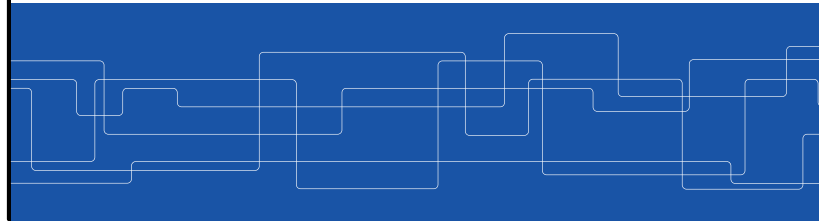




KTH ROYAL INSTITUTE
OF TECHNOLOGY

Name Services

Johan Montelius and Vladimir Vlassov





What's a name service

A service that provides information about remote resources given a name.



Terminology

Name or identifier:

- **name** - often human-readable
- **identifier** - not so

Pure names:

- **pure** - no internal information
- **non-pure** - contains information

Flat or hierarchical

- **flat** - all names directly comparable
- **hierarchical** - names interpreted in an environment

Resolving:

A name is **resolved**, resulting in information about an object, often the address, so one can access the object.

Address:

An **address**, at one level, could be a name on a lower level.




Flat or what

130.237.215.140

- Is this a pure name?
- Is it a flat name space?

```
> route
Kernel IP routing table
Destination    Gateway         Genmask         Flags Metric Ref    Use Iface
default        net215.it.kth.s 0.0.0.0         UG    1024  0      0 eth0
dhcprv-4a.lan. net215.it.kth.s 255.255.255.255 UGH    1    0      0 eth0
130.237.215.0  *               255.255.255.0   U     0     0      0 eth0
```

IP address is non-pure name because it contains a location information (class, net id and host id)



flat or what

```
eth0 Link encap:Ethernet HWaddr 00:1e:8c:93:c6:da
```

- Is this a pure name?
- Is it a flat name space?

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<http://www.aboutlinux.info/2006/11/ifconfig-dissected-and-demystified.html>

eth0 is the first ethernet interface

Link encap:Ethernet - This denotes that the interface is an Ethernet-related device

HWaddr 00:1e:8c:93:c6:da - This is the hardware address or MAC address unique to each Ethernet card manufactured. Usually, the first

half of this address will contain the manufacturer code, which is common for all Ethernet cards manufactured by the same manufacturer. The rest will denote the device Id, which should not be the same for any two devices manufactured at the same place.



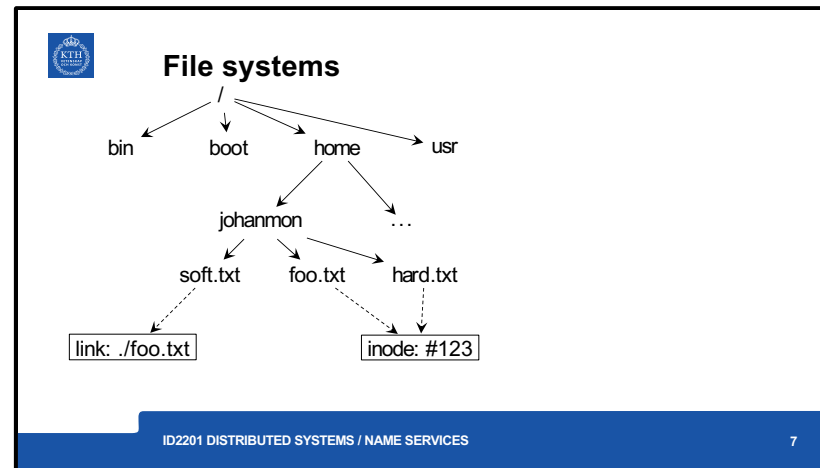
URI example

A scheme, a node, a port and a resource

`http://www.kth.se:80/people/~johanmon`
`mailto:johanmon@kth.se?subject=Test& body=Hej`
`spotify:track:6JEK0CvvjDjjMUBFoXShNZ`
`spotify:album:2mCuMMNdJkoyiXFhsQCLLqw`
`urn://isbn/0451450523`

