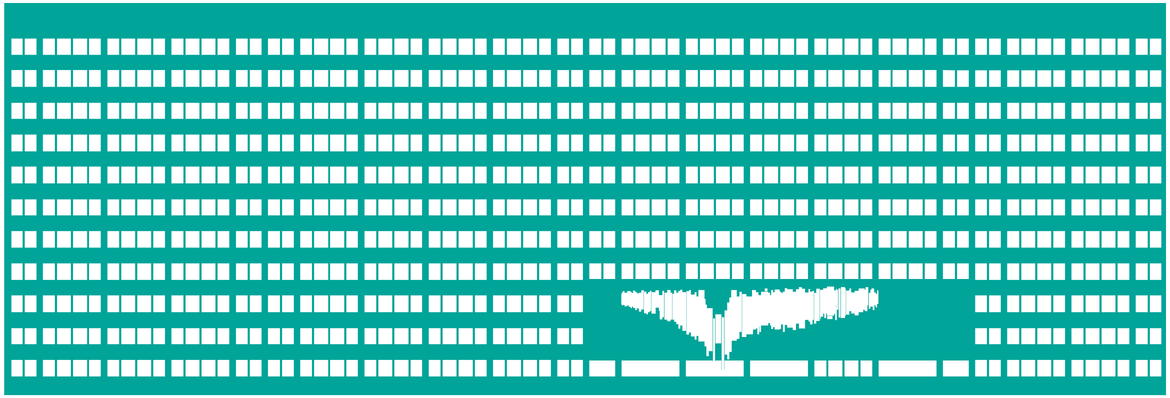
VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE | DEPARTMENT OF COMPUTER SCIENCE

Domain Name System (DNS)



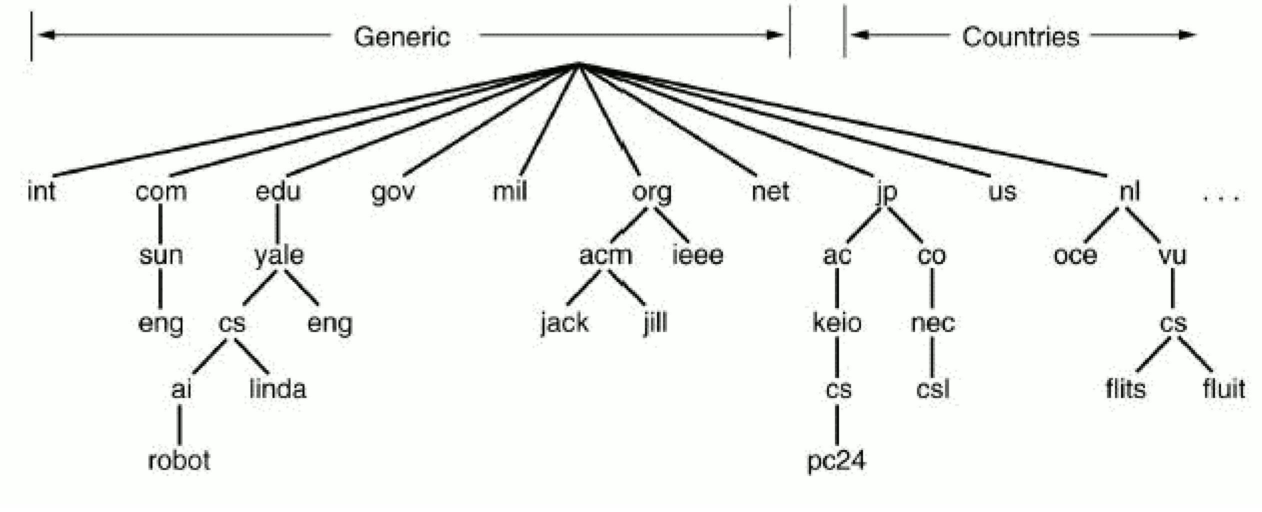
Computer Networks
Seminar 12

DNS Introduction (Domain Name System)

- Naming system used in Internet
- Translate domain names to IP addresses and back
- Communication works on UDP (port 53), large requests/responses are sent over TCP (port 53)
- DNS server processes requests, which gets from Resolver, and responses to them
- Resolver is system component, which communicates with DNS server

