ENUM Tier2

Infrastructure setup

and

management

Platform requirements

Tier 2 is the working horse of ENUM.

- High-availability (telecom grade)
- Scalability and speed (keep pace with upstream applications)
- Distributed provisioning interface (concurrent users)
- Auditing (version control, roll-back, disaster recovery)
- Standardized NAPTR record formats (interoperability)
- Capacity planning and management
- Interaction with other systems (gateways, SIP Proxies, billing systems)

DNS storage options

Flat file storage

- DNS server requires reload of the zone files after changes
- Reload requires increment of serial number otherwise slaves do not catch up with the master
- Text file management is unsuitable for Tier 2 ENUM

SQL storage

- SQL databases have multiple client capability. This means one can concentrate on the given problem instead of dealing with the interaction of the DNS server
- Solve the master / slave synchronization using SQL back-end replication or other APIs like SOAP/XML

DNS record size issue

- NAPTR results sets might not fit the maximum DNS packet of 512 bytes when using UDP, this is good enough for storing VoIP related records but not when ENUM is used for its full potential
- Recommendations emerged - as a rule of thumb don't use more than 5 mappings per number but still depending on actual record size
- Solutions for packet fragmentation EDNS0 and TCP but no standardized way exists today, count on UDP services only
- TCP queries slows down a server and from 15000/UDP queries per second down to 1500 (10:1 ratio) and TCP is subject to easy to perform denial of service attacks

NAPTR record formats

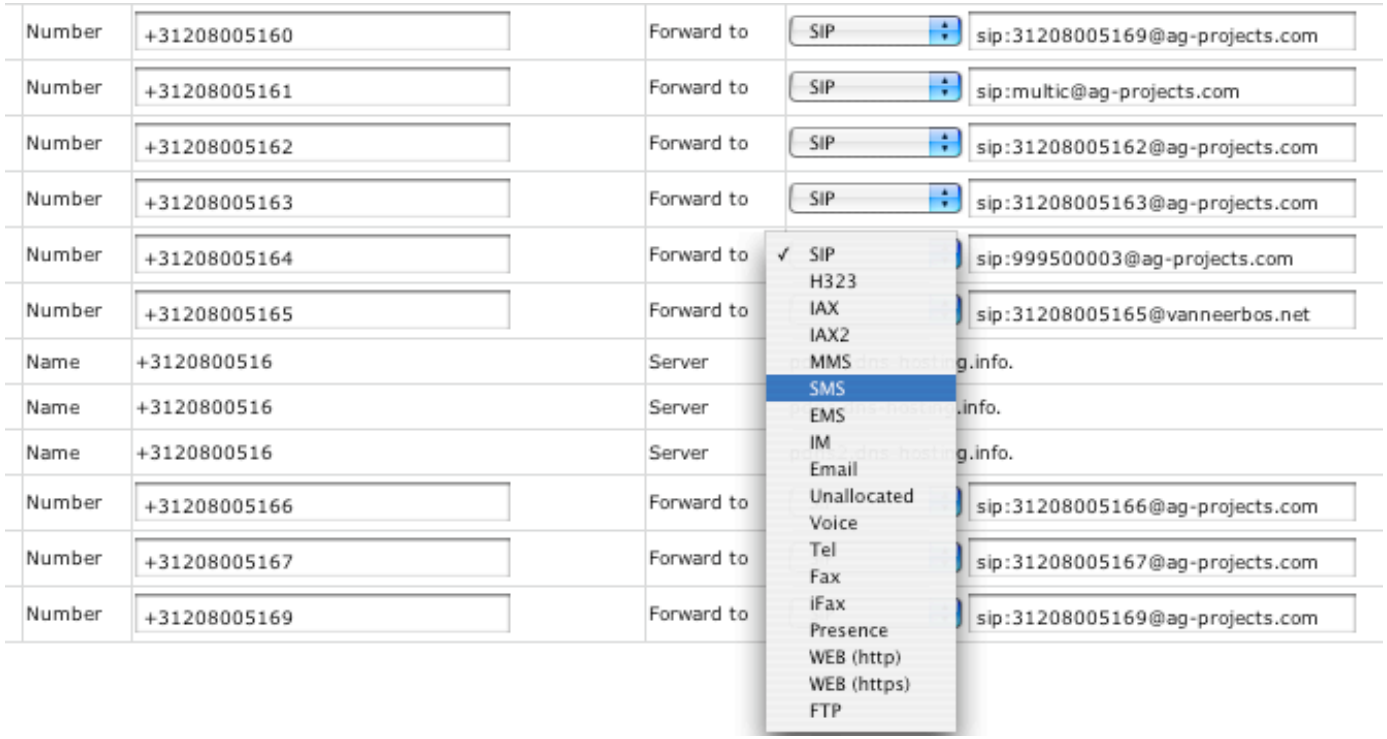
- Use standardized formats (what is standardized?)
- Don't follow blindly RFCs they need adjustment from the real-world, several recommendations emerged out ENUM trials carried so far:

