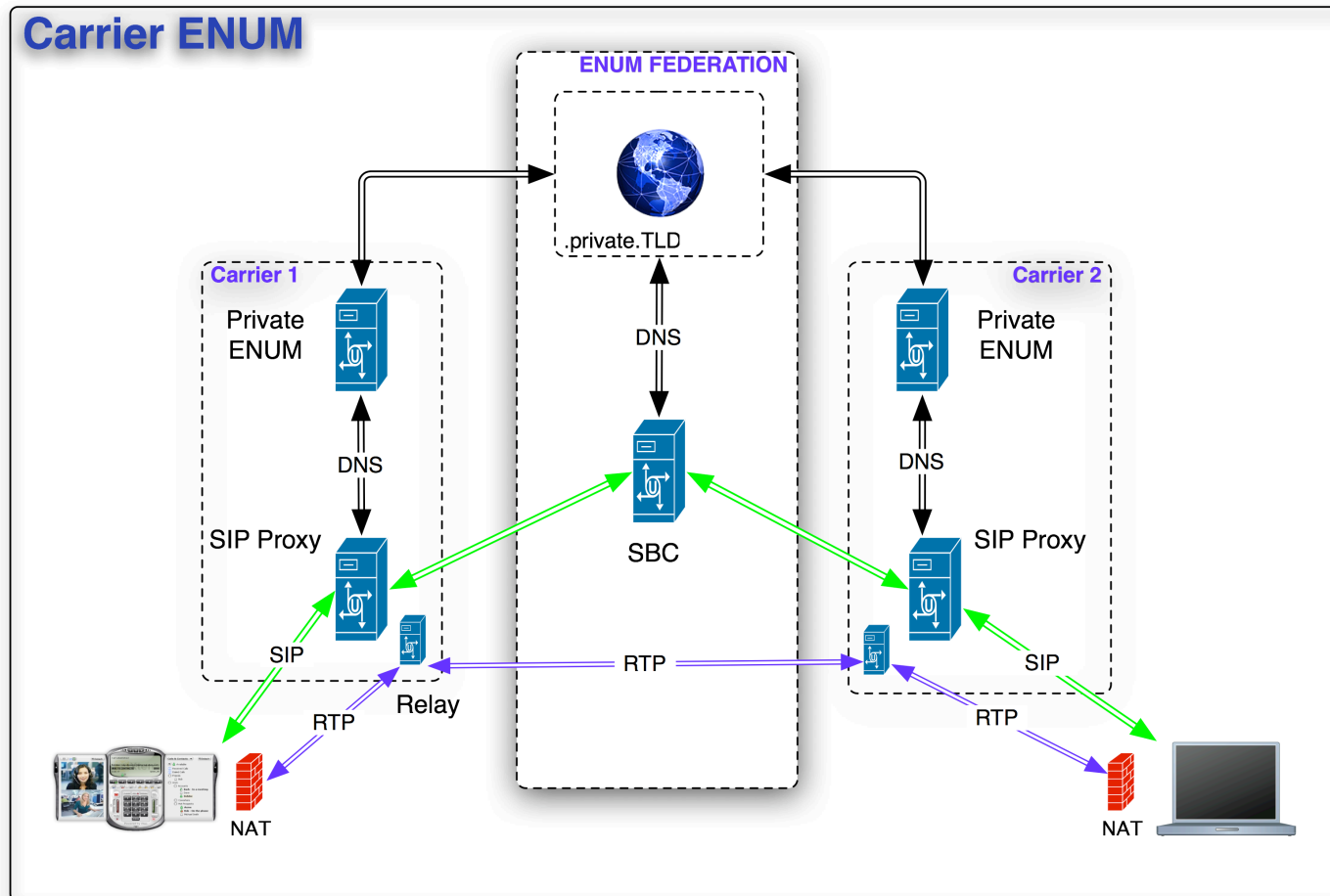
ENUM is now mainly used by carriers and their inter-domain routing

- get me carrier X (on IP) for number Y
- if no IP carrier is found, fall back to the PSTN
- provision all the numbers they service without end-user intervention
- share these numbers to authorized peers (grouped in the form of a federation)
- numbers are not visible on the Internet (private domains)

This is called **Carrier ENUM**

What is ENUM

This is now called **Carrier ENUM**



ENUM architecture

- On Internet, addressing layer is decoupled from the transport layer
- DNS is the global addressing system of the Internet
- DNS is a simple query/response mechanism for a scalable and distributed database
- DNS queries are performed before attempting connect to the remote application
- Standard DNS clients available in all IP devices can be used for ENUM resolution

ENUM is using DNS as a data model and query response mechanism

DNS tutorial on two slides

Where is www.google.com?

Query the DNS for www.google.com

:: ANSWER SECTION:

www.google.com.	600818	IN	CNAME	www.l.google.com.
www.l.google.com.	91	IN	A	64.233.183.99
www.l.google.com.	91	IN	A	64.233.183.103
www.l.google.com.	91	IN	A	64.233.183.104
www.l.google.com.	91	IN	A	64.233.183.147

The application (a web browser in this example) chooses 64.233.183.147 and establishes connection with the Google server.

DNS records used by ENUM

DNS uses the concept of record types. Examples:

1. A records - provide the IP address for a name
2. MX record - provide the mail server for a domain
3. NS records - provide the name server for a domain
4. SRV records - provide the IP address and port number for a specific service for a domain

NAPTR record type has been standardized to convey the information mapped to an E.164 number

What is a NAPTR record

- A way to store E.164 numbers and associated data in DNS
- Data describes how an E164 number maps to a list of destination/service combinations and with which priority

What is a NAPTR record

Telephone number: +31208005169

ENUM name: 9.6.1.5.0.0.8.0.2.1.3.e164.arpa

Inverted phone number TLD

9.6.1.5.0.0.8.0.2.1.3.e164.arpa. 3600 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

Query class (Internet)

Query type

Order

Preference

Flag: Output is URI

Service name (E164
to URL) and protocol

Greedy search

Replacement NAPTR
Resource Record for
next DNS resolution

Delimiter

ENUM services

Service Name	Service Type	URI schema
E2U+SIP	SIP	sip:, sips:
E2U+pres	presence	pres:
E2U+mailto	email	mailto:
E2U+fax	fax	tel:
E2U+sms	sms	tel:, mailto:
E2U+ems	ems	tel:, mailto:
E2U+mms	mms	tel:, mailto:
E2U+H323	H.323	h323:

Interaction between ENUM and other systems

- Interaction with Tier 0/1 registries (delegation of DNS zones)
- Interaction with service providers (record provisioning)
- Interaction with signaling and switching equipment (SIP)
- Interaction with the local number portability database (regulatory)
- Interaction with DNS servers and clients (name queries)
- Interaction with billing systems (flat fee against per minute charges)

Interaction between ENUM and other systems

- ENUM looks simple in technical terms and it becomes complex when it comes to implementation
- The reason for the complexity is that ENUM provides a mapping between name spaces managed by different authorities
- This means a lot of involvement from many entities to make it happen

Interaction between ENUM and other systems

9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

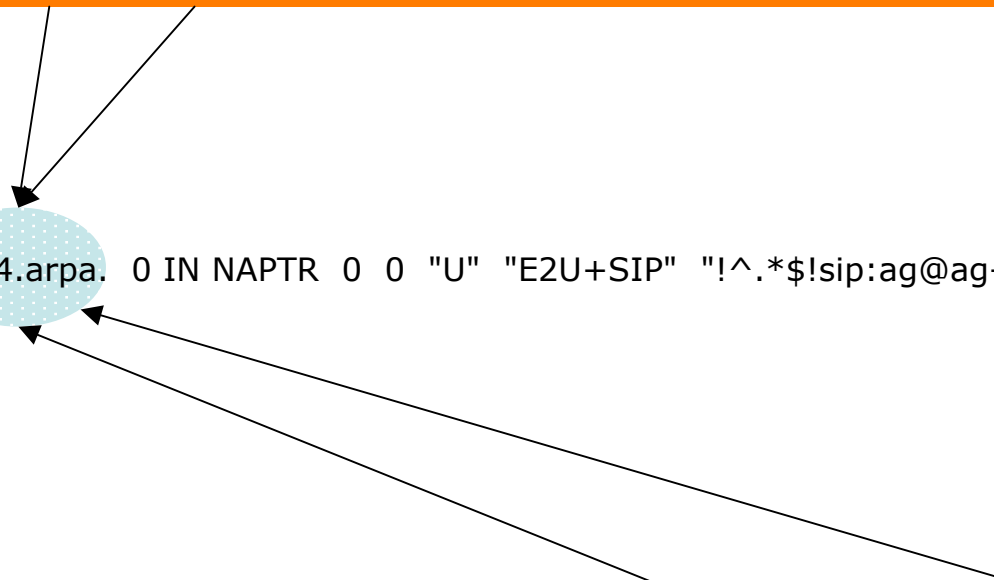
Interaction between ENUM and other systems

