Domain Name System

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Content

- Domain Name System (DNS)
  - Characterization
  - Organization
  - Configuration
  - Commands, Primitives (next course)

DNS

- IP Addresses (ex. 85.122.23.145) are difficult to remember

- It uses a **domain name system** to translate IT addresses in domain names and vice versa Domain names are organized in hierarchies

- RFC 1034, 1035, 1123, 2181

DNS| organizare

- Initial: **/etc/hosts** – pairs (name, IP)
  - Scalability problems

- Actual: DNS consists of a hierarchical domain scheme and a distributed database system to implement this scheme name
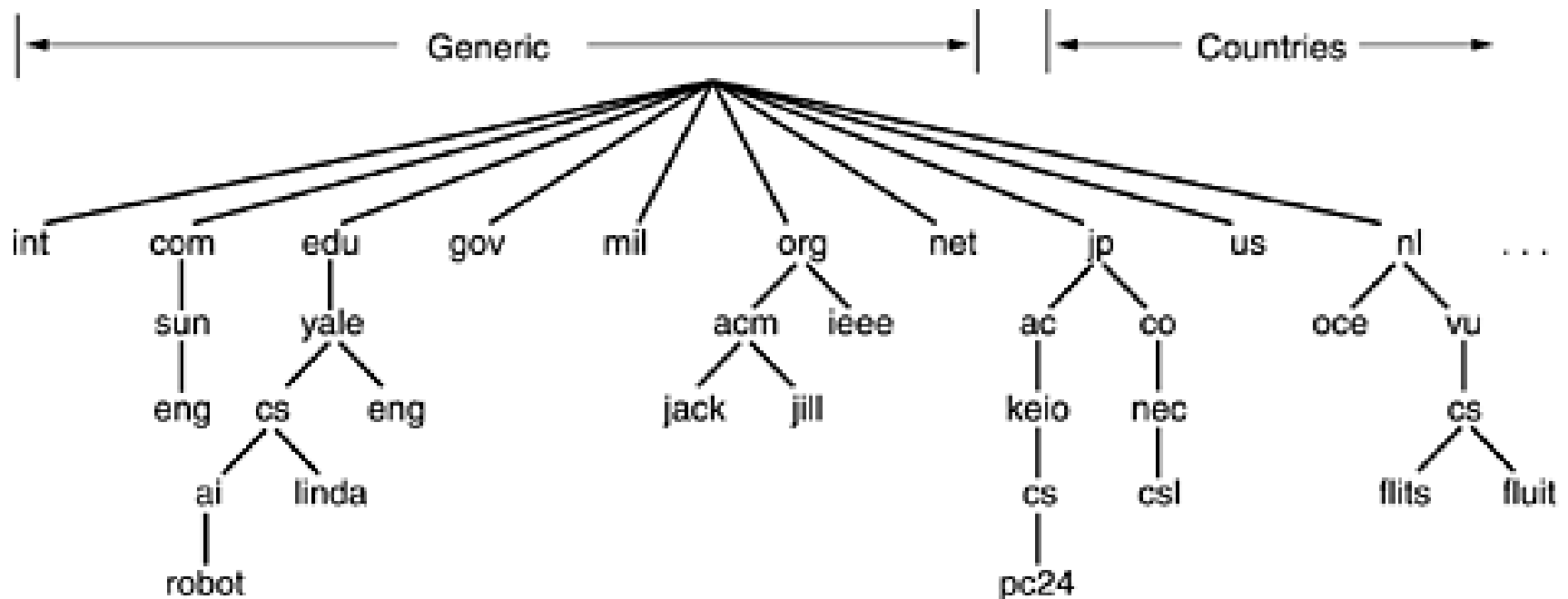
Figure. A portion of the space domain names on the Internet

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DNS| Domains types

- **Primary** (*Top Level Domains* – TLD)
  - For Internet Infrastructure – one domain: **.arpa** ARPA (Address and Routing Parameter Area)
    - "*Changes to the .arpa zone must be coordinated manually with IANA*"
  - State (*ccTLD*) – states code: .ro, .fr, .jp, …
  - IDN ccTLD (*Internationalized Country Code Top-Level Domains*)
    http://例子.测试   http://*example.test*