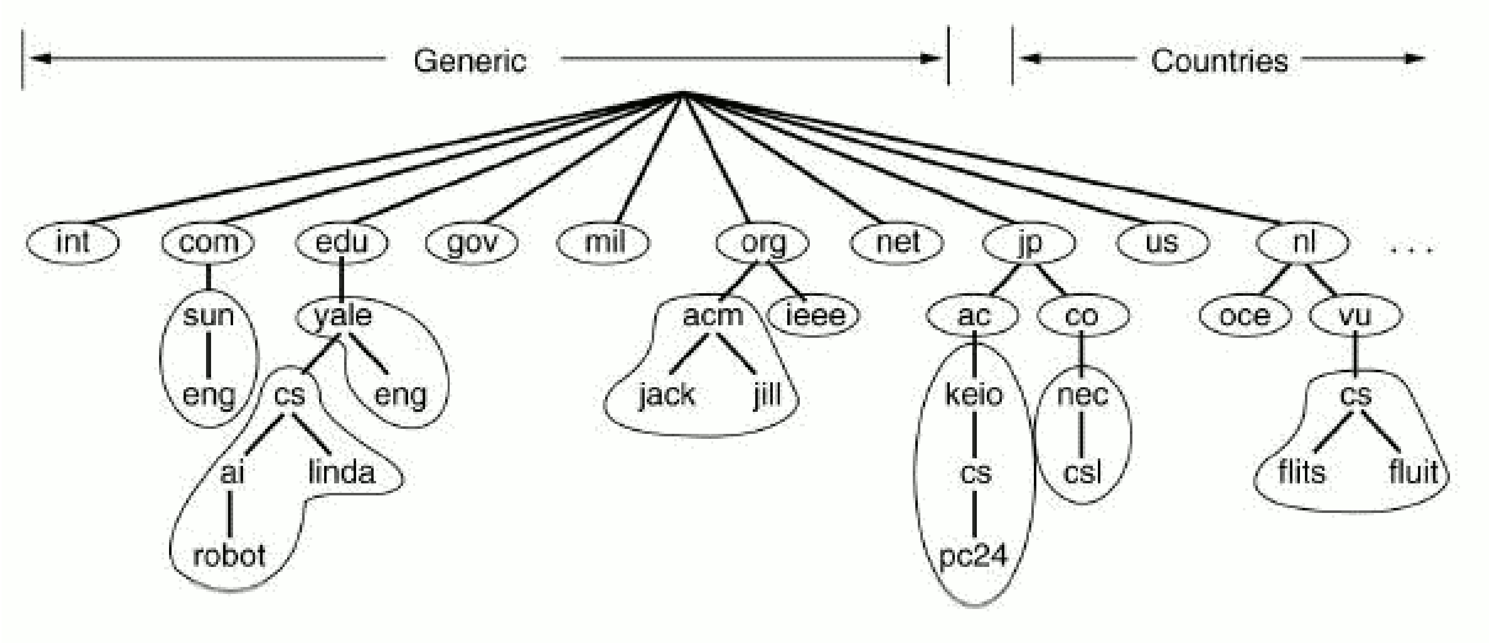
Domains

- Domains:
  - generic: .edu, .com, ...
  - country codes : .cz, .it, .uk, ...
- Domain names are hierarchically organized (root of the tree is domain ".")
- Maximum domain name length is 256 char. (1 subdomain max. 63 characters)



Zone

- Zone is a part of the tree stored on single DNS server
- DNS is authoritative for domains which are contained in the zone the server controls



DNS record types

- **SOA** – *Start of authority* – specifies authoritative information about a DNS zone, including the email of the domain administrator and several timers relating to refreshing the zone.
- **NS** – *Name server* – delegates a DNS zone to use the given authoritative name servers
- **MX** – *Mail exchange* – maps a domain name to a list of mail exchange servers for that domain
- **A/AAAA** – Address – returns IPv4/IPv6 address to given domain name
- **CNAME** – *Canonical name* – alias of one name to another
- **PTR** – *Pointer* – for storing reverse records