A scheme, a name space and an identifier

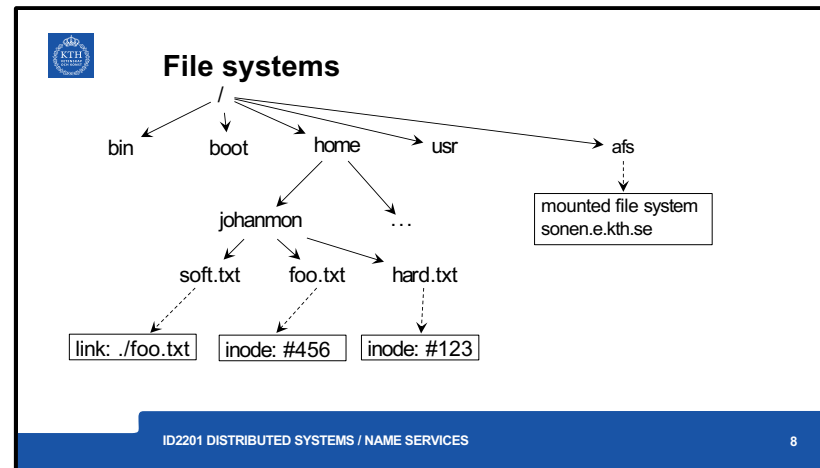
Uniform Resource Identifier (URI) includes URL and URN



In a Unix-style file system, the **inode** is a data structure used to represent a filesystem object, which can be one of the various things, including a file or a directory. **Each inode stores the attributes and disk block location(s) of the filesystem object's data.** An inode is referenced by number.

A **hard link** to a file will point to the place where the file is stored or the

inode of that file. A **symbolic (soft) link** will point to the actual file itself. Because file "soft.txt" points to file "foo.txt" itself, if file "foo.txt" is deleted, then file "soft.txt" will have nothing to point to; it is also deleted.



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DNS - Domain Name Service

- Originally the namespace was flat and stored in the hosts file on each client.
- John Postel developed DNS in -82, finally defined in Mockapetris RFC 1035 -87
- It grew from a few thousand entries to over 100 million entries!

Paul V. Mockapetris is an American computer scientist and Internet pioneer who, together with Jon Postel, invented the Internet Domain Name System. The Domain Name System is a name service design whose central naming database is used across the Internet.



DNS - Names and attributes

www.kth.se

A DNS name consist of:

- a top-level domain: **se**
- a sequence of subdomains: **kth**
- possibly a host name: **www**

Use **nslookup** to find the attributes of a name

```
> nslookup www.kth.se
Server:         127.0.1.1
Address:        127.0.1.1#53


Non-authoritative answer:
Name:   www.kth.se
Address: 130.237.28.40
```

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A naming domain is a namespace for which there exists a single overall administrative authority responsible for assigning names within it. This authority is in overall control of which names may be bound within the domain, but it is free to delegate this task. **Domains in DNS are collections of domain names; syntactically, a domain's name is the common suffix** within it. Otherwise, it cannot be distinguished from, for example, a computer name.

The administration of domains may be devolved to subdomains. The domain dcs.qmul.ac.uk – the Department of Computer Science at the Queen Mary University of London in the UK – can contain any name the department wishes. But the domain name dcs.qmul.ac.uk itself had to be agreed with the college authorities. who

domains) in use across the Internet were: com – Commercial organizations; edu – Universities and other educational institutions; gov – US governmental agencies; mil – US military organizations; net – Major network support centers; org – Organizations not mentioned above; int – International organizations.



DNS attributes

- A: the address of a host
- MX: the mail server of the subdomain
- CNAME: a symbolic link
- SOA: Start of Authority
- TXT: more stuff
- ... and more

```
> nslookup -type=SOA kth.se a.ns.kth.se
Server: a.ns.kth.se
Address: 130.237.72.246#53

kth.se
  origin = a.ns.kth.se
  mail addr = hostmaster.kth.se
  serial = 2015081901
  refresh = 14400
  retry = 900
  expire = 604800
  minimum = 86400
```

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Name servers store zone data in files in one of several fixed types of resource records, e.g., A, MX, CNAME, ...

-type=SOA SOA: Specifies the start-of-authority for a DNS zone.

The SOA ("Start Of Authority") Record for a domain provides technical information about the domain. It can be queried with the option -type=soa.

origin: The authority from which the information originated.

mail addr: The email address of the domain administrator (The first dot would be an @ symbol in an email address, so here the email address is hostmaster@kth.se).


serial: Revision data for this information, in the form YYYYMMDDNN. Here, the information is current as of August 19, 2015; 01 means it was the first revision made that day.

the secondary KTH name server's information is never more than 4 hours (14400 seconds) out of date.

retry: The secondary nameserver will wait this many seconds before attempting to reconnect to the primary name server after a failed attempt.

expire: The secondary nameserver's cache of the primary nameserver's

the last refresh.