ITU RIPE

9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

DNS

WHOIS



Interaction between ENUM and other systems

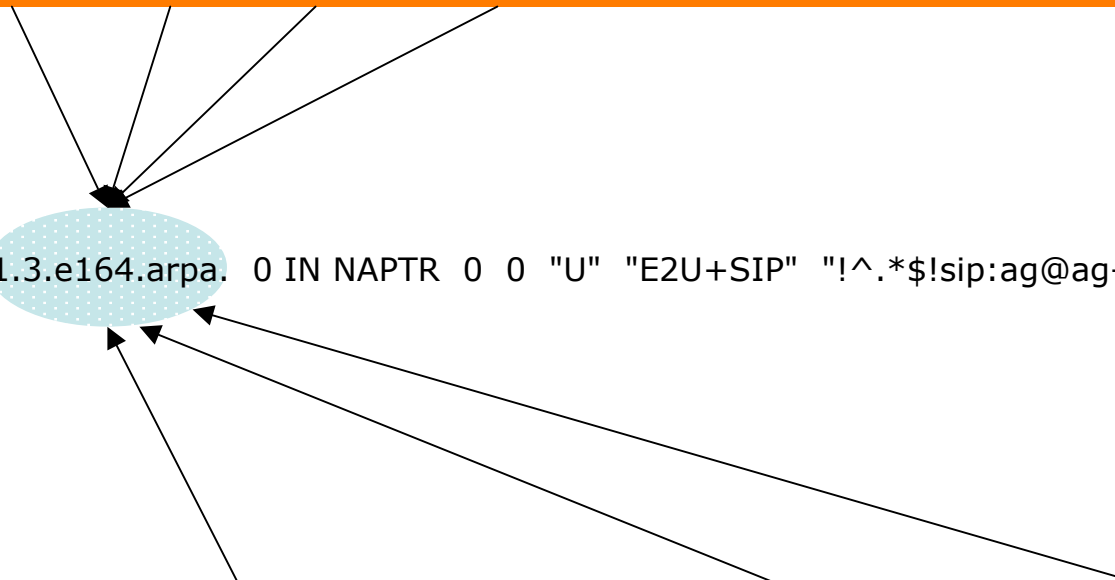
OPTA ITU RIPE SIDN

9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

IN

DNS

WHOIS



Interaction between ENUM and other systems

Telco OPTA ITU RIPE SIDN

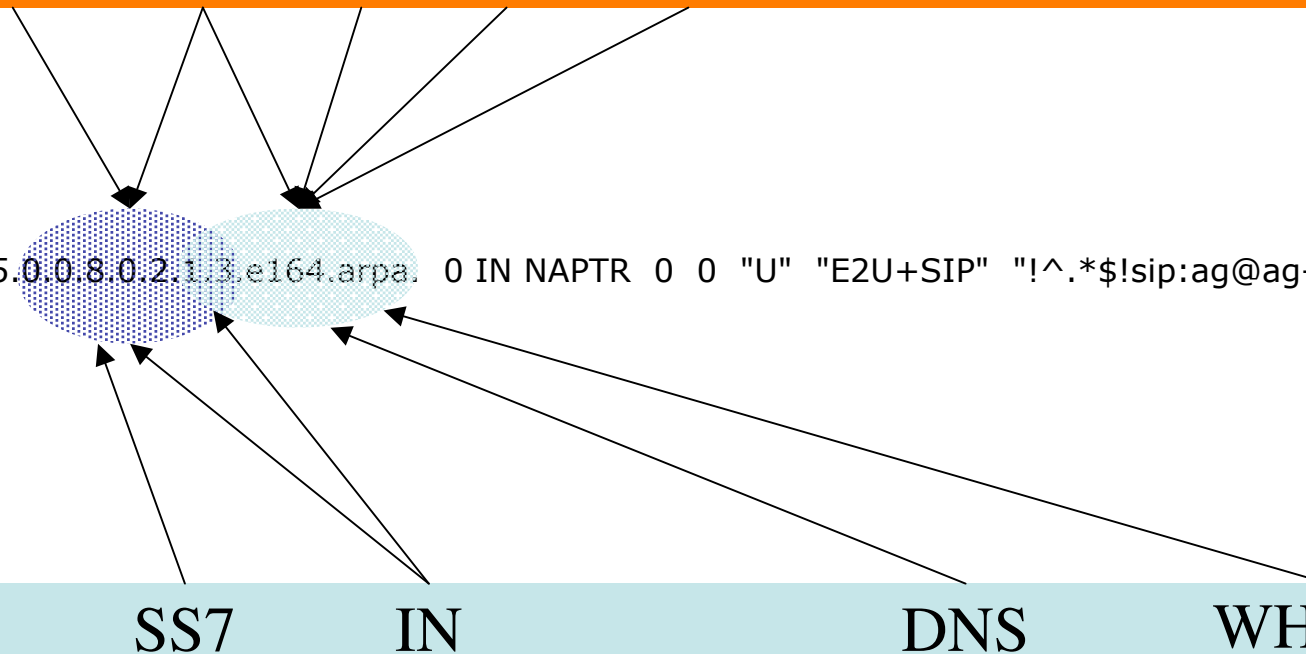
9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