ETSI TS 102 172 V2.0.3T T(2004-11)
http://enum.nic.at/documents/ETSI/Drafts/04bTD022%20Draft%20ts_102172v020003.pdf

ENUM Implementation Issues and Experience
http://www.ietf.org/internet-drafts/draft-ietf-enum-experiences-01.txt

NAPTR record formats

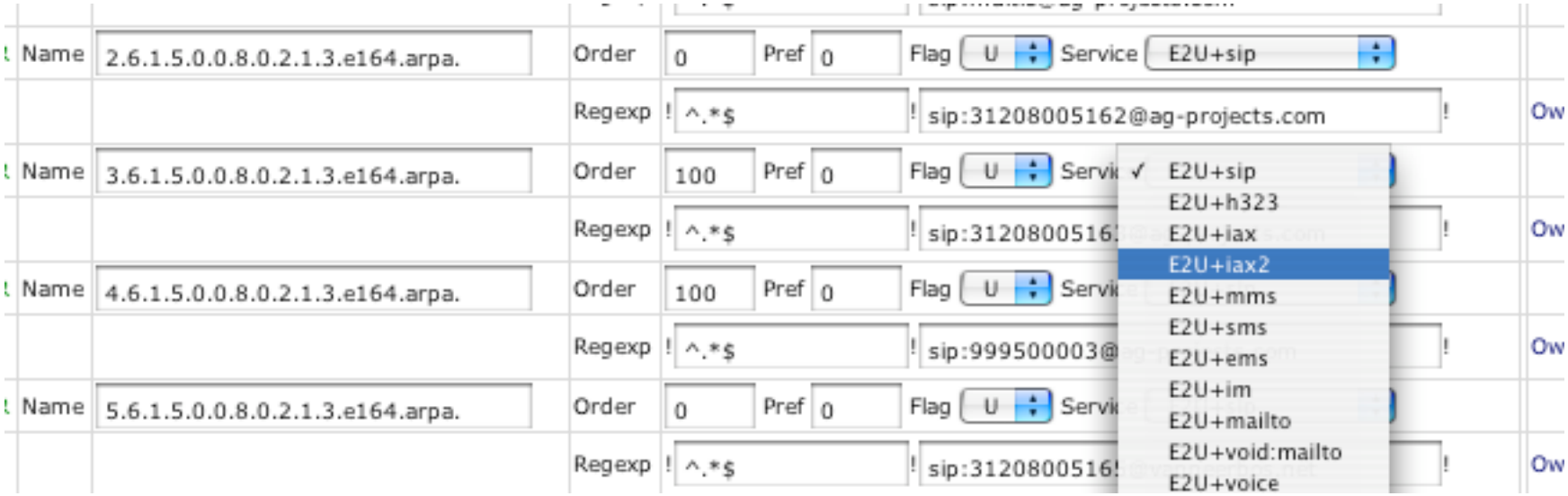
Make it easy for end-users. End-users are usually unaware of NAPTR records and the fact that ENUM is used for routing of their voice calls, E164 numbering plans and SIP address formats are better known and understood



NAPTR record formats

Provide finest control for those who need all what ENUM can offer including 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:")),