Getting the information from DNS server – nslookup program

- Alternatives of **dig** program used in OS Windows
- Commands:
  - `set type=<record_type>`
    - (NS,A, ... or ANY, which displays all the records)
- Example:
  -
    ```
    C:\> nslookup
    > server DNS_server
    > set type=A
    > homel.vsb.cz
    ```
- `Another utility – host`

Getting the information from DNS server – command dig

- Looks for and displays the information from DNS server (Linux)
- Parameters of program dig:
  - **@**<*server*> - name or IP address of DNS server
  - **-t** <*record_type*> - specifies record type
  - **-p** <*port*> - if we are using nonstandard port
- Example: **`dig -t A homel.vsb.cz`** (or dig homel.vsb.cz A)
- DNS server response:
  - **QUESTION SECTION** – request on DNS server
  - **ANSWER SECTION** – response to the request
  - **AUTHORITY SECTION** – tells which DNS server is authority
  - **ADDITIONAL SECTION** – additional information, usually contains IP addresses of authoritative DNS servers

Example of command DIG requests

- Gets IP address of yahoo.com
  - **dig** yahoo.com –t A or dig yahoo.com A
- Gets a list of mail servers for yahoo.com
  - **dig** yahoo.com MX +noall +answer
- List of authoritative DNS servers for yahoo.com
  - **dig** yahoo.com NS +noall +answer
- Displays all we tried with previous commands
  - **dig** yahoo.com ANY +noall +answer
- Gets PTR record
  - **dig** 49.149.196.158.in-addr.arpa. ANY +noall +answer
  - **dig -x** 158.196.149.9

Configuration of DNS server BIND

- **Bind** is DNS server implementation for OS OS Linux, Windows and FreeBSD. Configuration is split into few files.
- /etc/bind/**named.conf** – main configuration file. There are zones defined for which the server is authoritative (in named.conf.*).

  -
    ```
    options { //in named.conf.options file nowadays
      directory "/var/cache/bind";
         //where bind looks for configuration files
      recursion yes;                    //allows recursive lookup
      // uncomment forwarders and set them to 158.196.0.53
      // set dnssec-validation to false if it causes problems
      …
    };
    zone "." {     // link to the zone file with root servers
      type hint;//means that contains only list of root servers
      file "/etc/bind/db.root";
    };
    ```
- /etc/bind/db.* – records definition for particular zone (e. g. db.testEB4x)

testEB4 zone definition

- In bind distribution we implicitly find some zones pre-configured (**localhost**, **127.in-addr.arpa**, **0.in-addr.arpa**)
  - Definition of next zone in file **named.conf.*** could look like following:

    -
      ```
      zone "testEB4x.cs.vsb.cz" {
      type master;  //this name server will be
                    //primary and authoritative
                    //for this domain.
      file "/etc/bind/db.testEB4x";
        //File with definitions of the records
      };
      ```

Configuration of zone testEB4 file db.testEB4

- **`$ORIGIN cs.vsb.cz.`**
  - The value ORIGIN is implicitly added to the names, which doesn't end with dot.
- **`$TTL 604800`**
  - How long the record will be kept in cache
- **SOA** record must **always** be written **one time** at the beginning of zone file:

```
testEB4x IN SOA  ns.testEB4x admintestEB4.vsb.cz.
           (2018092414 ;
            604800 ;
            …  )
```

  - **ns.testEB4x**
    - Name of domain primary DNS server (ns.testEB4.cs.vsb.cz.)
  - **admintestEB4x.vsb.cz.**
    - E-mail of domain administrator (use "." instead of @)

Configuration of zone testEB4x file db.testEB4x

- **SOA** record should be followed by **NS** record specifying DNS server for given domain (`$ORIGIN testEB4.cs.vsb.cz.`)

```
                  NS        a.ns
        a.ns      A         158.196.135.88
```

- Assigning IP address to pc1.testEB4.cs.vsb.cz.

```
        pc1       A         158.196.135.66
                  TXT       "computer No.1"
```

- Alias definition for pc1

```
        www       CNAME     pc1
```

- Subdomain NS defintion

```
        subdom    NS        ns.subdom
        ns.subdom A    158.196.135.66
```

DNS server configuration for reverse lookup

- It serves for IP address to domain name mapping
- We put zone definition for reverse lookup into file **named.conf**
- Domain name of the record for reverse lookup of address A.B.C.D is