DNS attributes

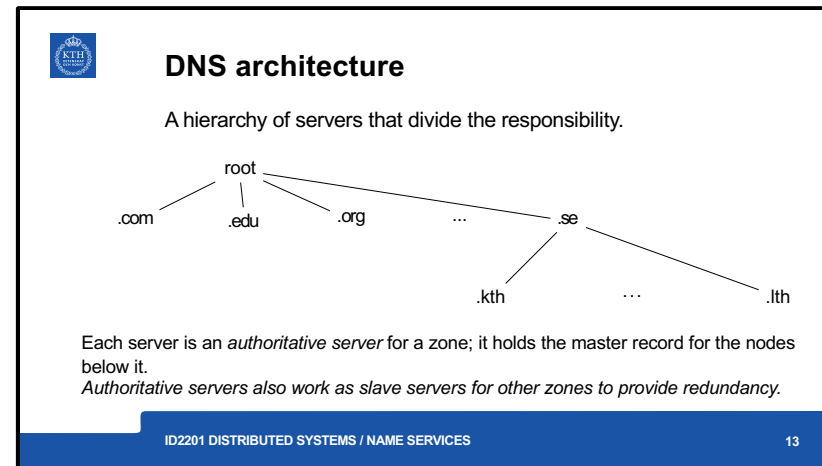
```
> nslookup -type=TXT kth.se a.ns.kth.se
Server: a.ns.kth.se
Address: 130.237.72.246#53

kth.se text = "3 - SE-100 44 STOCKHOLM"
kth.se text = "2 - Kungliga Tekniska Högskolan"
kth.se text = "5 - Tel. +46 8 790 60 00"
kth.se text = "1 - Royal Inst of Technology"
kth.se text = "v=spf1 a:mx5.kth.se a:mx6.kth.se a:mx7.kth.se a:smtp-3.sys.1"
kth.se text = "MS=ms86914267"
kth.se text = "4 - SWEDEN"
```

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-type=TXT Specifies the text information.

A TXT record (short for text record) is a type of resource record in the Domain Name System (DNS) used to provide the ability to associate some arbitrary and unformatted text with a host or other name, such as human-readable information about a server, network, data center, and other accounting information.

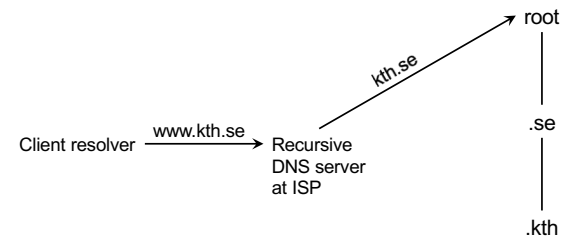


The problems of scale are treated by a combination of partitioning the naming database and replicating and caching parts of it close to the points of need. The DNS database is distributed across a logical network of servers. Each server holds part of the naming database – primarily data for the local domain. Queries concerning computers in the local domain are satisfied by servers within that domain. However, each server records the domain names and addresses of other name

servers so that queries
about objects outside the
domain can be satisfied.