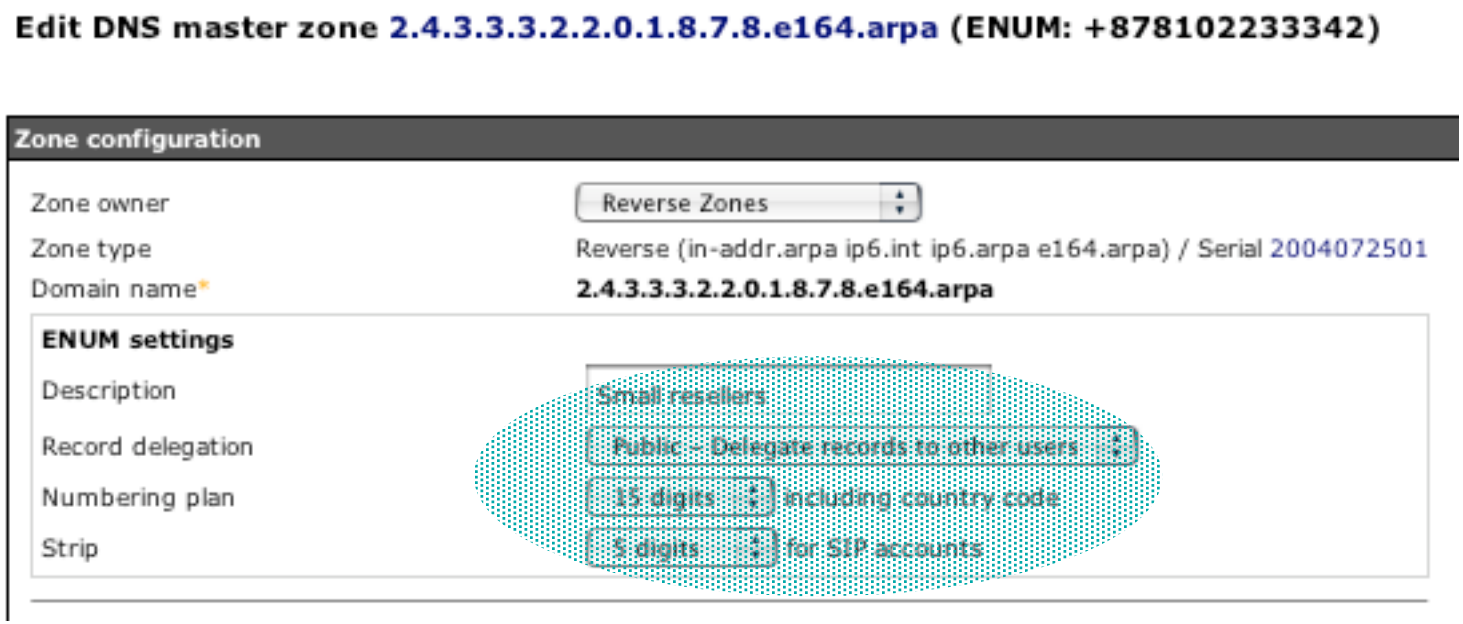


NAPTR zone management

- ENUM zones may contain large amounts of records. Using the DNS tree model, ENUM can be delegated on a digit boundary, a model that has also disadvantages, a zone must be first delegated and records of one zone cannot stay with two providers
- For Carrier ENUM - avoid fragmentation, populate zones efficiently, if you have lot of numbers assigned to your system make sure you split the pot into smaller chunks (make zones of 10/100/1000/10000 numbers) otherwise you might not be able to delegate a continuous large-enough block of numbers to a large reseller
- For User ENUM it makes sense to store separate zones per ENUM number. Whois data may be attached depending on local policy)

