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# Using the Domain Name System for Telephony Service

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# Background

- **VoIP reflects a convergence between the PSTN and Internet. The ENUM service, that maps E.164 number to URIs, supports the service inter-working between numbering/addressing schemes of those network and is used for VoIP routing.**
- **DNS will be used for establish the ENUM service, because it is scalable, decentralized, fast, low cost and the E.164 telephone number which is global and hierarchically allocated can be directly mapped to the global hierarchy of domains.**



# Purpose of thesis

- **Implement prototype for the ENUM service**
- **Evaluate the performance of the ENUM service**
- **Implement prototype for the ENUM dynamic service**
- **Study the efficiency of ENUM dynamic service**



# DNS overview

- **DNS is a hierarchical, distributed method of organizing the name space of the Internet. DNS works in a client-server mode.**
- **DNS synchronization mechanisms: AXFR, DNS NOTIFY, IXFR**
- **A zone can be dynamically updated by using the DNS UPDATE mechanism**



# ENUM overview

- **E2U service enables to use a E.164 number to access many type of terminals and services**

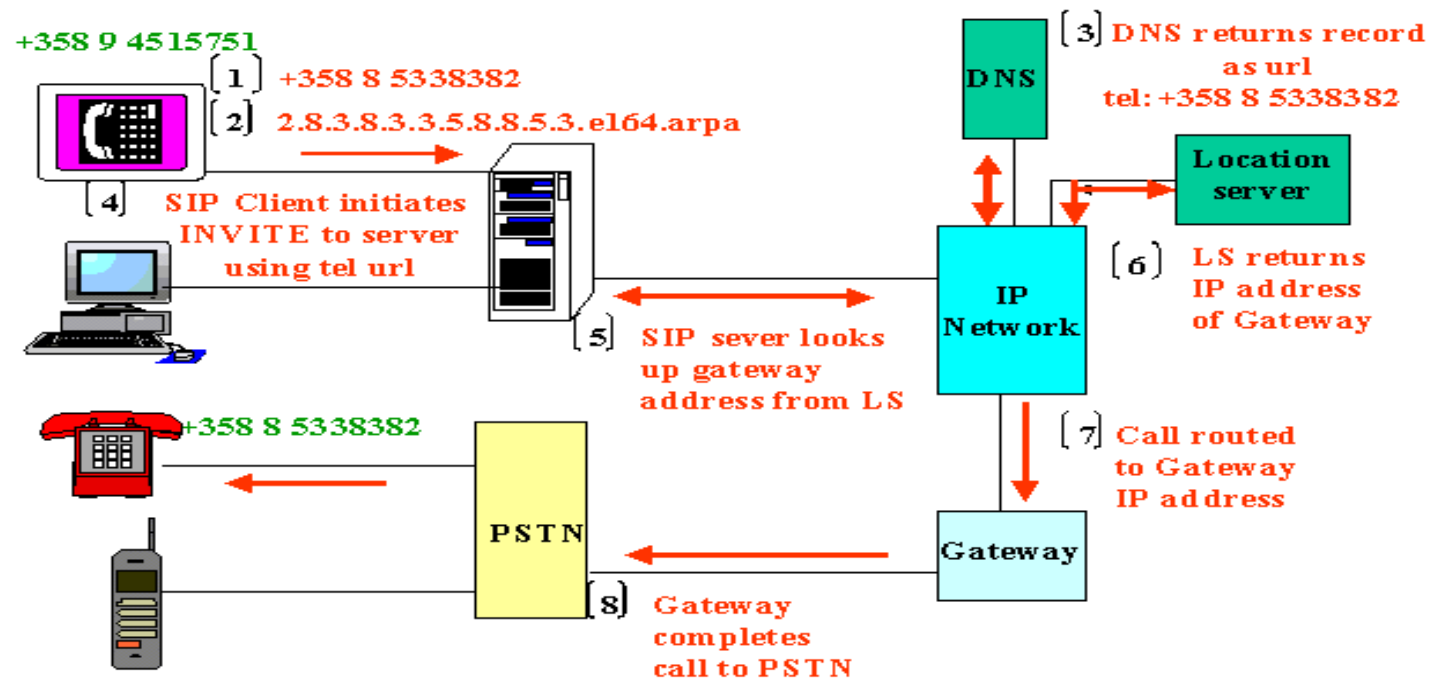
```
1.5.7.5.1.5.4.9.8.5.3.e164.arpa
IN NAPTR 10 10 "u" "sip+E2U" "!^.*$!sip:35894515751@tele.fi!".
IN NAPTR 10 10 "u" "sip+E2U" "!^.*$!sip:xiaoling@msn.com!".
IN NAPTR 20 20 "u" "smtp+E2U" "!^.*$!mailto:xiaoling@hotmail.com!".
```