SS7

IN

DNS

WHOIS



Interaction between ENUM and other systems

Telco OPTA ITU RIPE SIDN

9.9.2.5.0.0.8.0.2.1 3e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

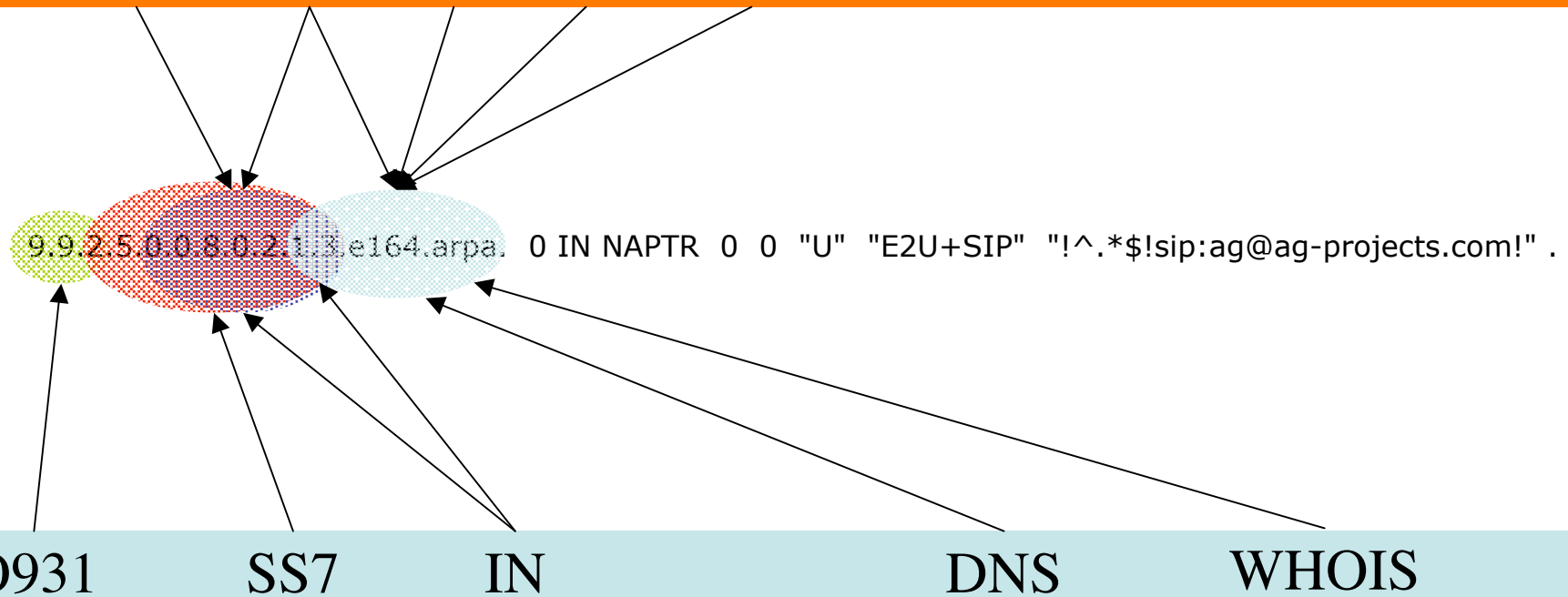
Q931

SS7

IN

DNS

WHOIS



Interaction between ENUM and other systems

User Telco OPTA ITU RIPE SIDN

9.9.2.5.0.0.8.0.2.1.3+164 arpa 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

