

CS 4/55231 Internet Engineering	Kent State University Dept. of Computer Science
	LECT-9

Client Server Model

- Client:** Any program can be a client temporarily of a specific remote service. Generally it is invoked, controlled by user. It runs only one session.
- Server:** A special purpose privileged program dedicated to one service. Waits passively for client requests.

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Server Models

- Multiple Services on One Computer
- Service Identification
- Multiple Copies of Servers for Single Service
- Dynamic Server Creation
- Service Reachable via Multiple Protocol
- A server can be client of another service

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TCP Ports and Client ID, & Server ID

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Some Internet Applications based on Server Client Architecture

- FTP
- NFS
- DNS
- EMAIL

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FTP

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FTP

- One of the most widely used protocol and the oldest application on Internet! It predates TCP/IP. An ARPANET protocol.


!	cr	macdef	proxy	send
\$	delete	mdelete	sendport	status
account	debug	mdir	put	struct
append	dir	mget	pwd	sunique
ascii	disconnect	mkdir	quit	tenex
bell	form	mls	quote	trace
binary	get	mode	recv	type
bye	glob	mput	remotehelp	user
case	hash	nmap	rename	verbose
cd	help	ntrans	reset	?
cdup	lcd	open	rmdir	
close	ls	prompt	runique	

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Format Translation

- LF <----> CR-LF
- TEXT ASCII <----> EDCDIC
- Binary mode: no change

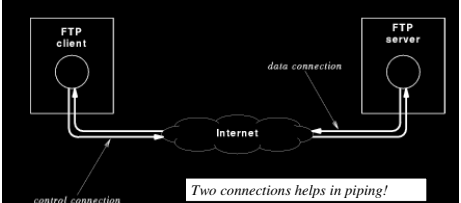



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FTP Control & Data Connection

- Uses separate control and data connections.
- One control connection per session, but may have several data connections in between.






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Network File System

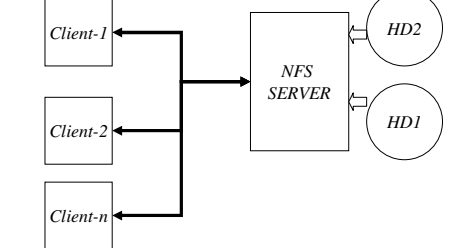
- Instead of full file transfer, it offers open, read, write, append a specific number of bytes, close operations on a remote file.
- Not the entire file, but only the requested, or modified, written data bytes travel across the network.
- There is no explicit client. NFS client has been integrated inside OS/UNIX file system. When a remote file is opened it is added in the directory structure.




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Network File System






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DNS

and also an example of server client software




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New Thing

- John Postel: Postel Address:
- ICANN New boss (November 1998, US DOC):
- Internet Corporation for Domain Name (ICANN) a nonprofit, public-benefit corporation.
- Its function is to oversee the present and future distribution and management of domain names and IP numbers on the Internet, and do so with a BOG.
- It will accredit competing domain name registrars who will actually do the registration of the COM, NET and ORG suffixes with so called Shared Registration System (SRS).
- Will assign new gTLDs (generic TLDs) vs. the current ccTLDs (country code TLD).
- 60 new registrars applied. NSI is not among them! NSI charged 35\$




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Domain Name Service

- Symbolic names are convenient for humans. The IP addresses are not easy to remember. As the size of internet started to grow, researcher decided to provide symbolic names to hosts.
- An application must translate a domain name into its IP address before it can communicate.
- This is performed automatically by a client (called **resolver**) and server (**DNS server**) software installed in most hosts.




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Structure of Domain Addresses

Domain Name	Assigned To
com	Commercial organization
edu	Educational institution
gov	Government organization
mil	Military group
net	Major network support center
org	Organization other than those above
arpa	Temporary ARPA domain (still used)
int	International organization
country code	A country

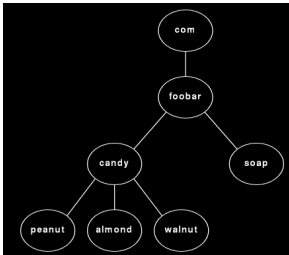
- Still Hierarchical!
 - Can be managed in distributed fashion.
 - IANA only assigns top domains.




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Domain Names inside an Organization



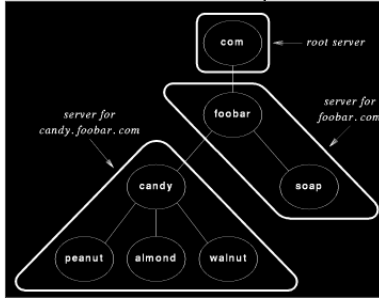



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DNS Server Hierarchy

- DNS design goal: "Autonomy" and "distributed" DB and resolution.
- DNS servers are also hierarchical and independent. Each one is only the authority of a sub-tree.