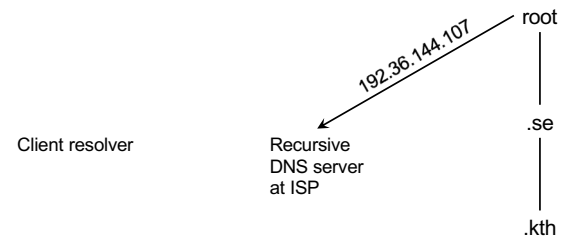


DNS resolution



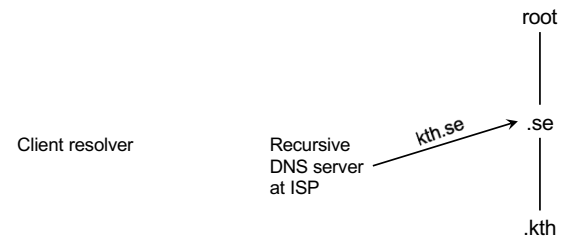


DNS resolution



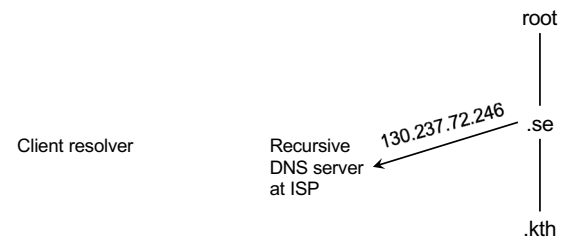


DNS resolution



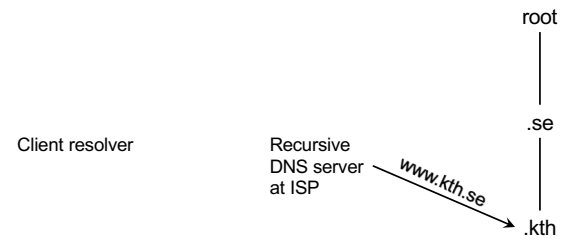


DNS resolution



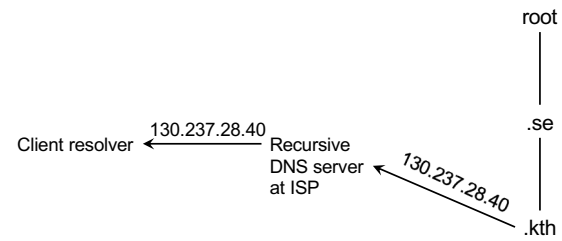


DNS resolution



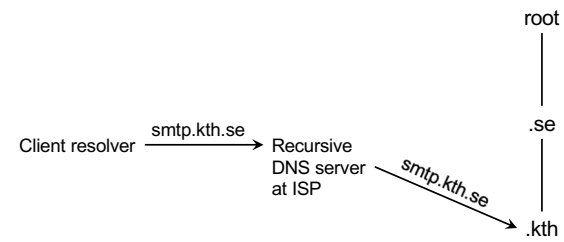


DNS resolution



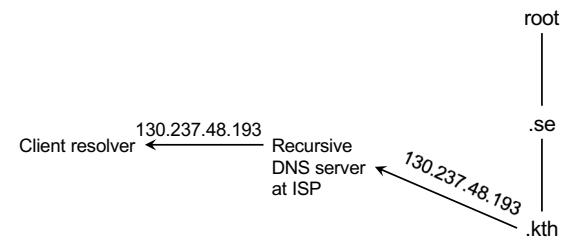


DNS resolution



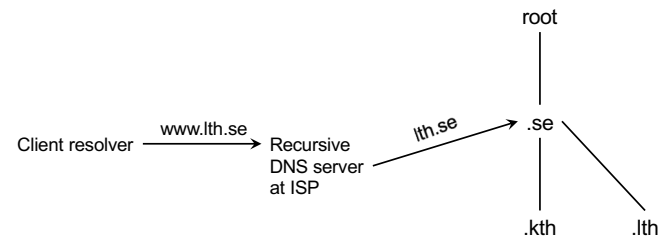


DNS resolution



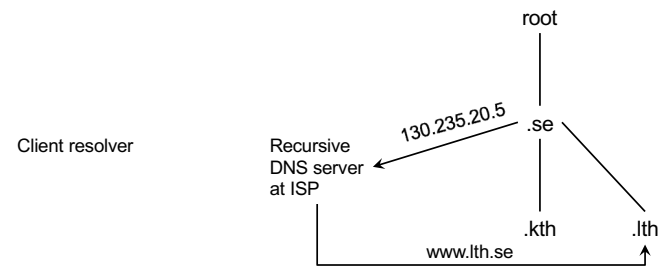


DNS resolution



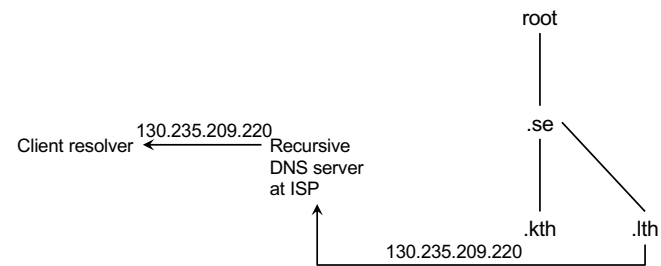


DNS resolution



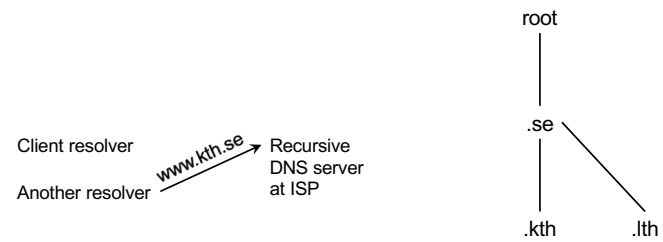


DNS resolution



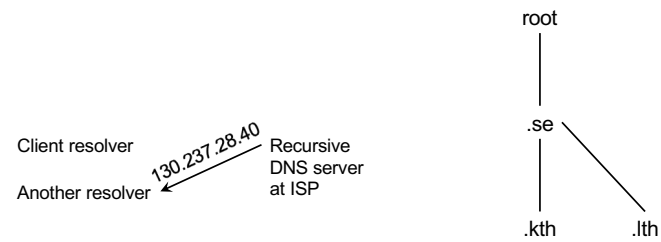


DNS resolution





DNS resolution




The recursive or caching-only DNS server is essential for performance.



DNS infrastructure

- There are 13 DNS *logical root servers* in operations.
- Each *logical root server* is replicated at up to 20 locations worldwide but shares the same IP address.
- An ISP has several recursive DNS servers used by subscribers (i.e., you).
- Due to caching, there could be delays in updates to up to 24 hours.
- DNS servers can be used as load balancers and hand out different or multiple replies based on time and location.



DNS Round Robin load balancing

```
> nslookup -type=A www.google.com ns1.google.com
Server:      ns1.google.com
Address:     216.239.32.10#53

Name:   www.google.com
Address: 64.233.161.106
Name:   www.google.com
Address: 64.233.161.104
Name:   www.google.com
Address: 64.233.161.147
Name:   www.google.com
Address: 64.233.161.103
Name:   www.google.com
Address: 64.233.161.105
Name:   www.google.com
Address: 64.233.161.99
```

```
> nslookup -type=A www.google.com ns1.google.com
Server:      ns1.google.com
Address:     216.239.32.10#53

Name:   www.google.com
Address: 64.233.161.104
Name:   www.google.com
Address: 64.233.161.105
Name:   www.google.com
Address: 64.233.161.106
Name:   www.google.com
Address: 64.233.161.99
Name:   www.google.com
Address: 64.233.161.147
Name:   www.google.com
Address: 64.233.161.103
```