+31-20-8005299

Q931

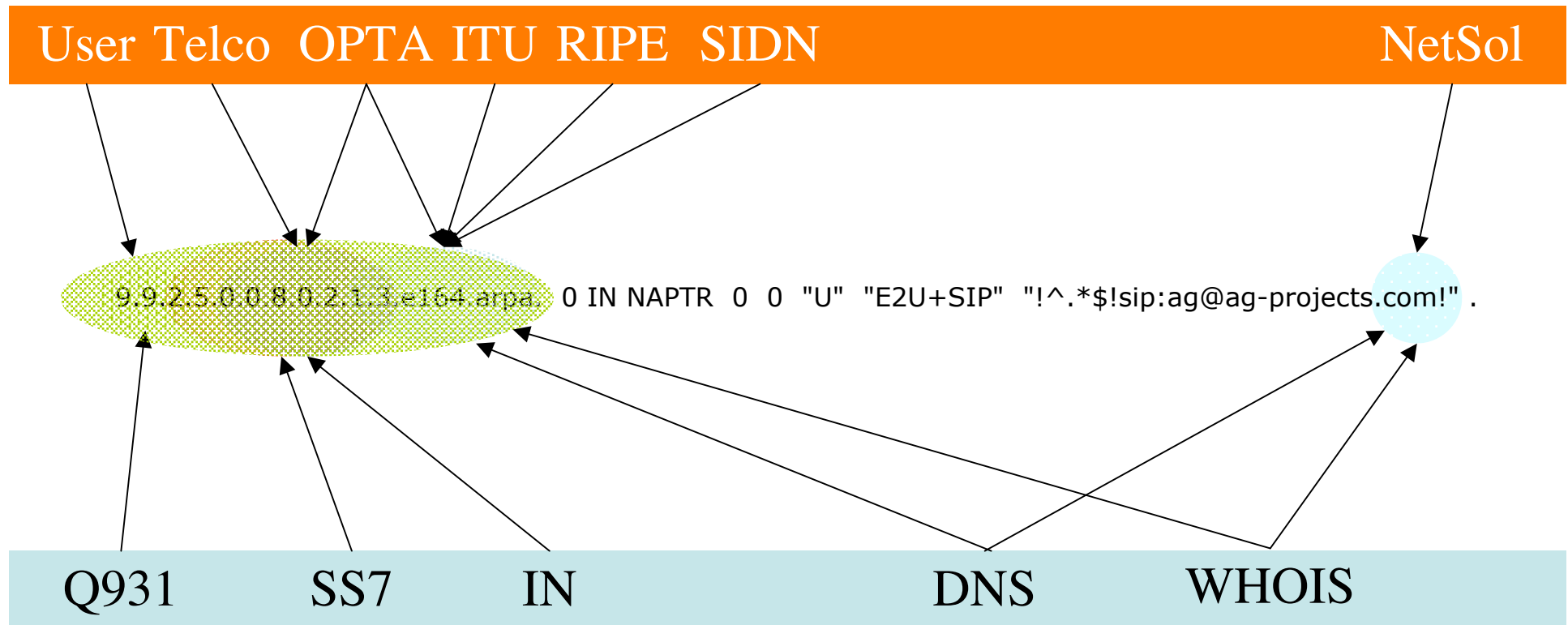
SS7

IN

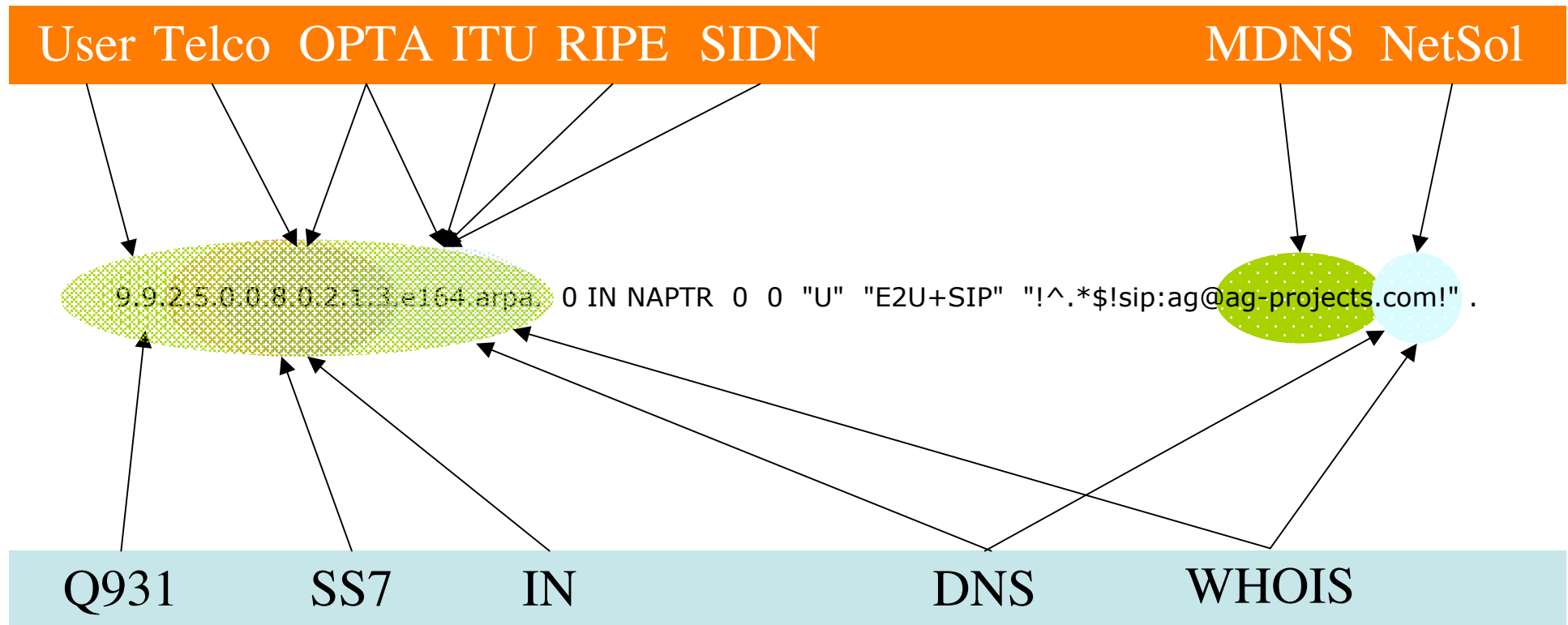
DNS

WHOIS

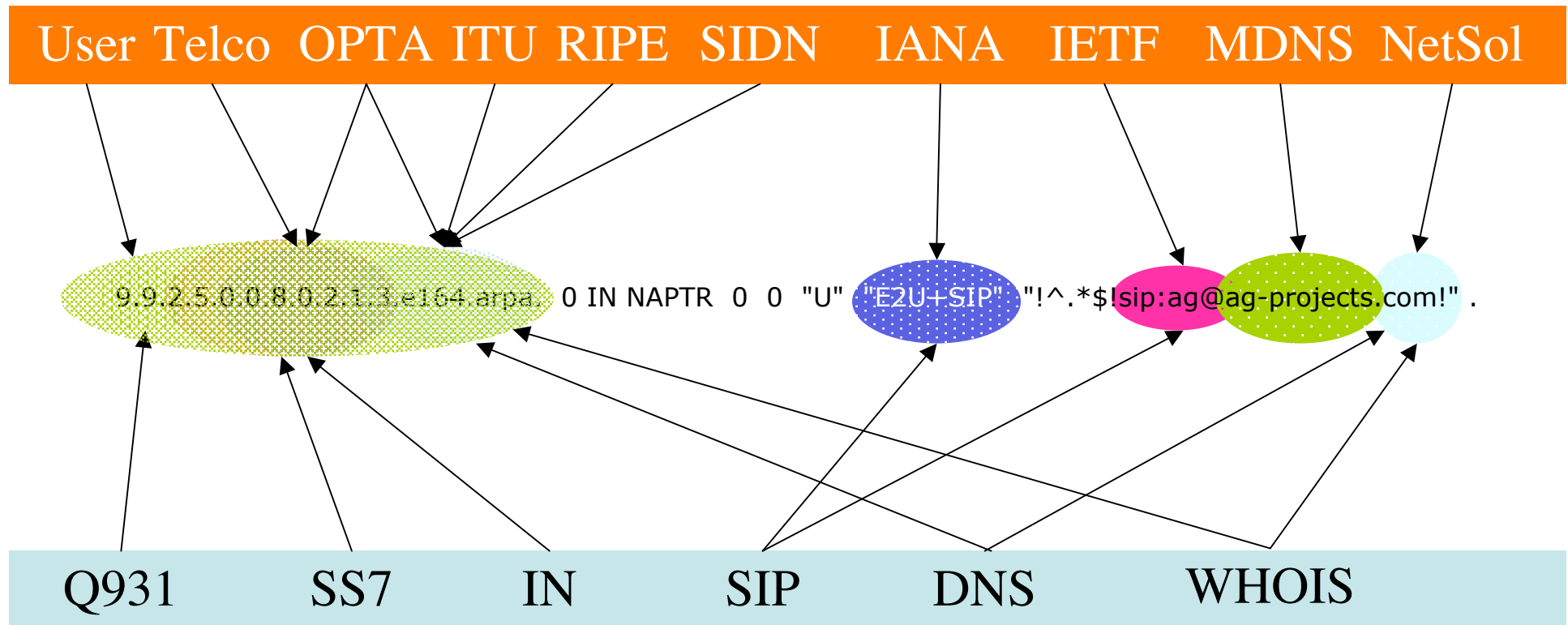
Interaction between ENUM and other systems