- **ENUM resolution protocol is used for determining the application service interoperability**

```
1.5.7.5.1.5.4.9.8.5.3.e164.arpa
IN NAPTR 10 10 "u" "sip+E2VOICE" "!^.*$!sip:35894515751@tele.fi!".
IN NAPTR 10 10 "u" "sip+E2IM" "!^.*$!sip:xiaoling@msn.com!".
IN NAPTR 20 20 "u" "smtp+E2EM" "!^.*$!mailto:xiaoling@hotmail.com!".
```

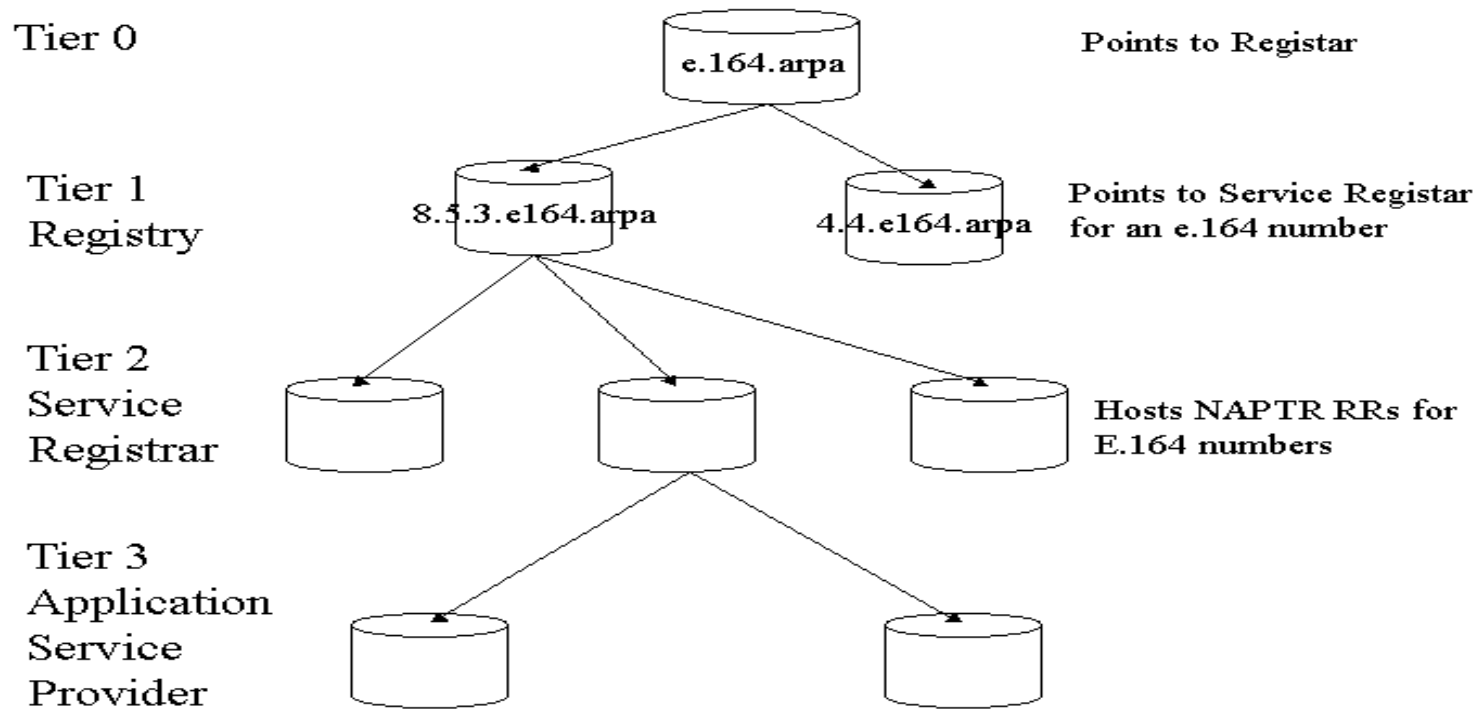


## Call from IP-based Network to PSTN





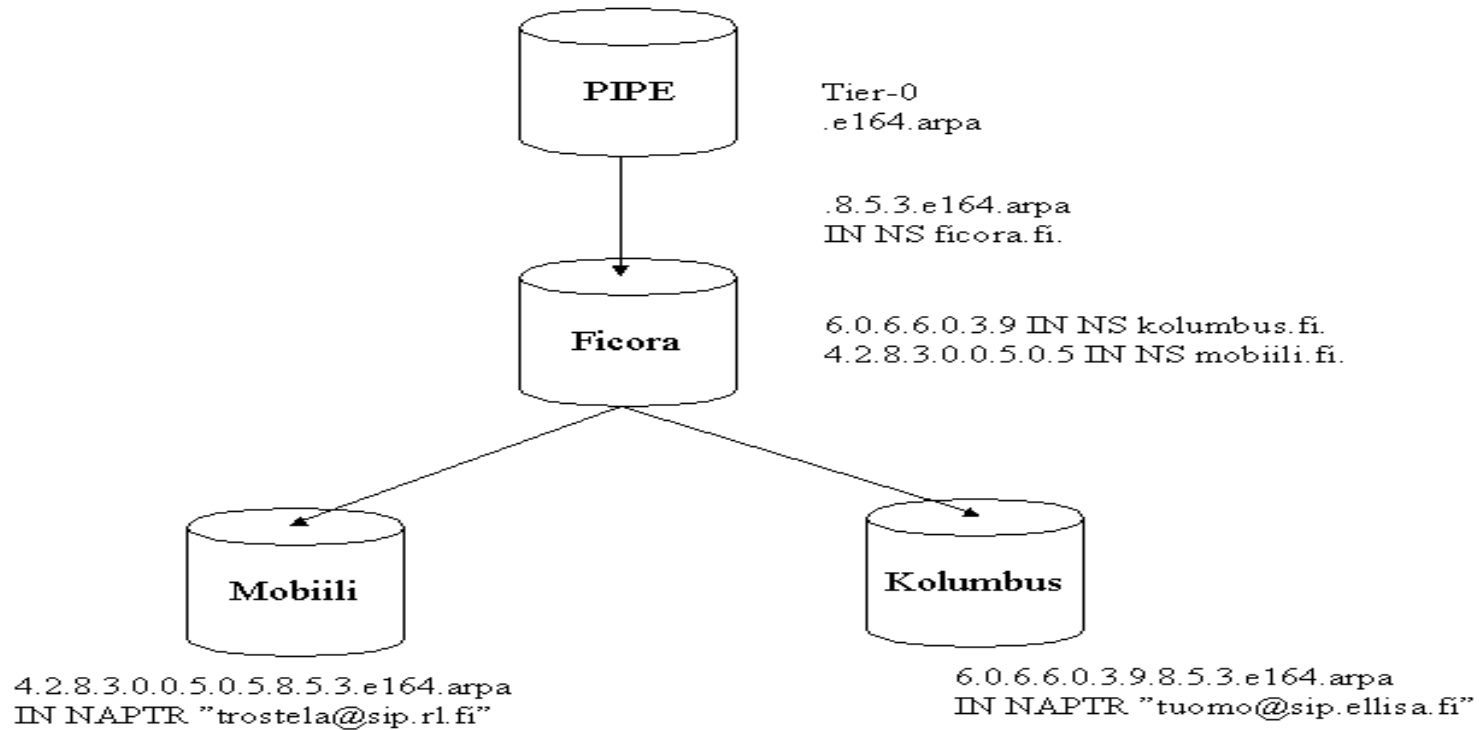
## ENUM Registry/Registrar Model







## American Model for ENUM Dynamic Service





## ■ Advantages of ENUM

- **ENUM is a bridge between the IP-based network and PSTN**
- **ENUM solves the inter-domain call routing based on a telephone number in VoIP**
- **ENUM will be split into the “operator ENUM” and the “user ENUM”. The operator ENUM will not open to queries from users at all and allow dealing with the secret telephone number. The user ENUM will deal with private numbering plan such as now supported by PBX network**