  - Generics: .biz, .com, .info, .name, .net, .org, .pro
  - Sponsored: .aero, .edu, .gov, .int, .jobs, .mil, .tel
  - Reserved: .example, .invalid, .localhost, .test
  - Pseudo-domains: .bitnet, .local, .root, .uucp etc.

http://www.iana.org/domains/root/db/

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DNS| Tipuri de domenii

www.iana.org/domains/root/db

Domain Names

Overview

Root Zone Management

  Overview

  Root Database

  Hint and Zone Files

  Change Requests

  Instructions & Guides

  Root Servers

.INT Registry

.ARPA Registry

IDN Practices Repository

Root Key Signing Key (DNSSEC)

Reserved Domains

Root Zone Database

The Root Zone Database represents the delegation details of top-level domains, including gTLDs such as .com, and country-code TLDs such as .uk. As the manager of the DNS root zone, IANA is responsible for coordinating these delegations in accordance with its policies and procedures.

Much of this data is also available via the WHOIS protocol at whois.iana.org.

Domain	Type	Sponsoring Organisation
.abogado	generic	Top Level Domain Holdings Limited
.ac	country-code	Network Information Center (AC Domain Registry) c/o Cable and Wireless (Ascension Island)
.academy	generic	Half Oaks, LLC
.accountants	generic	Knob Town, LLC
.active	generic	The Active Network, Inc
.actor	generic	United TLD Holdco Ltd.
.ad	country-code	Andorra Telecom
.ae	country-code	Telecommunication Regulatory Authority (TRA)
.aero	sponsored	Societe Internationale de Telecommunications Aeronautique (SITA INC USA)
.af	country-code	Ministry of Communications and IT

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DNS| Tipuri de domenii

- Domain name
  - Sub-tree of the domain tree
  - The physical topology is not taken into consider

- **Sub-domains**:
  - Full path name not exceed 255 characters
- **Name of computers** (hosts)