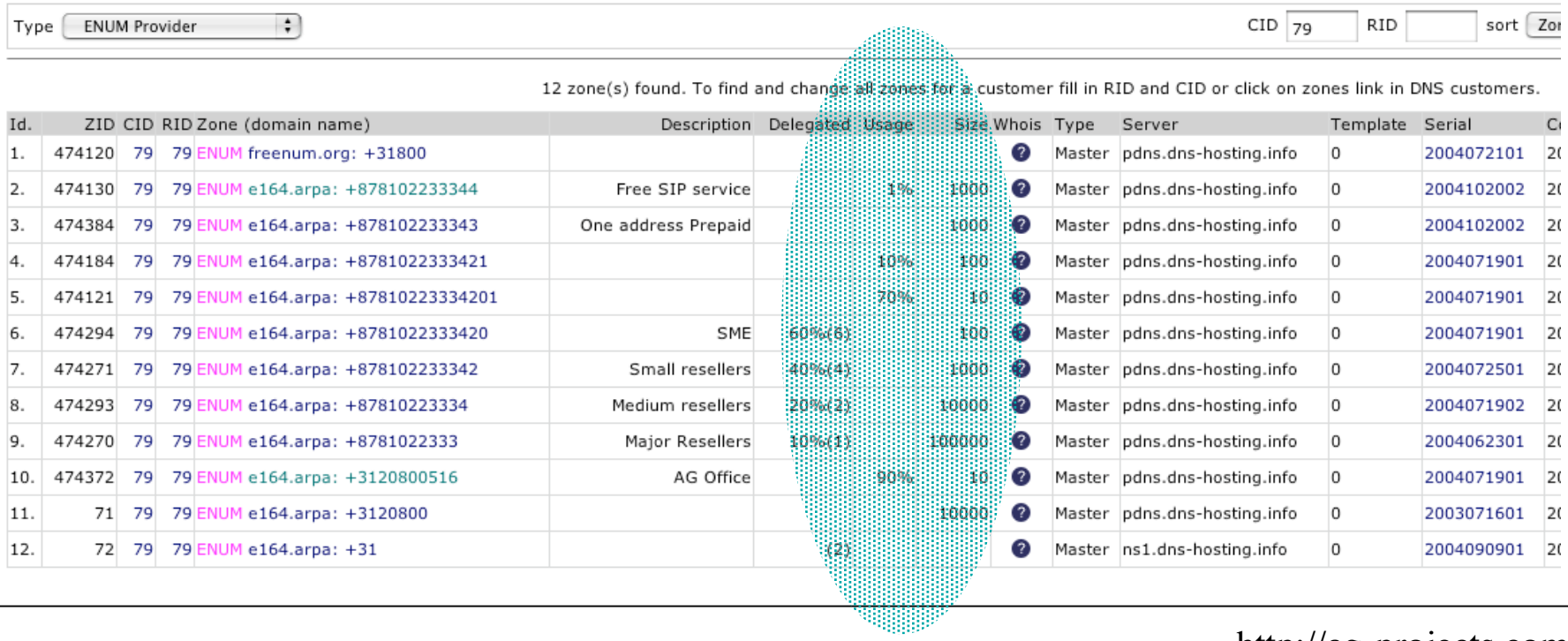
NAPTR zone management

ENUM zones have attributes that go beyond DNS concepts. Such attributes should be linked by the provisioning system to the zone. E164 number length (for fixed numbering plans) is an important attribute which influence the number of unique records that can be used within the zone.



Capacity management

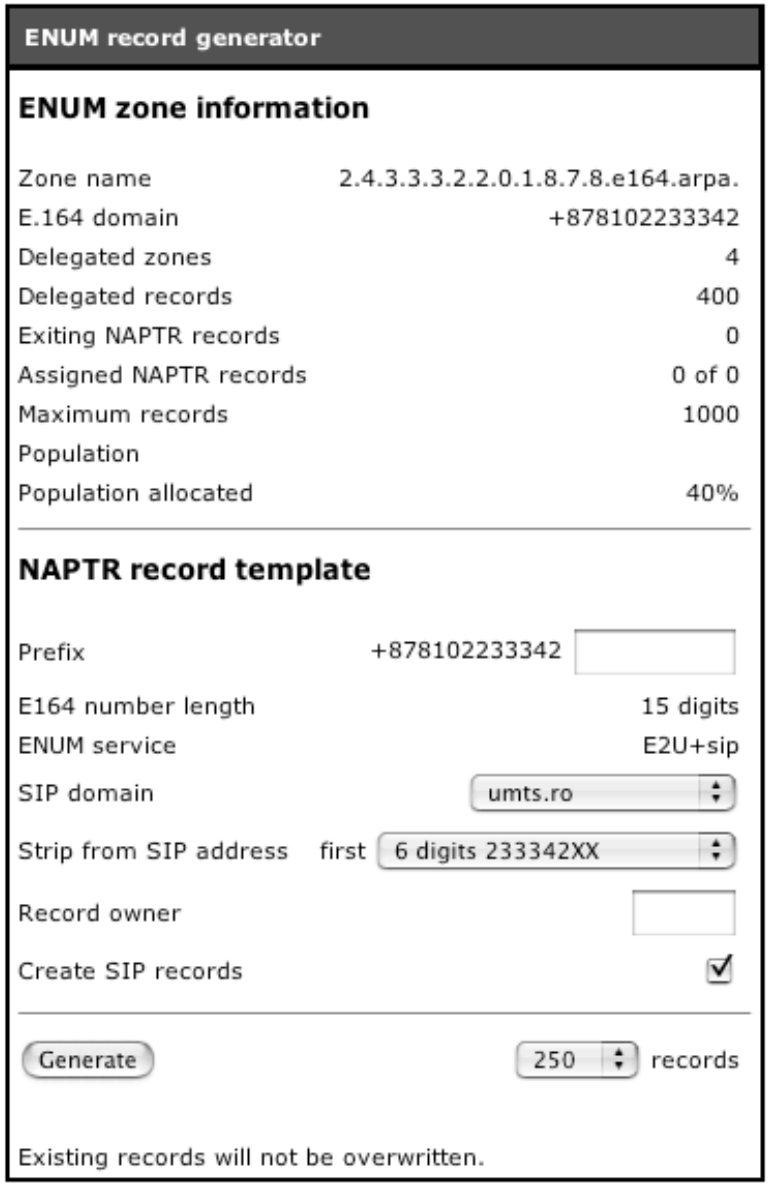
Capacity management is important, allocating and delegating numbers requires skills (see IPV4 address depletion). Provisioning engine must have up to date information about ENUM zone usage, record ownership, current zone population, percentage of delegation, usage ratio, unallocated or unassigned records.