  D.C.B.A.in-addr.arpa.

  -
    ```
    zone "135.196.158.in-addr.arpa" {
     type master;
     file "/etc/bind/db.135.196.158.in-addr.arpa";
    };
    ```

Zone configuration 135.196.158.in-addr.arpa.

- Based on same rules used for configurating nomrmal zone. There must exist records **SOA** a **NS** (name server responsible for domain)
- Instead of record **A** we use record **PTR**, which maps IP addresses to domain names

```
$ORIGIN 135.196.158.in-addr.arpa.
66         PTR pc1.testEB4x.cs.vsb.cz.
```

resolv.conf, hosts, host.conf

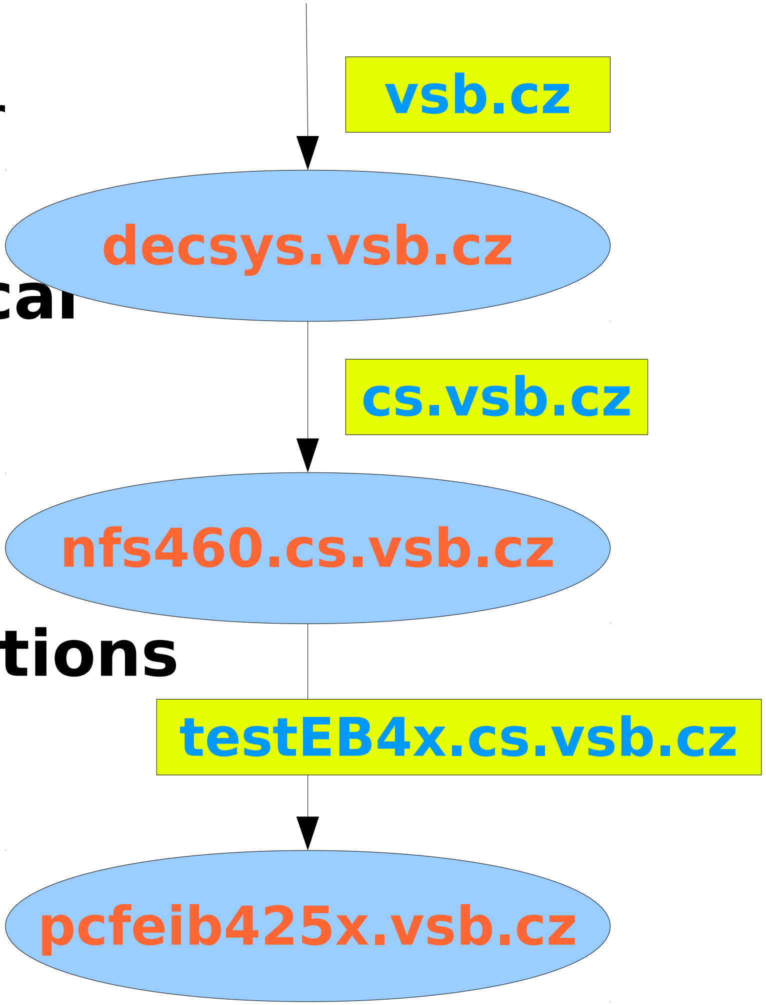
- Files contaning **resolver** configuration (Linux), in **`/etc`**
  - **resolv.conf** – configuration of DNS on client's side
    - commands:
      - search <domain> – implicit added domain
      - nameserver <DNS server IP address>
  - **hosts** – manually (staticaly) configured addresses (also in Windows)
    - <IP address> <name> [<name2> ...]
  - **host.conf** – order of record sources (static and DNS addresses) in resolving (no effect in new OS)
    - order hosts, bind – first file hosts, after DNS

Tools for checking BIND DNS server configuration

- Syntactic check of configuration files
  - **named-checkconf** *(etc/bind/named.conf*
    - Or for individual named.conf.* config files