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-Type=A Specifies a computer's IP address



Directory service

A directory service will look up an object given a description of its *attributes*.

More general than name services that typically require a *name* to be given.



X.500/LDAP

X.500

- the vision of a global telephony directory
- standardized by ITU in 1997
- used Directory Access Protocol (DAP)

LDAP


- Lightweight DAP, RFC 2251 in 1997
- initially used as a proxy for DAP servers
- used by email clients for address books
- simple interface to databases

X.509 is the standard for digital certificates

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ITU: International Telecommunication Union is the United Nations specialized agency for information and communication technologies – ICTs.



LDAP example

```
> ldapsearch -x -h ldap.kth.se
-b ou=Addressbook,dc=kth,dc=se -LLL "ugUsername=johanmon"

dn: cn=Johan Montelius (johanmon),ou=Addressbook,dc=kth,dc=se
objectClass: top
objectClass: person
ugUsername: johanmon
ugKthid: u1bx6gxe
givenName: Johan
sn: Montelius
displayName: Johan Montelius
mail: johanmon@kth.se
cn: Johan Montelius (johanmon)
```

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The **ldapsearch** command-line utility can locate and retrieve directory entries. This utility opens a connection to the specified server using the specified distinguished name and password and locates entries based on a specified search filter. The search scope can include a single entry, an entry's immediate subentries, or an entire tree or subtree.

Search results are returned in LDIF format.



LDAP example

```
> ldapsearch ... "(&(sn=Montelius)(objectClass=eduPerson))" givenName

dn: cn=Erika Montelius (erikamo),ou=Addressbook,dc=kth,dc=se
givenName: Erika

dn: cn=Hans Montelius (hansmo),ou=Addressbook,dc=kth,dc=se
givenName: Hans

dn: cn=Johan Montelius (johanmon),ou=Addressbook,dc=kth,dc=se
givenName: Johan
:
:
```



Summary

- name services - maps unique names to resources
 - DNS - distributed hierarchical architecture
- directory services - query directory given attributes
 - X.500
 - LDAP