Type ENUM Provider CID 79 RID sort

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(



Engine for bulk provisioning

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

Provisioning scenario

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

Operations and usage issues

- Make sure each location has **built-in resilience** (master/slave clustering or load balancer). Consider hosting DNS servers next to the SIP servers (if ENUM provider == SIP Provider)
- There is no clear consensus about how to handle multiple ENUM **priorities** in the client side (not really an ENUM problem). For example SER supports Q values which can be populated from NAPTR priorities but no sequential forking was until recently available (through SER AVP module provided by Voice System)
- Client side - make sure the DNS resolver results delivered to upstream application are used not only in the right order but also in sync with SIP events (don't use the results from an early DNS query for a transaction that is in progress using target obtains from a later query)
- Avoid recurring DNS queries that have been performed earlier in routing decision - Network optimization (maybe the new ENUM dip indicator?)

VoIP related issues

- **Timers**. ENUM is used primarily by SIP. DNS recursive query algorithm have timeouts (up to 75 seconds) that conflict with SIP timers. If the first DNS server is not reachable by the time a second server is queried (>5 seconds), SIP request has timed-out. Question for DNS specialists, how to deal with this?

- **High-availability**. Distributed SIP location servers may fail if used for incoming calls should clients be located behind NAT because only the server that handled the registration maintains an open tunnel to the client. SIP registration Expires (coming from client side) may in the end decide the maximum downtime for a fail-over or a dispatcher mechanism should be built in the distributed SIP farm.

Accounting issues

Following the RFC for SIP RADIUS accounting, billing the call to the right entity is an issue. For example: Adrian.Georgescu@call.arcor.de dials +878102233342019 which maps in ENUM to sip: 31208005169@ag-projects.com that has unconditional redirection to his mobile phone (PSTN). Standard Radius SIP attributes will log:

```
Acct-Status-Type = Start
User-Name = "Adrian.Georgescu@call.arcor.de"
Calling-Station-Id = "sip:Adrian.Georgescu@call.arcor.de:7060"
Called-Station-Id = "sip:+878102233342019@call.arcor.de"
Sip-Translated-Request-URI = "sip:0031620534309@voipgw02.budgetphone.nl"
```

Where can we find the billing party? We cannot really tell from a standard Radius packet. Make sure by using ENUM your accounting system can deal with the associated VoIP traffic:

Found 8 CDRs for normalization.