DNS

- Example:
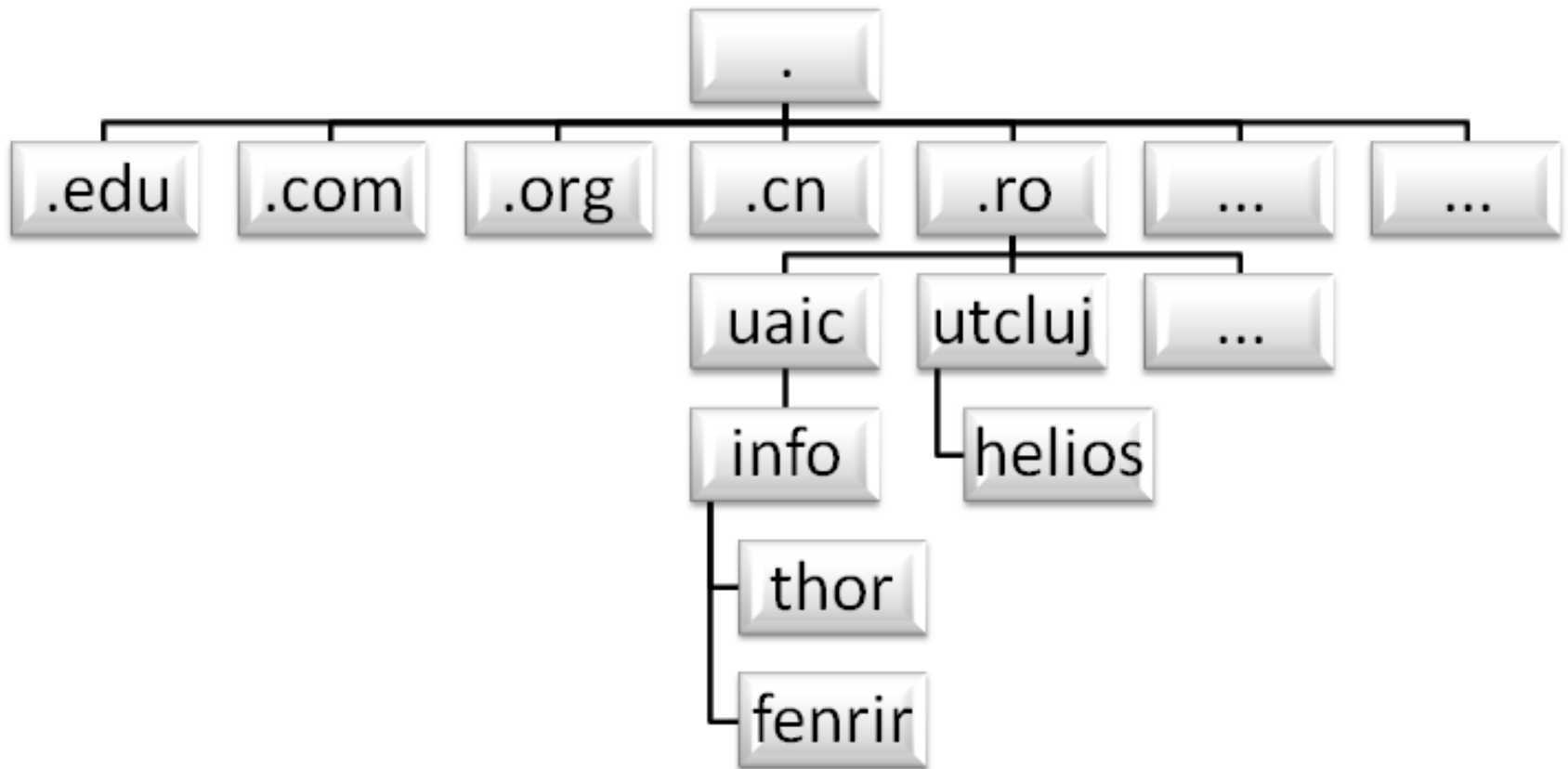
DNS| organization

- Rules to allocate to domain names:
  - Each domain controls how its subdomains are assigned
  - To create a new subdomain, permissions are requested from the upper domain (each domain will have an authority at a certain level)
  - The naming domain is performed in respect to the organizational boundaries, not those of networks
  - A certain level of hierarchy can be controlled by multiple servers

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DNS| organization

- *Name servers*
  - Theoretically, a single name server can contain the entire DNS database and can respond to all requests
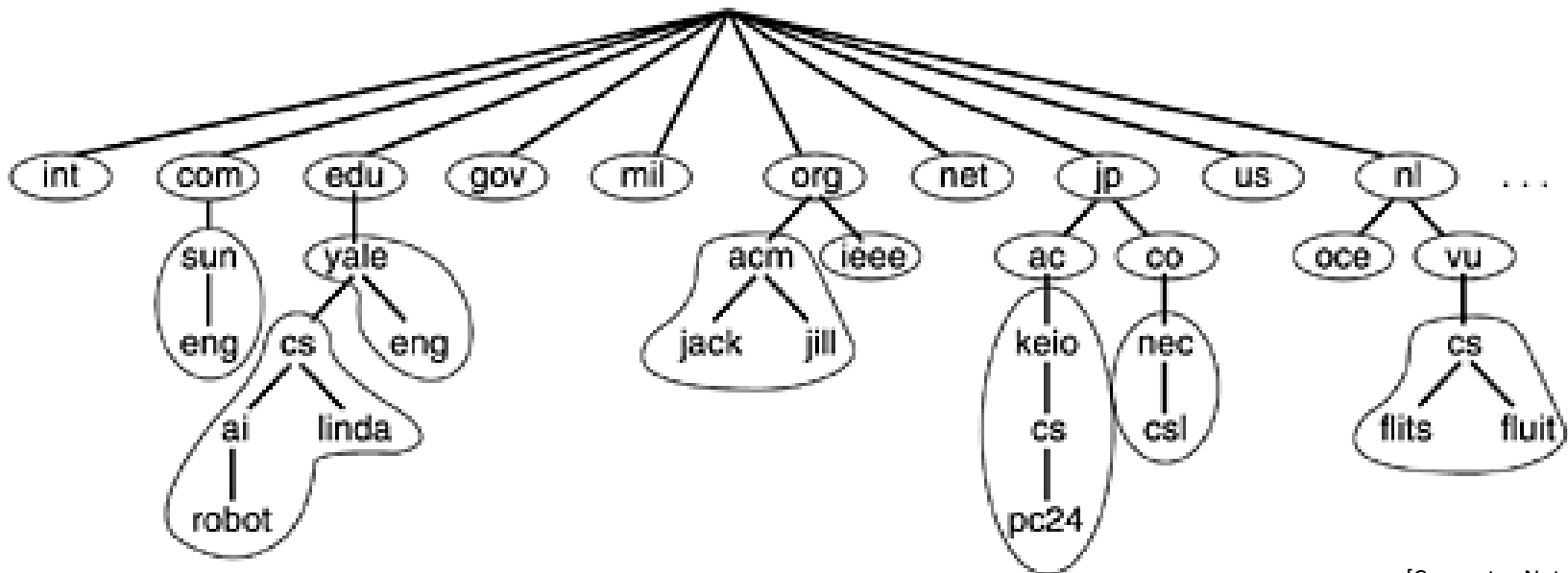 - Problems: loading and *"single point of failure"*