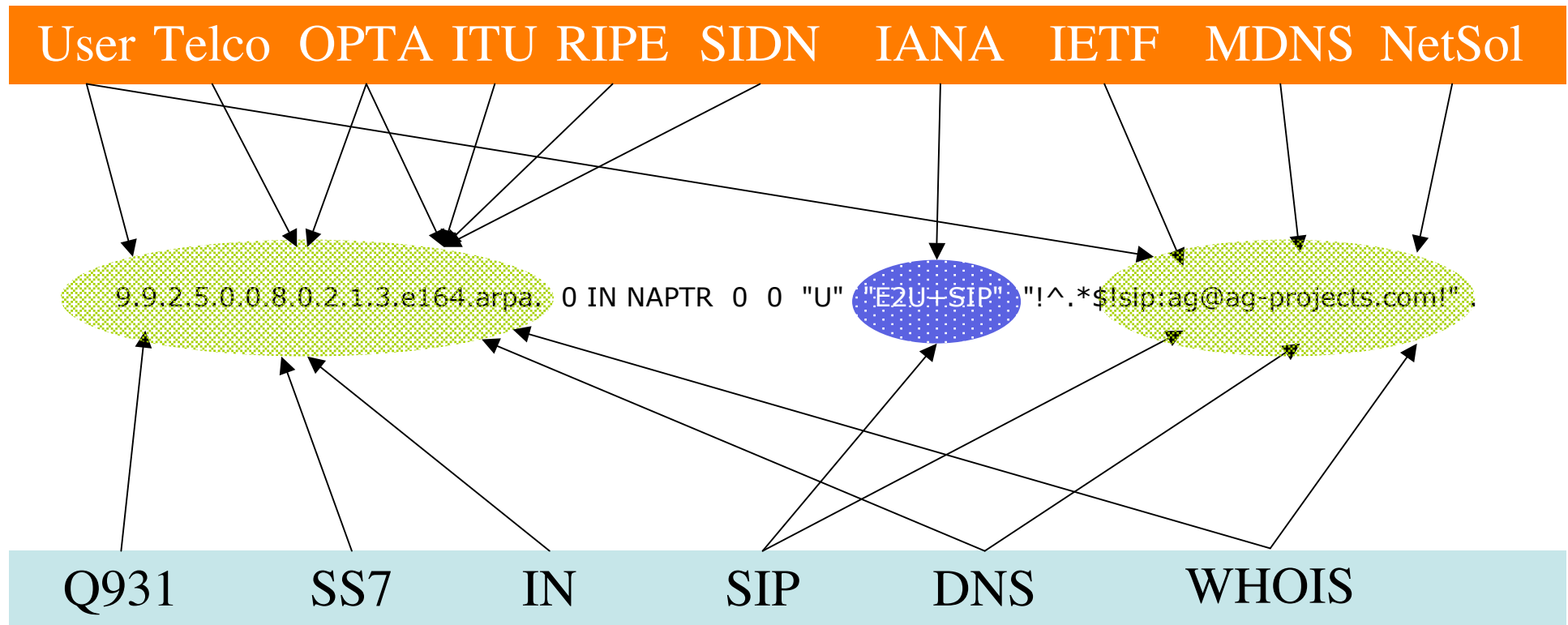
Interaction between ENUM and other systems



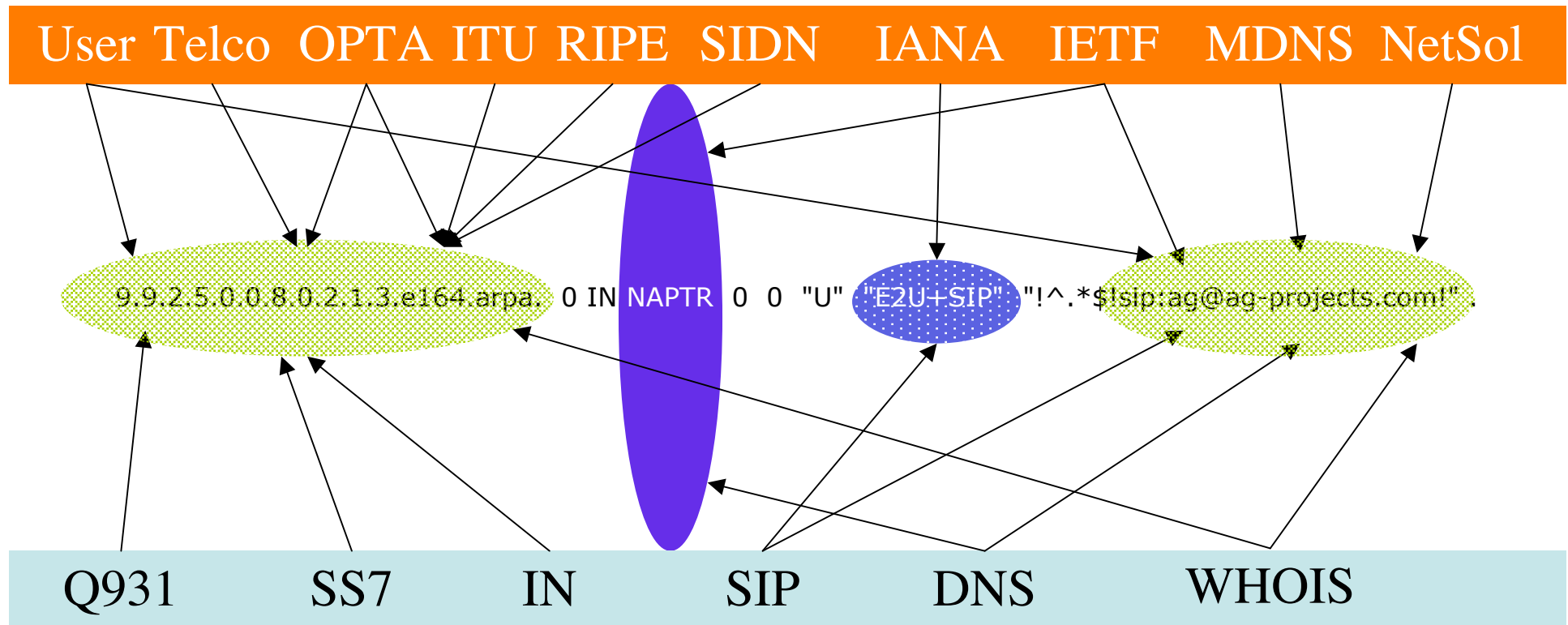
Interaction between ENUM and other systems