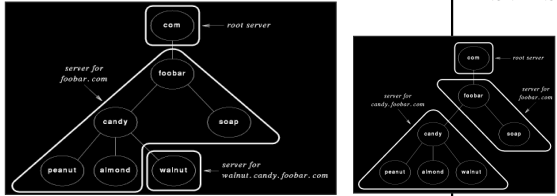



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Server Architecture

- The trees can be divided in any way






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DNS Server


- Each server contains a database of IP addresses within its own authority domain.
- It can add delete, modify new entries for the computers in its own domain.
- Plus, each server is required to know:
 - a root server, and
 - all the server's that are authorities for names further down the 'delegated' hierarchy.



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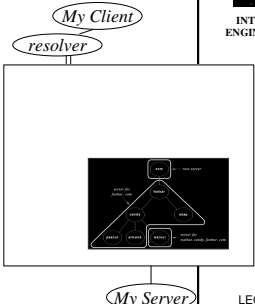
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Name Resolution




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- Resolver initiates a query
 - gethostbyname()).
- It can use UDP (preferred) or TCP.
- How the request from a remote computer C for walnut.candy.foobar.com is resolved?



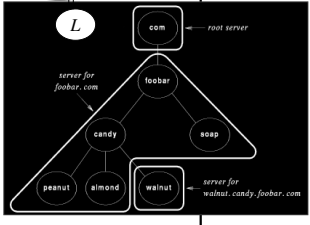
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Name Resolution (contd..)




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- How the request from C for myserver.walnut.candy.foobar.com is resolved?
 - C contacts local DNS server L
 - L contact .com root R.
 - R sends IP of foobar.com F (candy).
 - L contacts F (Walnut).
 - F sends IP of Walnut..
 - L contacts Walnut



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Optimization




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- Server Duplication
 - root servers are duplicated.
 - A local server can contact all, however, uses the one which relies fastest (geographical locality)
- Caching
 - all local DNS servers tries to cache the bindings (temporal locality).

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DNS Database




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- Each DNS database has five entries to match domain names to value.
- Abbreviation handling is local!
- Usually one computer will have one resolver and all applications will share it.

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Fields in DNS Resource Record




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- Domain Name
- Time_to_live
 - High value means can be cached longer
- Class
 - IN (Always IN for internet info).
- Type
- Value
 - Depends on Type (example IP).

If you send a mail, that can reach. But ping may not work!

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DNS Resource Types



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
- A IP address
- MX mail exchange.
- NS name server
- CNAME alias domain name
- PTR alias for an IP address
- SOA source of authority (admin's
- HINFO host idescription (CPU etc.)
- TXT comment

If you send a mail, that can reach. But ping may not work!

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Example DNS Entries

- cs.kent.edu 22000 IN SOA boss@kent.edu
- cs.kent.edu 22000 IN MX 1 mail1.kent.edu
- cs.kent.edu 22000 IN MX 2 mail2.kent.edu
- ma.kent.edu 2300 IN HINFO Sun Unix
- www.kent.edu 4400 IN CNAME web.kent.edu
- Web.kent.edu 4400 IN A 131.123.46.24



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
DNS Registration

- Registering first level domain names

Go to InterNIC

- Automatic Search of registration Information

Go Aegis



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Internet Mail

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Electronic Mail Message Format

```

From: John_Q_Public@foobar.com
To: 912743.259843@nonexist.com
Date: Wed, 4 Sep 96 10:21:32 EDT
Subject: lunch with me?


```

Bob,

Can we get together for lunch when you visit next week? I'm free on Tuesday or Wednesday -- just let me know which day you would prefer.

John

Keyword	Meaning
From	Sender's address
To	Recipients addresses
Cc	Addresses for carbon copies
Date	Date on which message was sent
Subject	Topic of the message
Reply-To	Address to which reply should go
X-Charset	Character set used (usually ASCII)
X-Mailer	Mail software used to send the message
X-Sender	Duplicate of sender's address
X-Face	Encoded image of the sender's face



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Multimedia Document


- MIME: Multipurpose Internet Mail Extensions
 - non ASCII documents can also be mailed without special encoding.

```

MIME-Version: 1.0
Content-Type: Multipart/Mixed; boundary="-----x"
Content-Type: text/plain
this is test.
-----x

```

Codeage Example:




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
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Mail System

- Email program = Composer+Mail Transfer
- Sender computer becomes client to the receiver computer.
- SMTP: Simple Mail Transfer Protocol
- Mail Explorer and Forwarder

Optimizations:
• all receiver on the same computer receives by one connection.





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Mail Gateways

- A computer dedicated to the processing of email.

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Gateways may have exploders.

Relays can make email access uniform.

Relays:
 List Contents
 javed 84321234@bristi.mcs.kent.edu

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Remote Mailbox

- All computers may not have mailbox. Also you may want to look into one server to check all your email!

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Sender-to-Mail Server vs. POP (or IMAP) Server to User's Computer

- SMTP vs. POP
- mail only vs. mailbox info
- authentication

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