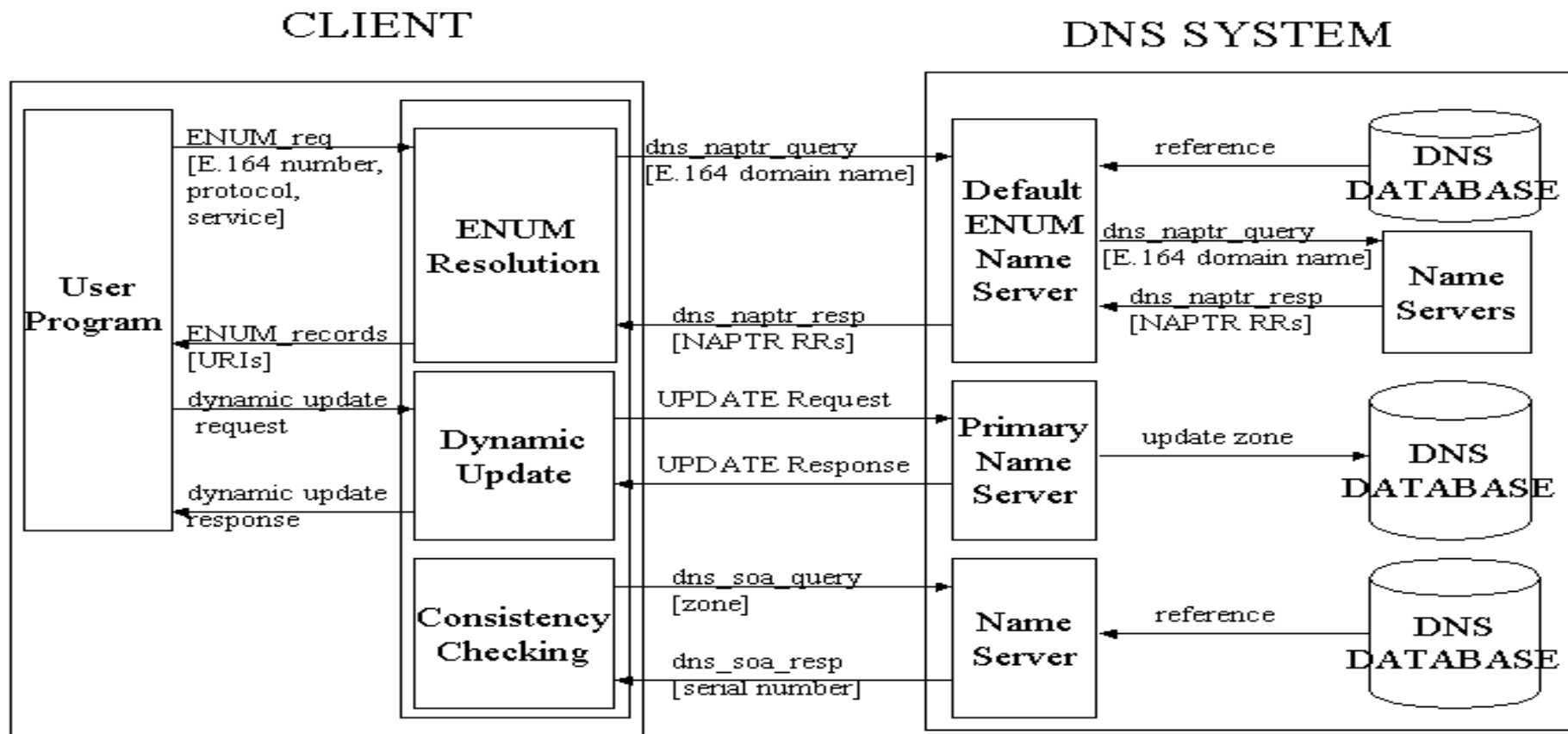
## ■ Problems of ENUM

- **Security**
- **The ported device maybe unreachable if the name server which is unaware of the change answers an ENUM query of the number by utilizing its out of date cache information or zone data.**
- **There are multiple ENUM providers and users or putative agent of users are allowed to change routing or supplier information. The adequate mechanisms for identification and authentication of those requesting the change and for authorization of those changes should be designed.**