Interaction between ENUM and other systems



Interaction between ENUM and other systems



Interaction between ENUM and other systems

User Telco OPTA ITU RIPE SIDN IANA IETF MDNS NetSol

9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!".

Q931

SS7

IN

SIP

DNS

WHOIS

Interaction between ENUM and other systems

User Telco OPTA ITU RIPE SIDN IANA IETF MDNS NetSol

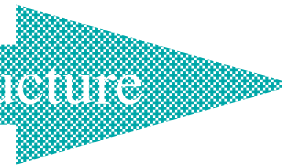
+31-20-8005299

NAPTR

sip:ag@ag-projects.com



Moving to all IP infrastructure



Q931

SS7

IN

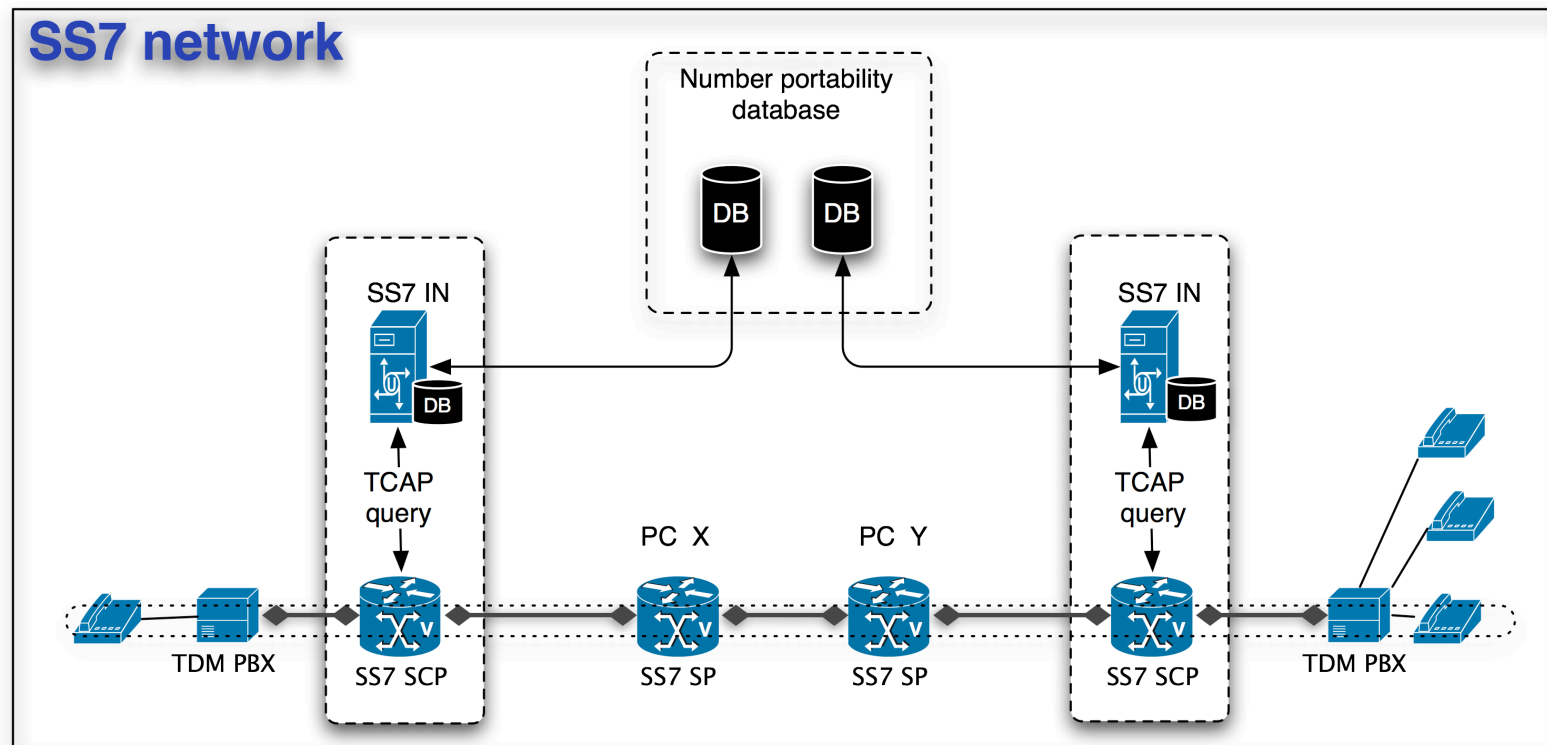
SIP

DNS

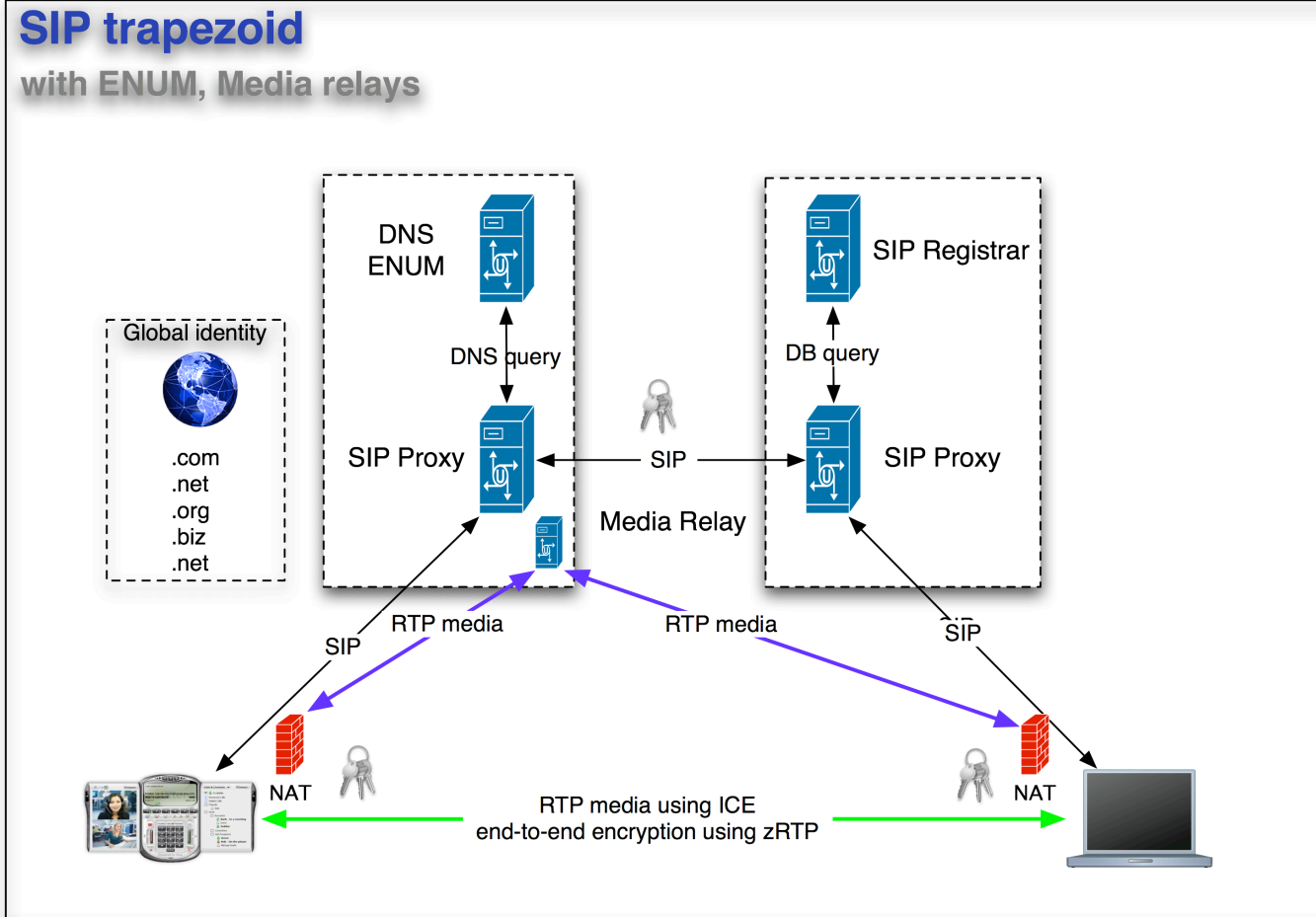
WHOIS

Migrating from SS7/IN to SIP/ENUM

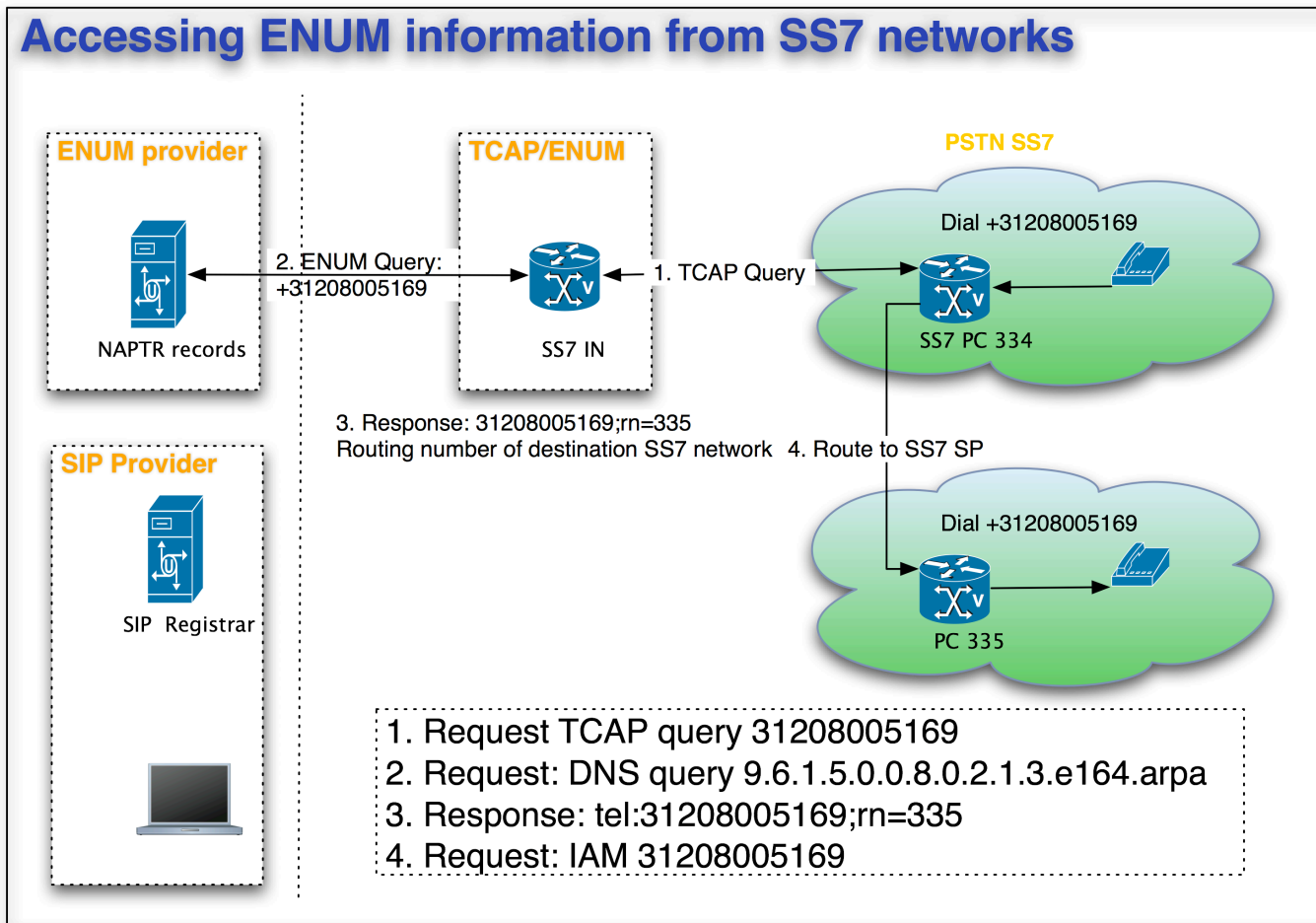
Migrating from SS7/IN to SIP/ENUM



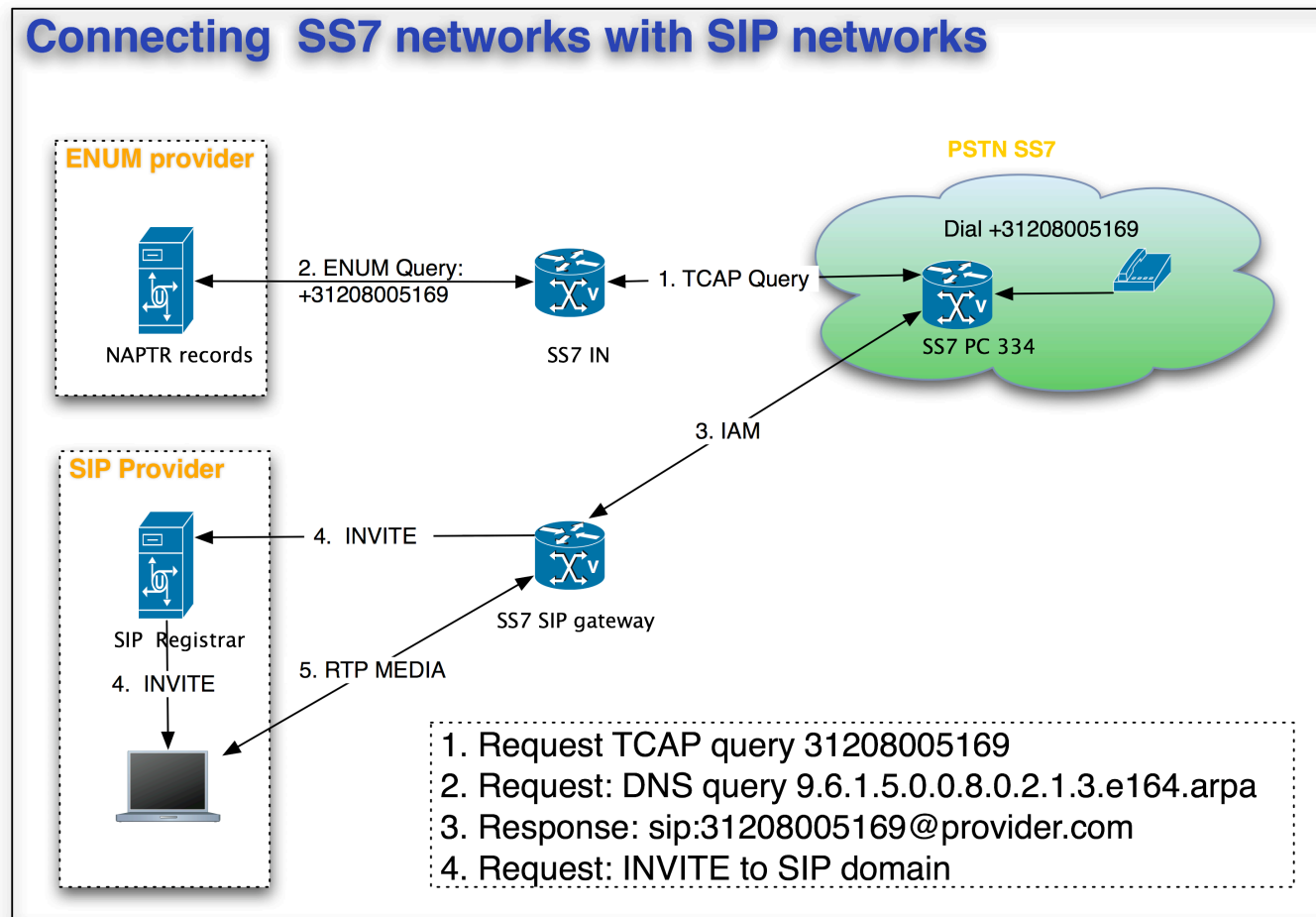
Migrating from SS7/IN to SIP/ENUM



Migrating from SS7/IN to SIP/ENUM



Migrating from SS7/IN to SIP/ENUM



Migrating from SS7/IN to SIP/ENUM

Changes in the infrastructure:

- SIP Proxy/Registrar servers replace SS7 switches
- DNS servers replace the IN databases
- Deploy gateways for non-SIP protocols
- Upgrade PBXs with SIP trunking capability
- Legacy phones may be supported

Migrating from SS7/IN to SIP/ENUM

Migrating from SS7/IN to SIP/ENUM

The internal organizational processes changes quite a bit:

- Voice routing becomes another task of the IT staff, same as managing e-mail servers
- Number management becomes a DNS provisioning task
- Lot of specialized work-places disappear

Migrating to SIP and ENUM require changes inside your technical organization

Migrating from SS7/IN to SIP/ENUM

Your business model changes quite a bit:

- Interconnection agreements renegotiated on different terms
- Your network becomes more open (technical challenges)
- You need to change vendors
- You need to change interconnect partners
- From per minute charges to flat fee model (can you do this?)

Migrating to SIP and ENUM require a compatible business model

Coffee break

After the break

Business opportunities for ENUM

Part 2

Business opportunities for ENUM

\$\$\$

Business opportunities for ENUM