From 2004-11-25 08:48 to 2004-11-25 23:55

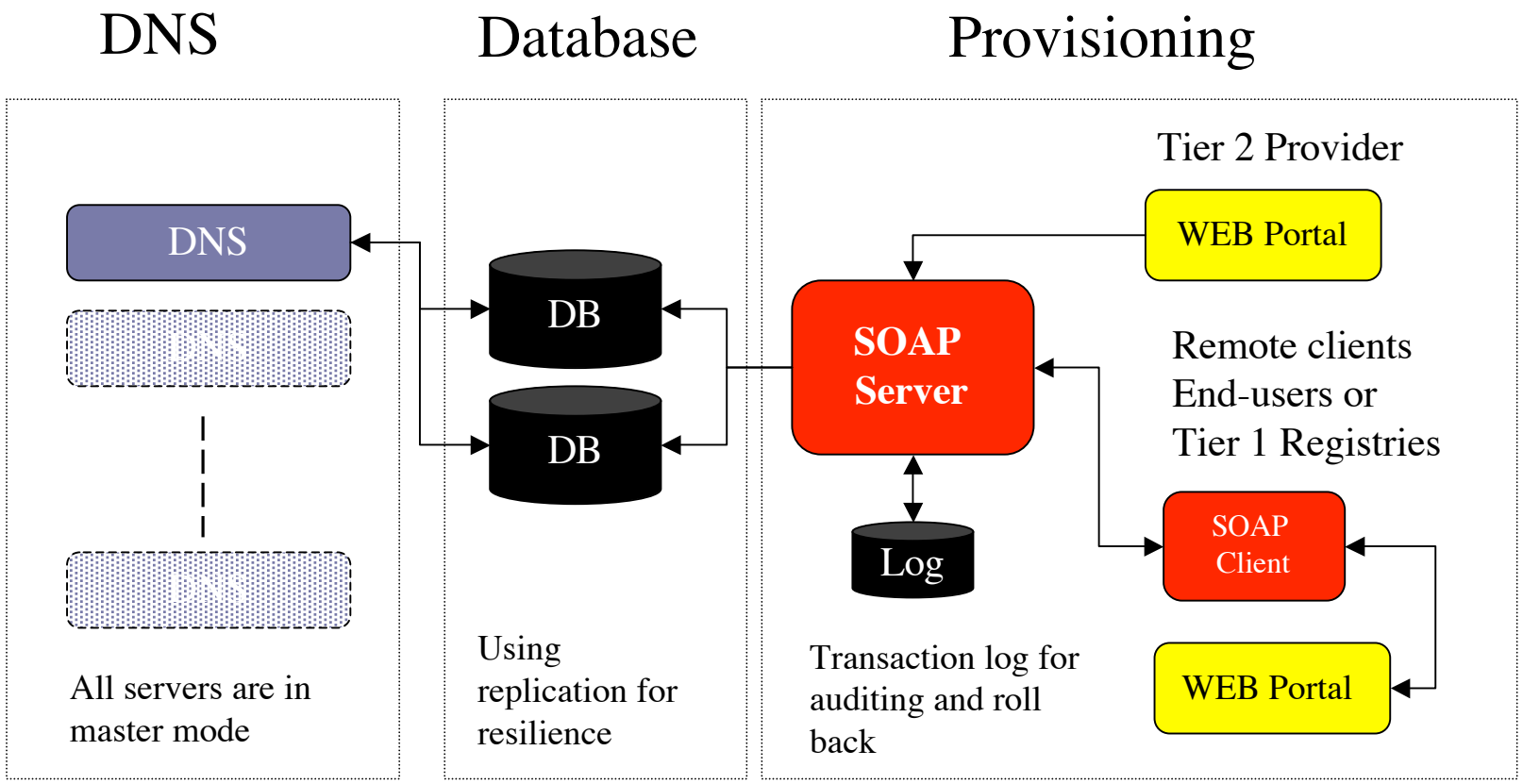
	Call date-time / Local date-time	SIP Caller/SIP Billing Party	In	SIP Destination	Out	Dur	Price	KBIn	KBOut	User agents/Status	Codec
1	2004-11-25 09:51:21 2004-11-25 09:51:21 Europe/Amsterdam	adrian.georgescu@call.arcor.de 31208005169@ag-projects.com	In	+02233342019@call.arcor.de +31620534309 (Nederland mobiel 31620)	Out	00:02	0.0526	10.76	13.14	X-Lite release 1103m + Cisco-SIPGateway/IOS-12.x Invite / Ok (200)	GSM Audio

Provisioning issues

NAPTR changes should be propagated in real time in a system where:

