ENUM provisioning techniques

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Intro

- From the PSTN remains only the E.164 numbering plan
- SIP deployments triggered the necessity for ENUM
- ENUM allows VoIP devices to be reached from the PSTN
- ENUM enables applications beyond voice (Video and IM)
- ENUM is the equivalent of SS7 IN on the Internet

ENUM is a multi-tier model
Tier 2 is the working horse of ENUM

ENUM is rolled out as we speak

- So is important to do it right
- ETSI organized the first ENUM plugtest in June this year

And we saw is that, among others, provisioning has an important role in mitigating some of the problems

Download the ENUM report from the plugtest site:

http://www.etsi.org/plugtests/history/2005enum.htm

Provisioning interfaces for ENUM

- Registration of ENUM domains in Tier 1 (you may use EPP for it)
- Management of NAPTR records in Tier 2

We focus on the links between ENUM at Tier 2 and the rest of the puzzle

Provisioning roles of ENUM Tier 2

- Interaction with Tier 0/1 registries
- Interaction with end-users (for user-ENUM at least)
- Interaction with telecom operators (carrier ENUM)
- Interaction with payment gateways
- Interaction with PSTN gateways
- Interaction with connected services (like SIP)
- Interaction with DNS servers

Provisioning has impact on VoIP

- Standards need refining RFCs 2915/2916 moved to 3761, 3762, 3763, 3764
- Incorrect NAPTR records can break applications
- Different applications are designed to cope with certain record formats (E2u+sip or sip+E2U, the old formats)
- Non-terminal NAPTR records are not well understood
- Other problems like ETSI and IETF conflicting notations (like sip: and voice+sip: URIs)

Provisioning has impact on VoIP

- Merging multiple DNS tree is difficult (carrier ENUM)
- We should try to have as less as possible TLDs
- Too many DNS records may not be returned using UDP, there are some workarounds
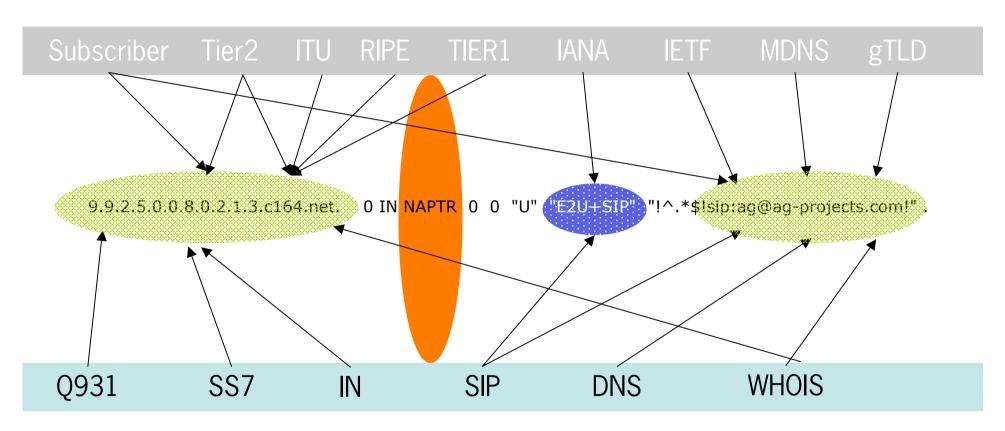- The best practices now is to limit the provisioning of number of mappings for an ENUM to five

ENUM Requirements for EDNS0 Support(L. Conroy, J. Reid)
Internet draft: draft-conroy-enum-edns0

ENUM is more than DNS

- ENUM consists of discrete NAPTR records which, map E.164 numbers into IP addressing schemes including protocol (SIP, H323)
- NAPTR records can support new services/protocols without having to redesign ENUM
- DNS related issues – Identity, security of authoritative servers, real-time updates, serial number management, DNS resolver timeouts in the context of telephony call-setup times)

ENUM zones require storage and linkage with non-DNS information. NAPTR records contain links to several entities, a provisioning system should know how to link them together

NAPTR records are more than DNS entities

Subscriber   Tier2   ITU   RIPE   TIER1   IANA   IETF   MDNS   gTLD

9.9.2.5.0.0.8.0.2.1.3.c164.net.   0 IN NAPTR 0 0 "U" "E2U+SIP" "!^.*$!sip:ag@ag-projects.com!" .

Q931   SS7   IN   SIP   DNS   WHOIS

Institutions, Providers, Subscribers, Protocols, Networks, Machines

NAPTR records are more than DNS entities

DNS itself has provisioning capabilities using dynamic updates

But do you want to use this for ENUM?