ENUM solves technical problems but it also must solve a stringent business problem.

We have two forms of ENUM with associated business models

- User ENUM (in e164.arpa)
- Carrier ENUM (in private or public trees)

Business opportunities for ENUM

Who are the stake-holders for ENUM?

1. DNS Registries & Registrars
2. Carriers, operators and enterprises
3. Regulatory
4. Vendors
5. End-users

For each of them ENUM may solve a certain problem and/or create a business opportunity.

Business opportunities for ENUM

What business cases relate to ENUM?

1. Telephone number hosting (User ENUM)
2. Pure VoIP service in ENUM (User ENUM)
3. Triple play operators (Carrier ENUM)
4. ENUM peering (Carrier ENUM)
5. Vendors (User and Carrier ENUM)

The main driver is the use of VoIP and migration to all IP infrastructure.

Business opportunities for ENUM

What business cases relate to ENUM?

1. Do you have other cases?
2. Let's explore them one by one

1. Telephone number hosting

Stakeholder

- National DNS registries
- User ENUM

Driving factors

- Must be done by somebody
- Non-profit
- Government initiative

1. Telephone number hosting

OPTA ITU RIPE SIDN

9.9.2.5.0.0.8.0.2.1.3.e164.arpa. 0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*\$!sip:ag@ag-projects.com!" .

User ENUM

1. Telephone number hosting

Cost model

- Validation process
- DNS infrastructure
- Manage NS records
- Low maintenance costs

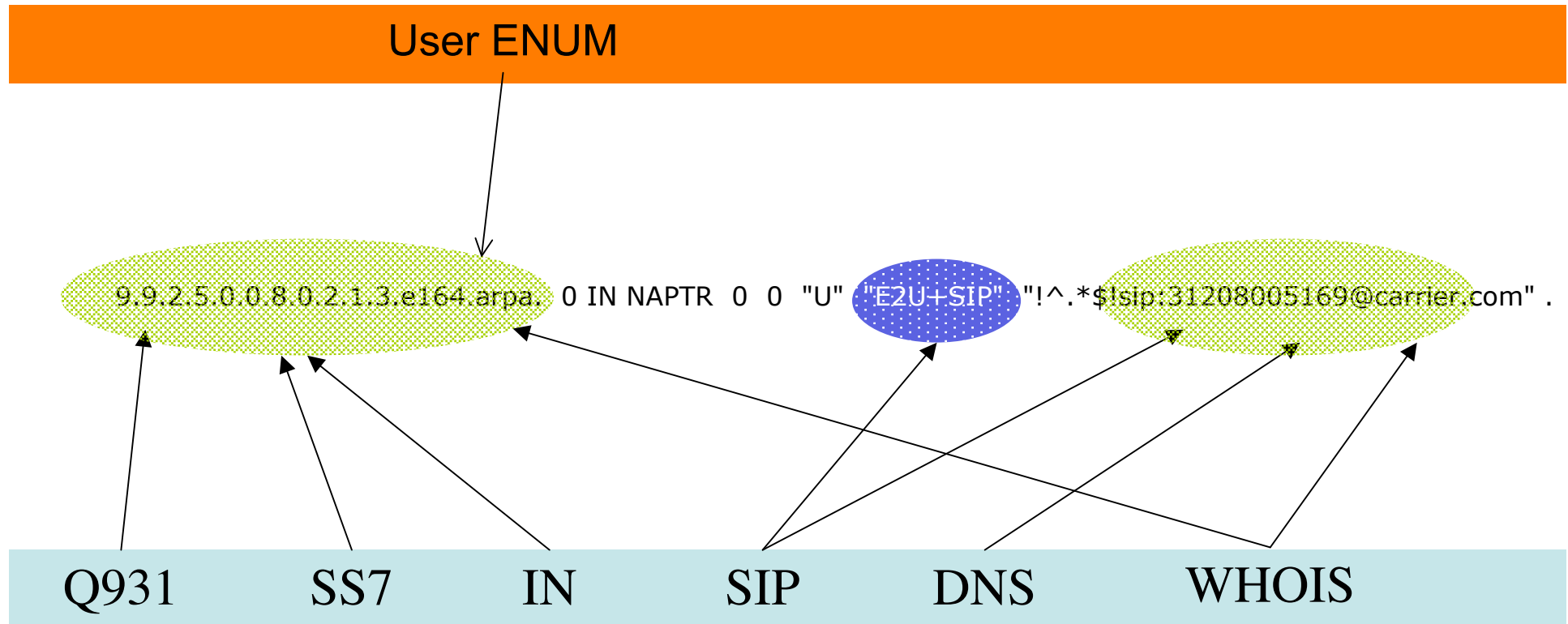
Revenue model

- Per number
- Per year subscription
- Subsidized (non-profit organizations)

\$\$\$

- 1 Euro/month/number
- One time validation fee

2. Pure VoIP service



2. Pure VoIP service

Stakeholder

- MVNO, Telecoms, DNS registrars
- IP access providers
- User ENUM

Driving factors

- Profit driven
- Gain market share
- Provide cheap voice calls

2. Pure VoIP service

Cost model

- SIP & DNS infrastructure
- PSTN gateways
- SIP UA licensing
- Interconnect fees
- High maintenance costs

Revenue model

- Per subscriber
- Monthly traffic bundles (free national traffic with 100 international minutes)
- Additional fees per number
- Sell SIP devices