  - DNS name space is divided into non-overlapping areas

DNS| organization

- Name servers

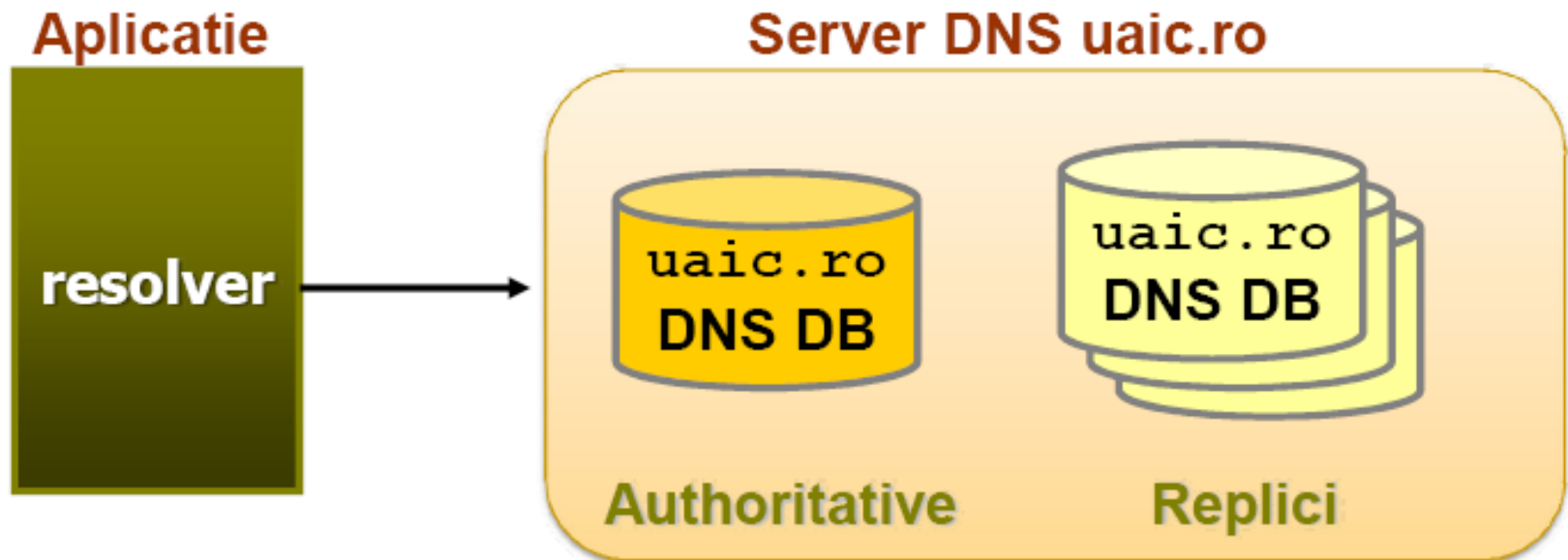 Example: A possible division of DNS namespace in areas

[Computer Networks, 2003
Andrew S. Tanenbaum]

DNS| organization

- Name servers
  - There is a *primary/authoritative name server* that manages a certain domain, and possibly, more secondary servers contain replicated databases
  - TCP is used for DNS replication
  - UDP is used for queries (*lookups*)

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DNS| organization

- ## DNS Client

  - Called ***resolver***, sends an UDP packet to DNS server; the server seeks the name and returns the IP address

Aplicatie

Server DNS uaic.ro

resolver →

uaic.ro
DNS DB

uaic.ro
DNS DB

Authoritative

Replici

[Retele de calculatoare – curs 2007-2008, Sabin Buraga]

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DNS| organization

- Example of name server implementations: **BIND** (Berkeley Internet Name Domain), MSDNS, PowerDNS etc.