ENUM provisioning entry example

ENUM is useless alone, you need an application. A real world example looks like "Create one Voice over IP account" consisting of:
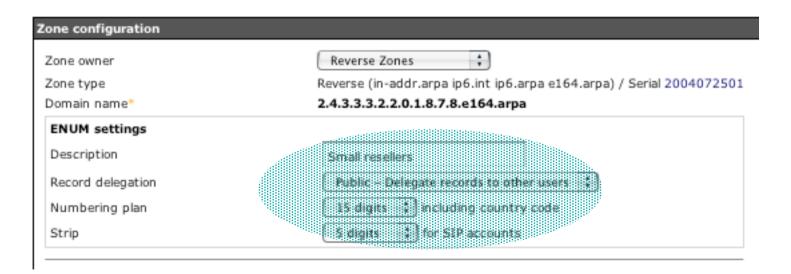
- 1 SIP account on the SIP proxy
- 1 ENUM mapping in the DNS server
- 1 voicemail account on the Voicemail server
- 1 DDI on the PSTN class 5 switch
- One recurrent payment request

So creating records into the DNS is just part of the problem

ENUM zones contain non-DNS information

- Numbering plan information (fixed/variable)
- Records usage (population/delegation/in use/free)
- Templates for generation of other related entities (SIP accounts)
- Access lists beyond transfers/query/notify

Edit DNS master zone 2.4.3.3.3.2.2.0.1.8.7.8.e164.arpa (ENUM: +878102233342)

Zone configuration	
Zone owner	Reverse Zones
Zone type	Reverse (in-addr.arpa ip6.int ip6.arpa e164.arpa) / Serial 2004072501
Domain name*	2.4.3.3.3.2.2.0.1.8.7.8.e164.arpa

ENUM settings

Description	Small resellers
Record delegation	Public - Delegate records to other users
Numbering plan	15 digits including country code
Strip	5 digits for SIP accounts

Provisioning and privacy

- DNS is a public database, content put in DNS is meant to be public
- Do you want your web page to be found? Same question apply for your telephone number, if is yes that it must be made public
- What is behind the telephone number can however be protected
- Use anonymous SIP URIs for NAPTR targets
- Link the real user identity with the name space within the applications (by using aliases)
- SIP provides mechanisms for Identity and Privacy

Privacy is solved starting with provisioning techniques and ending with the applications

Provisioning engine tasks

- Check records for correctness
- Logical checks and syntax checks
- Network locking mechanisms
- Accounting, version control and auditing
- Used for push of data into the DNS server
- Used to retrieve data from external systems (like LDAP)

Provisioning for User ENUM and Carrier ENUM

- User ENUM has lots of zones with few records
- Carrier ENUM has few zones with lot of records

- For Carrier ENUM you need access lists, or different views
- For User ENUM you have privacy issues

You need a different DNS management approach for two models and eventually two different DNS server solutions as well
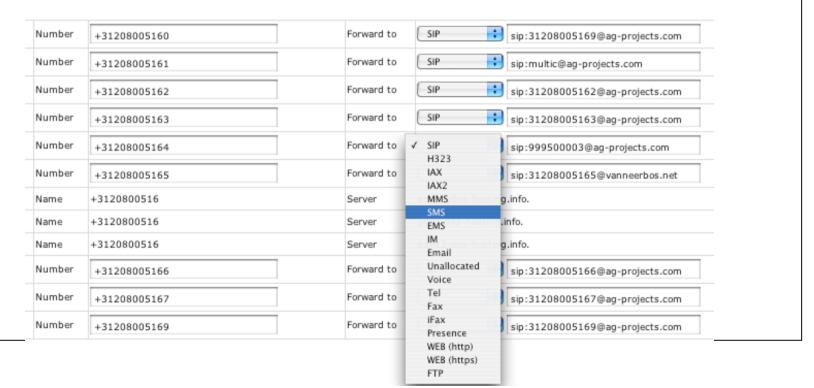
Provisioning engine tasks

- Concurrent access to DNS data in a controlled environment
- Atomically combine ENUM and SIP provisioning requests
- Must be DNS server agnostic- Bind, PowerDNS, Nominum
- Should integrate SIP redirect services with ENUM (number portability solution)
- Should integrate domain registration and DNS zone management
- Record generation / dynamic provisioning- translates non-DNS data into NAPTR records