\$\$\$

- 10-40 Euro/month/subscriber

3. Triple play operators

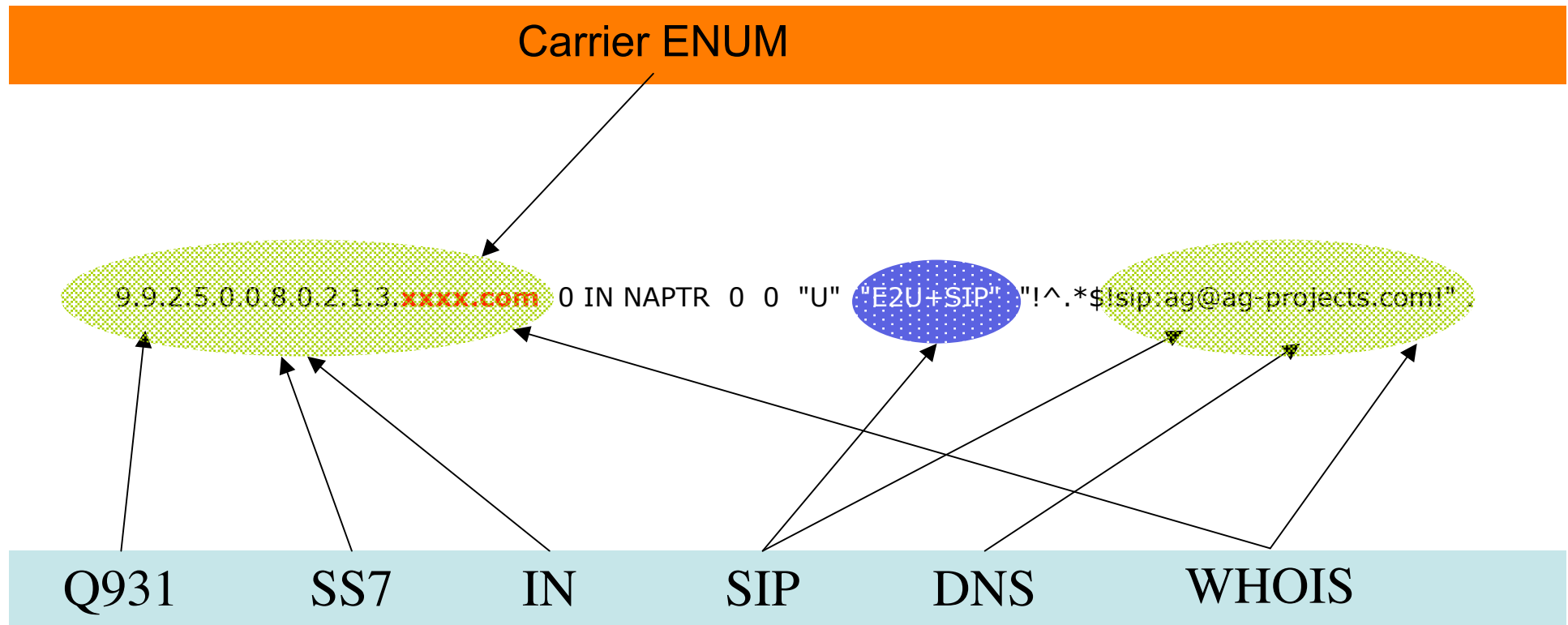
Stakeholder

- Cable operators
- FTTH providers
- Carrier ENUM

Driving factors

- Reduce churn
- Eliminate competitors
- Savings in long distance
- **Bundle all services into one bill**

3. Triple play operators



3. Triple play operators

Cost model

- Access infrastructure
- Telephony devices
- SIP & DNS infrastructure
- PSTN gateways
- Interconnect fees
- High operational costs

Revenue model

- Per subscriber
- Complete bundles IP, TV, VoIP
- Monthly service
- Subsidized devices

\$\$\$

- 20-40 Euro/month/subscriber

4. ENUM peering

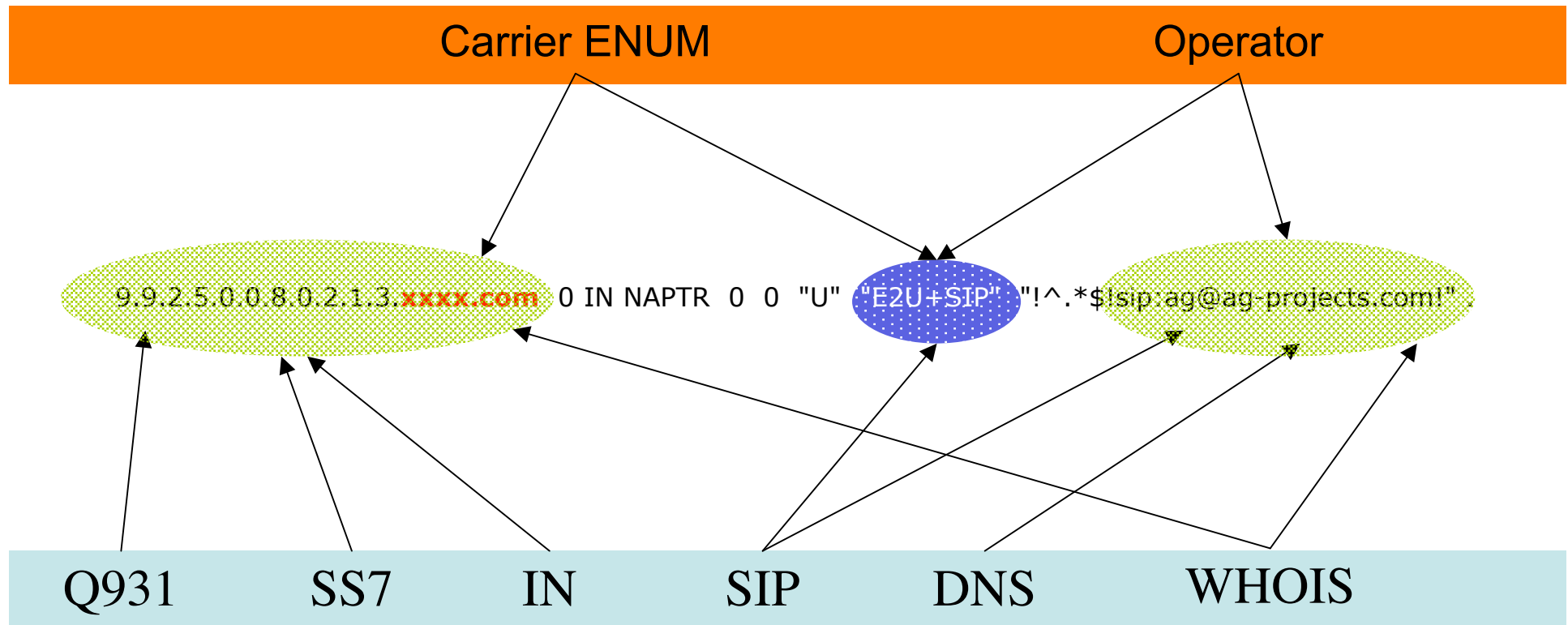
Stakeholder

- Federation providers
- Carrier ENUM

Driving factors

- There is a need for data aggregation from multiple carriers by a third party
- Lack of trust in the Internet
- QoS & privacy requirements
- The chase for the unique private TLD (winner takes all)

4. ENUM peering



4. ENUM peering

Cost model

- SIP infrastructure
- DNS infrastructure
- Marketing (lots of it)
- International presence

Revenue model

- Per connected carrier
- Per exchanged traffic

\$\$\$

- Ask Eli

5. Infrastructure vendors

Stakeholder

- Platform suppliers for service providers

(Like AG Projects)

Driving factors

- See the previous four cases

5. Infrastructure vendors

Cost model

- Software development
- Support processes

Revenue model

- Per operator (for platforms deployed at customer premises)
- Per traffic (for hosted services)

\$\$\$

- Ask me in private

My presentations about ENUM can be found at:

<http://ag-projects.com/ENUM/>

Thank you,

Adrian Georgescu
ag@ag-projects.com