  - **named-checkzone** *zone zone_db_file*
    - Out-of-zone data or missing A records for domains where part of DN is repeated twice mean there is an error as well.
- Running named in foreground (sudo)
  - **named -g**
  - If not possible, try: **service bind9 stop**

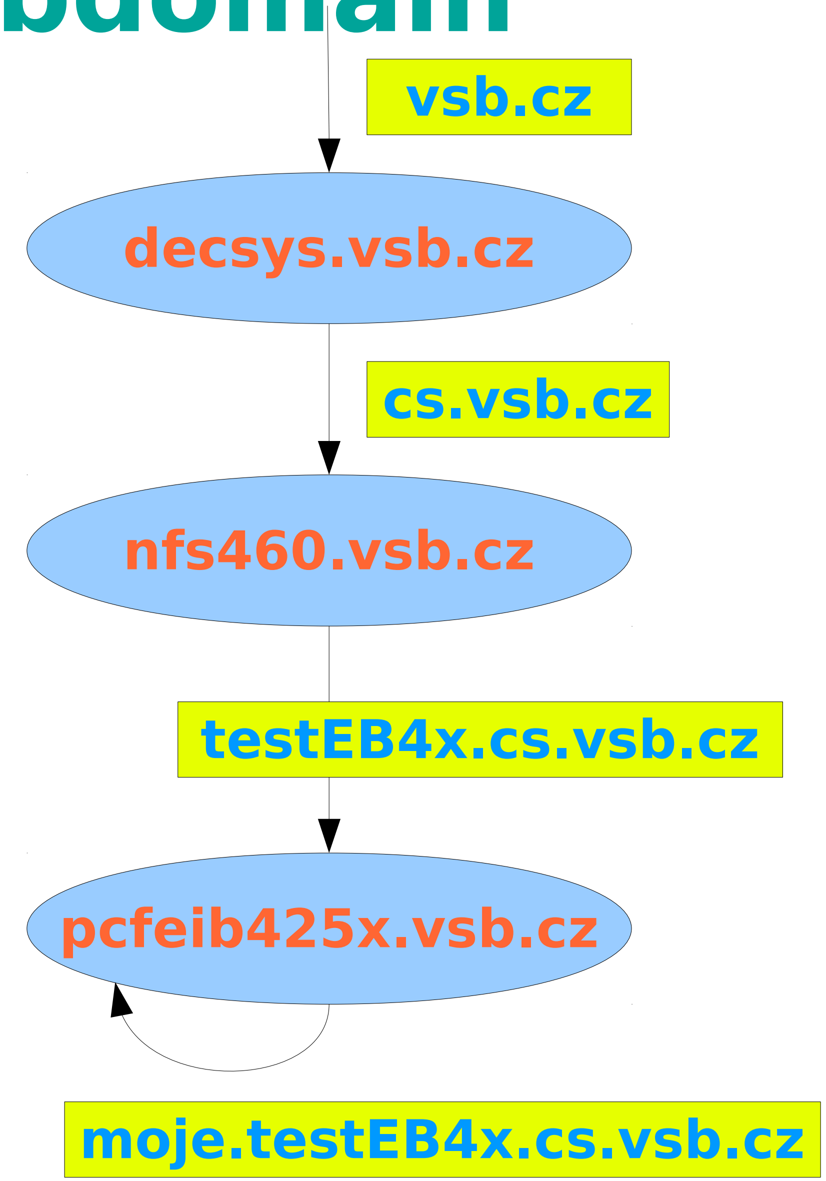
First Task – basic DNS records

- Bind DNS server configuration
  - Add your DNS server for testEB4x**.cs.vsb.cz**
    - In **named.conf.local**
  - Add **SOA**, **A** and **TXT** records
  - Enable Reverse lookup
    - In **named.conf.options**
  - Set client resolver (**`/etc/resolv.conf`**)
  - Test the whole solution



Second task - subdomain

- Add another level (subdomain) into DNS tree.
- Add an **SOA** record and all necessary **NS** and **A** records, for the subdomain add also **MX** and **TXT** records.



vsb.cz

decsys.vsb.cz

cs.vsb.cz

nfs460.vsb.cz

testEB4x.cs.vsb.cz

pcfeib425x.vsb.cz

moje.testEB4x.cs.vsb.cz

Third task – reverse records

- Configure the DNS server to be authoritative for the Z.Y.X.0/24 subnet’s **X.Y.Z.in-addr.arpa** zone, which will be assigned to you.
- Insert the **PTR** records for some addresses to this zone and test the reverse translation.
  - When checking the reverse translation, make sure the client is communicating directly with your DNS server.