SOAP/XML is a good tool to expose public interfaces, an Open Standard supported by most high-level programming languages (C, C++, Java, Python)
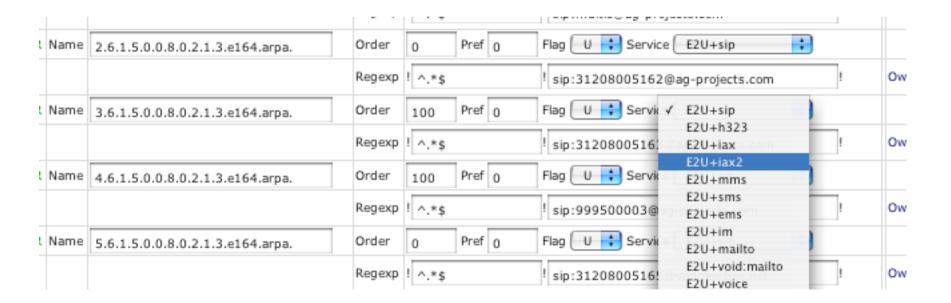
Provisioning of NAPTR records in E164 format

Make it easy for end-users. End-users are usually unaware of NAPTR records and the fact that ENUM is used for routing of their voice calls, E164 numbering plans and SIP address formats are better known and understood

Provisioning of NAPTR records in DNS format

Provide finest control for operator, ENUM regular expression handling while preventing data input which syntactically or logically does not comply with ENUM purpose.
Example: "E2U+MMS" => array("service"=>"E2U+mms",
                                        "schemas"=>array("tel:","mailto:")),
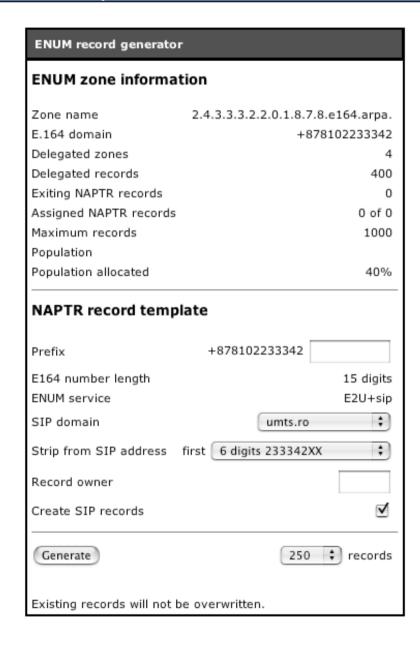
Capacity management

Capacity management is important, allocating and delegating numbers requires skills (see IPV4 address depletion).

ENUM zone usage, record ownership, current zone population, percentage of delegation, usage ratio, unallocated or unassigned records.

| Type | ENUM Provider | | | | | CID 79 | RID | | sort Zo |

12 zone(s) found. To find and change all zones for a customer fill in RID and CID or click on zones link in DNS customers.

Id.	ZID	CID	RID	Zone (domain name)	Description	Delegated	Usage	Size	Whois	Type	Server	Template	Serial	C
1.	474120	79	79	ENUM freenum.org: +31800					?	Master	pdns.dns-hosting.info	0	2004072101	2(
2.	474130	79	79	ENUM e164.arpa: +878102233344	Free SIP service		1%	1000	?	Master	pdns.dns-hosting.info	0	2004102002	2(
3.	474384	79	79	ENUM e164.arpa: +878102233343	One address Prepaid			1000	?	Master	pdns.dns-hosting.info	0	2004102002	2(
4.	474184	79	79	ENUM e164.arpa: +8781022333421			10%	100	?	Master	pdns.dns-hosting.info	0	2004071901	2(
5.	474121	79	79	ENUM e164.arpa: +87810223334201			70%	10	?	Master	pdns.dns-hosting.info	0	2004071901	2(
6.	474294	79	79	ENUM e164.arpa: +8781022333420	SME	60%(6)		100	?	Master	pdns.dns-hosting.info	0	2004071901	2(
7.	474271	79	79	ENUM e164.arpa: +878102233342	Small resellers	40%(4)		1000	?	Master	pdns.dns-hosting.info	0	2004072501	2(
8.	474293	79	79	ENUM e164.arpa: +87810223334	Medium resellers	20%(2)		10000	?	Master	pdns.dns-hosting.info	0	2004071902	2(
9.	474270	79	79	ENUM e164.arpa: +8781022333	Major Resellers	10%(1)		100000	?	Master	pdns.dns-hosting.info	0	2004062301	2(
10.	474372	79	79	ENUM e164.arpa: +3120800516	AG Office		90%	10	?	Master	pdns.dns-hosting.info	0	2004071901	2(
11.	71	79	79	ENUM e164.arpa: +3120800				10000	?	Master	pdns.dns-hosting.info	0	2003071601	2(
12.	72	79	79	ENUM e164.arpa: +31		(2)			?	Master	ns1.dns-hosting.info	0	2004090901	2(

ENUM record generator

ENUM zone information

Zone name	2.4.3.3.3.2.2.0.1.8.7.8.e164.arpa.
E.164 domain	+878102233342
Delegated zones	4
Delegated records	400
Exiting NAPTR records	0
Assigned NAPTR records	0 of 0
Maximum records	1000
Population	
Population allocated	40%

NAPTR record template

Prefix	+878102233342 [ ]
E164 number length	15 digits
ENUM service	E2U+sip
SIP domain	umts.ro
Strip from SIP address first	6 digits 233342XX
Record owner	[ ]
Create SIP records	☑

(Generate)   250 ⇕ records

Existing records will not be overwritten.