- As interactively resolver (client), it can be used: **nslookup**, **host** or **dig**.

DNS| queries

- Queries:
  - **Recursive** – if a DNS server does not know the address for the requested name, then it will query another DNS server
  - **Incremental** – if the DNS server does not know how to respond, it will return an error and another DNS server address (also called *referral*) that may know the answer to your query

[http://technet.microsoft.com/en-us/library/cc775637%28v=ws.10%29.aspx]

DNS| queries

- Each domain is associate with a set of resource records (*resource record* – **RR**)
- The mechanism:
  - The request: the *resolver* sends a domain name
  - The response: the resource records associated with that name (stored in DNS database)

DNS creates a correspondence between the domain Names and the resource records

DNS| queries

- RR general form:

Domain_Name Time_to_live Type Class Value

Domain name – specifies the field covered by this registration

Time-to-live – gives an indication of how stable the recording is

DNS| queries

Tip - specifies the registration type

- **SOA** (*Start Of Authority*) : the current domain, administrator e-mail address, etc.

- **A** – host IP

- **MX** (mail exchangers) – specifies the domain name ready to accept mail for the specified domain

- **CNAME** (*Canonical Name*) – allows creation of pseudonyms

- **PTR** (Pointer) – Alias for IP address

- **HINFO** – allows to find: computer type, operating system type corresponding to the domain

- **TXT**: uninterpreted text (comments)

DNS| queries

Class: for Internet its value is IN

Value: this field can be a number, a domain name or an ASCII string; the semantics depend on registration

Example of DNS resource records

Type	Meaning	Value
SOA	Start of Authority	Parameters for this zone
A	IP address of a host	32-Bit integer
MX	Mail exchange	Priority, domain willing to accept e-mail
NS	Name Server	Name of a server for this domain
CNAME	Canonical name	Domain name
PTR	Pointer	Alias for an IP address
HINFO	Host description	CPU and OS in ASCII
TXT	Text	Uninterpreted ASCII text

DNS| configuration

- Example of a file containing a DNS zone specification

```
; Zone file for axiologic.ro
;
; The full zone file
;
$TTL 3D
@       IN      SOA     ns1.axiologic.ro. abss.axiologic.ro. (
                        2007050103          ; serial, todays date + todays serial #
                        14400               ; refresh, seconds
                        7200                ; retry, seconds
                        1209600             ; expire, seconds
                        1D )                ; minimum, seconds
;
@               NS      ns1.axiologic.ro.                   ; Inet Address of name server
@               NS      ns2.axiologic.ro.                   ; Inet Address of name server
@               MX      5 mailx.axiologic.ro.       ; Primary Mail Exchanger
;
localhost       A       127.0.0.1
axiologic.ro.   A       72.249.105.153
www             A       72.249.105.153
mailx           CNAME   axiologic.net.
mail            A       207.210.101.144
ftp             A       72.249.105.153
axiologic.ro. IN TXT "v=spf1 mx mx:mailx.axiologic.ro. ~all"
ns1             A       207.210.101.144
ns2             A       207.210.101.216
~
(END)
```