- New records are acquired from ENUM registrars
- Conflicts must be resolved between concurrent request for same number
- Atomicity is critical - in SIP centric environments ENUM may be just an associated attribute but failure to create associate ENUM records might require roll-back of the entire transaction
- Provisioning is done by ENUM Tier2 provider, its resellers and end-users can change their own records
- A mechanism should guarantee data integrity (syntax and logical correctness of the user input), auditing and data recovery

Tier 2 concept platform



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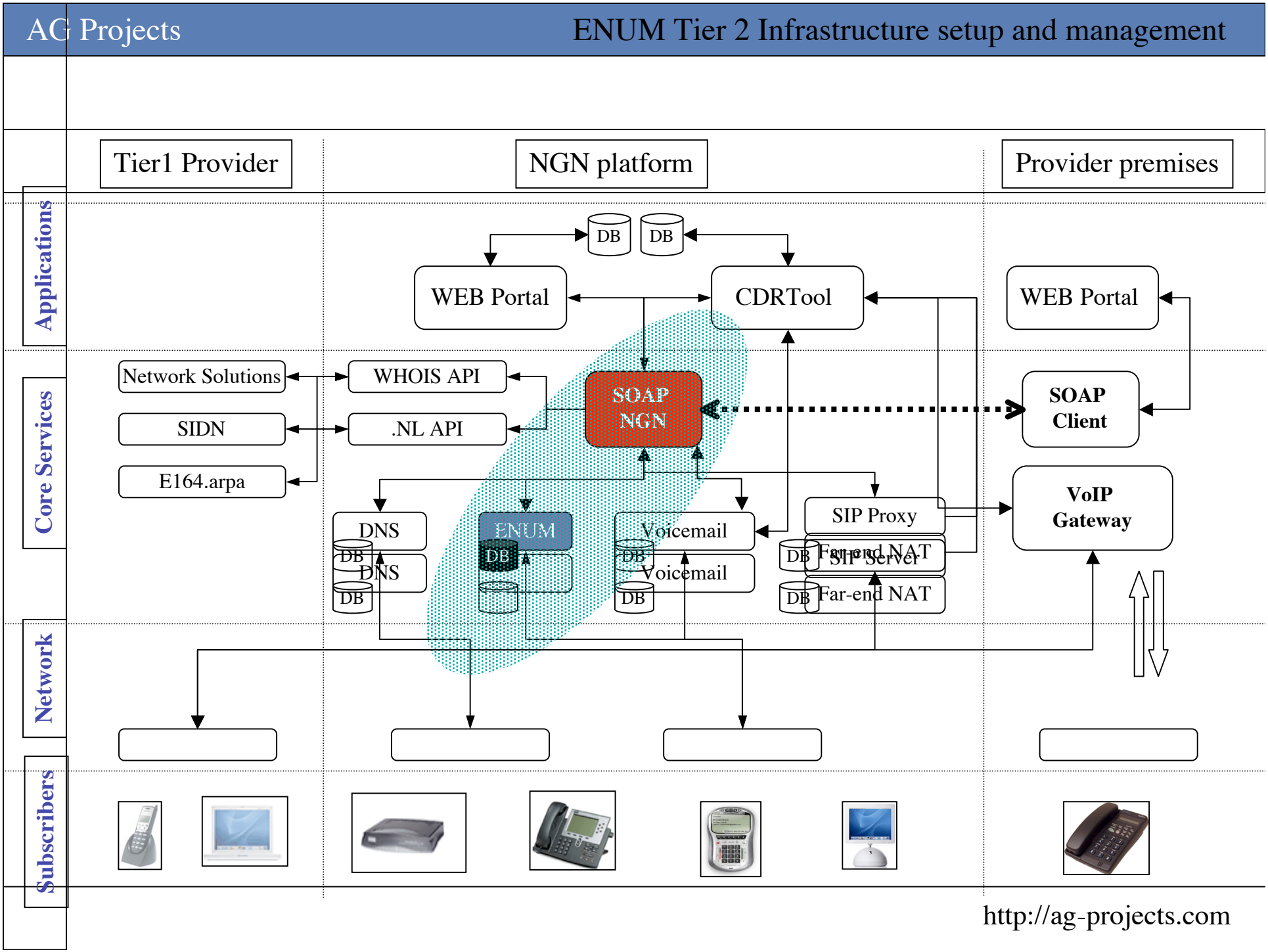
ENUM Tier 2 Infrastructure setup and management