Bulk provisioning

Carrier-ENUM zones are often provisioned in bulk, numbering plan generators or imports from external data sources should be possible

Provisioning scenario

Generate 10000 SIP records in domain example.com with associated 10000 NAPTR records under private tree 1.3.e164-provider.nl.

Provisioning engine design

- High-availability (telecom grade)
- Scalability and speed (keep pace with upstream applications)
- Interoperability, use of standardized NAPTR record formats
- Retrieval of data from external sources
- Capacity planning and capacity management
- Auditing, version control
- Disaster recovery plan

What is an ENUM system actually?

DNS servers + Storage + Provisioning Interfaces

SOAP/XML engine primitives

SOAP/XML scheme to manage zone records

The zones store numbers

```
<complexType name="EnumRange">
<sequence>
<element name="id" nillable="false" type="ngnpro:EnumRangeId"/>
<element name="minDigits" nillable="true" type="xsd:int"/>
<element name="maxDigits" nillable="true" type="xsd:int"/>
<element name="size" nillable="true" type="xsd:int"/>
<element name="used" nillable="true" type="xsd:int"/>
</sequence>
</complexType>
```

Provisioning engine primitives

SOAP/XML scheme to manage discrete numbers

The number have attributes outside DNS

```
<complexType name="EnumNumber">
<sequence>
<element name="id" nillable="false" type="ngnpro:EnumId"/>
<element name="owner" nillable="true" type="xsd:integer"/>
<element name="info" nillable="true" type="xsd:string"/>
<element name="mappings" nillable="true"
    type="ngnpro:EnumMappingArray"/>
</sequence>
</complexType>
```

Provisioning engine primitives
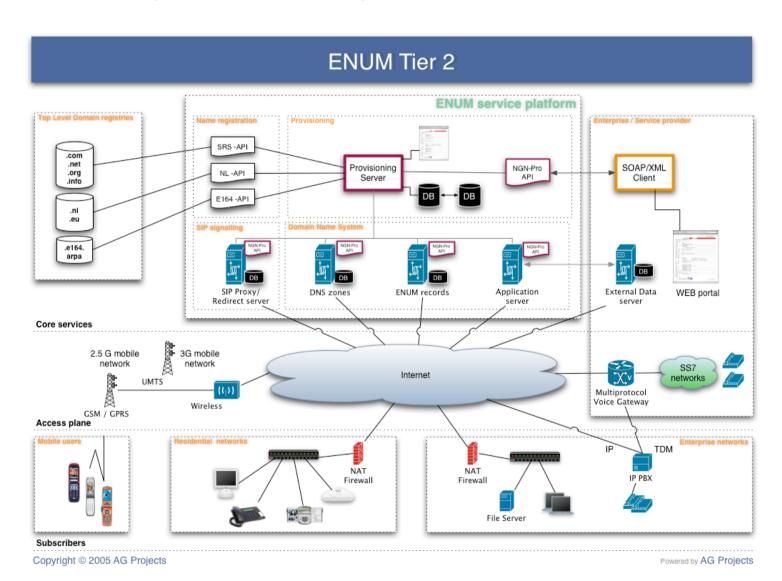
SOAP/XML scheme to manage mappings

Number has mappings which correspond to DNS NAPTR records

```
<complexType name="EnumMapping">
<sequence>
<element name="id" nillable="true" type="xsd:integer"/>
<element name="type" nillable="true" type="xsd:string"/>
<element name="mapto" nillable="true" type="xsd:string"/>
<element name="priority" nillable="true" type="xsd:int"/>
</sequence>
</complexType>
```

Provisioning engine primitives

SOAP/XML scheme to manage zone records

SOAP messages (functions)

```
<wsdl:message name="AddEnumRangeRequest">
<wsdl:message name="DeleteEnumRangeRequest">
<wsdl:message name="GetEnumRangesRequest"/>
<wsdl:message name="AddEnumNumberRequest">
<wsdl:message name="UpdateEnumNumberRequest">
<wsdl:message name="DeleteEnumNumberRequest">
<wsdl:message name="GetEnumNumberRequest">
<wsdl:message name="AddEnumMappingRequest">
<wsdl:message name="UpdateEnumMappingRequest">
<wsdl:message name="DeleteEnumMappingRequest">
```

ENUM Tier 2 platform blueprint

This presentation is available at
http://ag-projects.com/ENUM/

Thank you,
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Questions?