DNS| clients, resolvers, servers
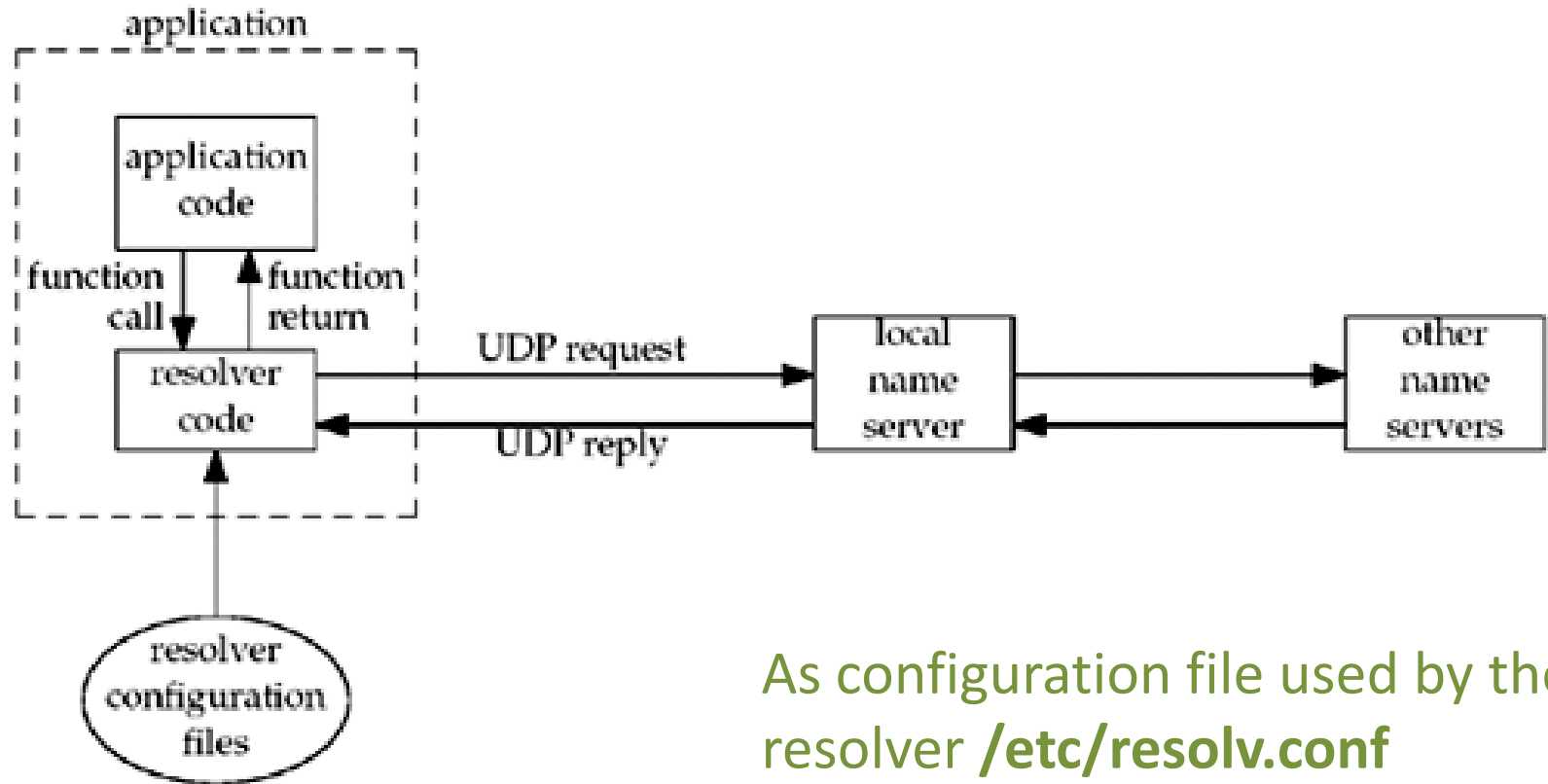
As configuration file used by the resolver **/etc/resolv.conf**

[Unix Network Programming, R. Stevens
B. Fenner, A. Rudoff - 2003

DNS| configuration

- /etc/resolv.conf file:

```
[adria@thor ~] $ cat /etc/resolv.conf
domain info.uaic.ro
search info.uaic.ro
nameserver 85.122.16.1
nameserver 85.122.16.4
[adria@thor ~] $ 
```

DNS| reverse queries

- Problem:
  - If we have an address, which will be its symbolic name? (*reverse DNS resolution* or *reverse DNS lookup*)

Example:

1)
```
[adria@ns1 ~]$ host 85.122.23.1
1.23.122.85.in-addr.arpa domain name pointer thor.info.uaic.ro.
[adria@ns1 ~]$
```

2) 2001:db8::567:89ab

    b.a.9.8.7.6.5.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.8.b.d.0.1.0.0.2.ip6.arpa

DNS| optimizations

Spatial proximity: local servers will be queried more often than others at the distance

Temporal proximity: if a set of fields are referenced repeatedly then DNS caching mechanism is used

For each DNS entry a TTL (*time to live*) value is set

Replication is also used (multiple servers, multiple root servers) – the nearest(geographically) server will be interrogated

Summary

- Domain Name System (DNS)
  - Characterization
  - Organization
  - Configuration
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Questions?