# Test Result

## System Architecture



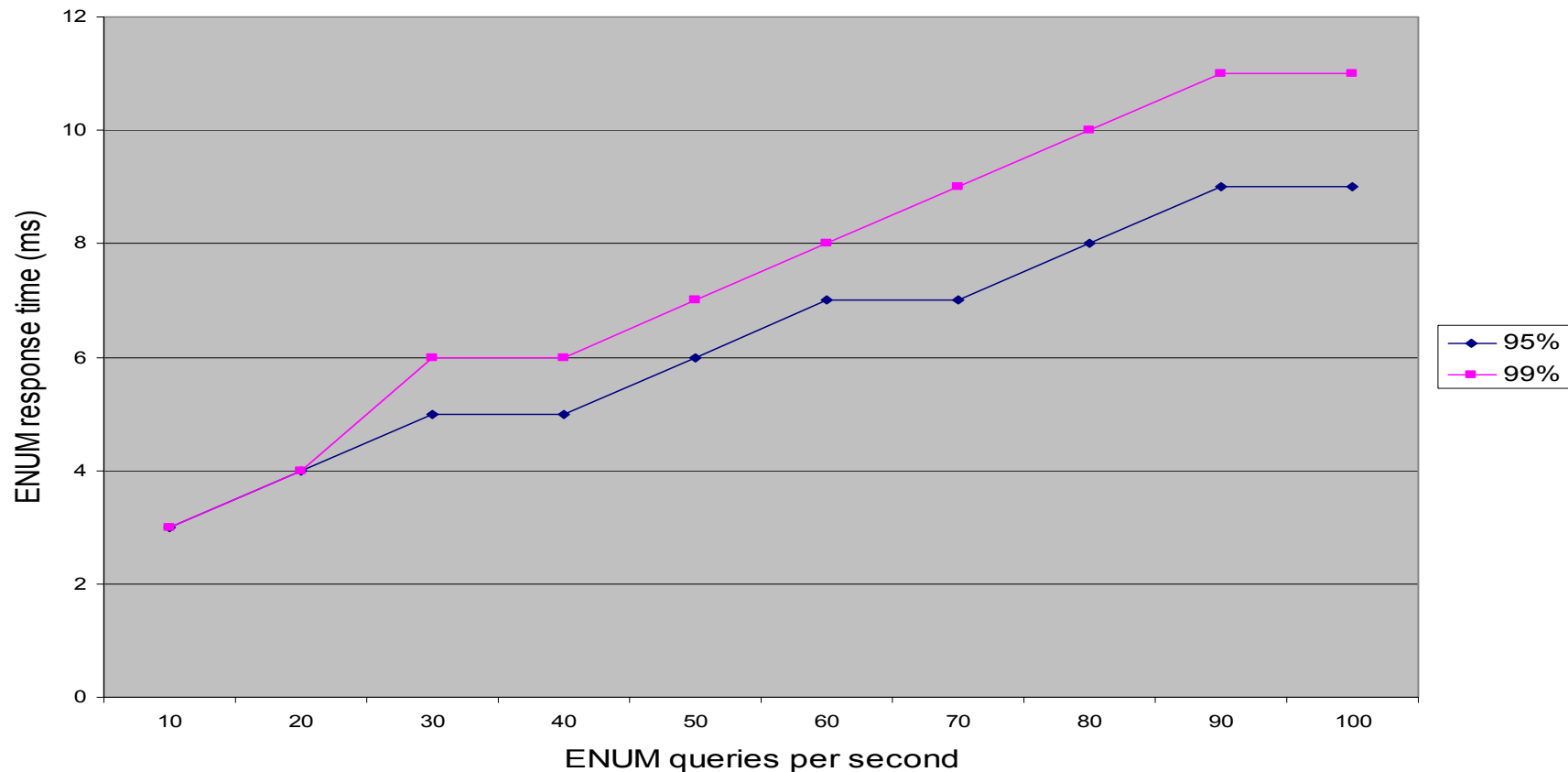


## ■ Performance of ENUM service

- The time used for getting the ENUM service is mainly used for exchanging the DNS messages among name servers.
- The time used for getting the ENUM service increases by about 5 milliseconds for one extra name server involved in the intranet. It takes 15 ms when four name servers are queried.
- It takes average 112 ms to get the ENUM service from a name server sitting in USA.



■ Network and name server loading have a big effect on the performance of the ENUM service





## ■ Efficiency of ENUM dynamic service

- Sensitive to the number of the name servers to be updated

Number of Name Servers	Average (ms)	> 95% (ms)	> 99%
2	59	75	92
3	618	2,164	3,686
4	3,537	8,316	12,262
5	5,138	10,430	23,180



## ■ Affected by the topology of AXFR/IXFR dependency graph

Layers for two slave name servers	Average (ms)	> 95% (ms)	> 99%
1	618	2,164	3,686
2	535	1,741	2,878

- It takes less time to propagate the change of the zone data among the slave name servers that are arranging in different layers of the dependency graph.
- In some case, the flat topology should used, for example, when providing the ENUM service in a corporate network based on a VPN with many sites. Testing result shows it is ok.





# Conclusion

- **The performance of the ENUM service meets the latency expectations in the telecommunication industry**
- **Providing the ENUM dynamic service has several disadvantages and should be well considered**
- **Suitability of the DNS dynamic service**
  - **Mobility ----- No**
  - **Call forwarding ----- Questionable**
  - **NP ----- Yes**



# Future work

## ■ Security

- Malicious redirection and Denial of Service (DoS)
  - Security of the ENUM dynamic service
- 
- Effect of the loading of the network and the name servers to the performance of the ENUM service