http://ag-projects.com

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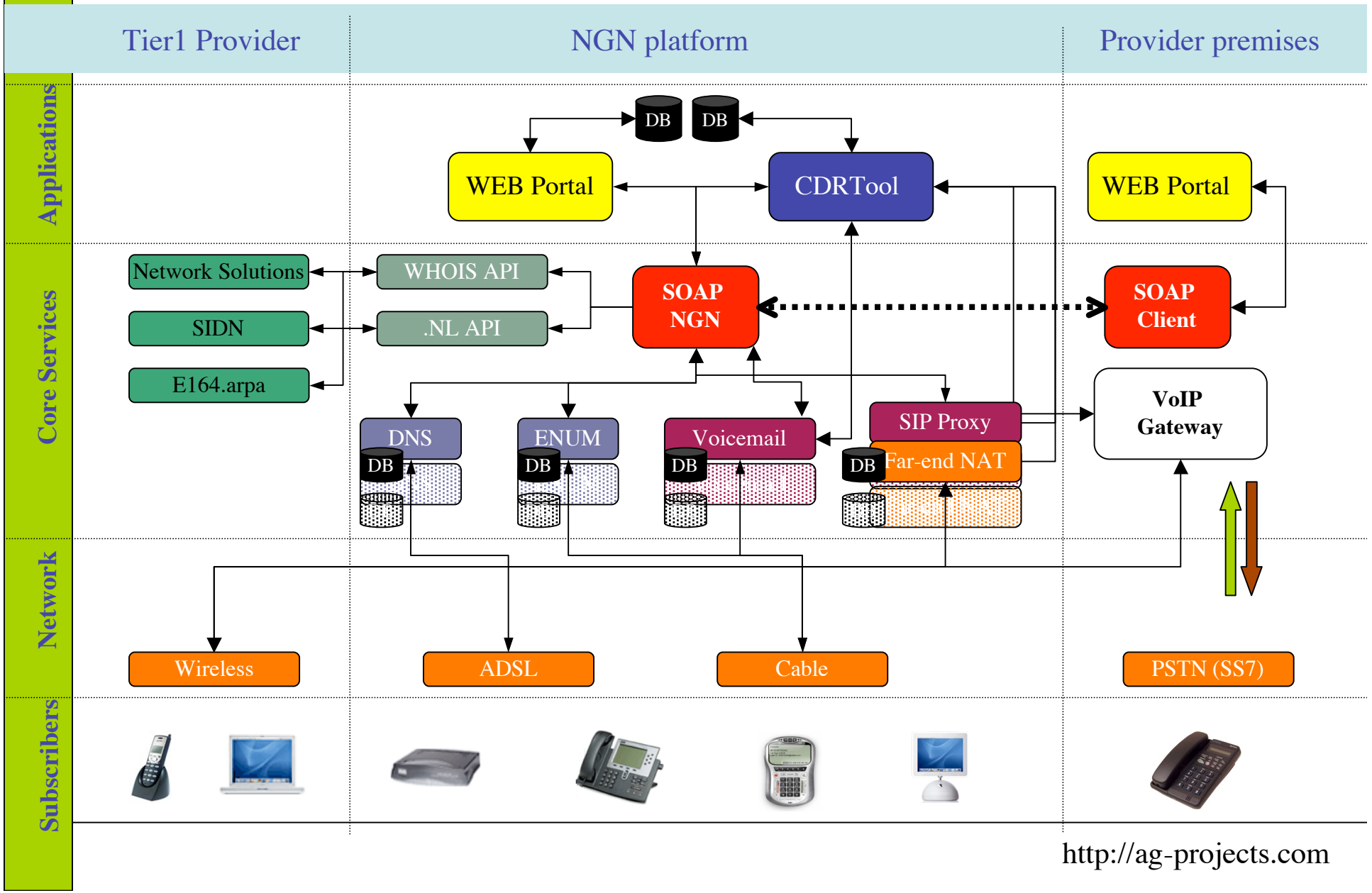

This presentation is available at:

http://ag-projects.com/docs/Present/ETSI-20041130.pdf

Thank you,
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