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Sub: Computer Networks

Section II: Application Layer

CO6: Compare sustainable engineering practice indicating the scientific purpose and utility of communication frameworks and standards

Unit-VI Application Layer:

[CO6→ PO1, PO2, PO4, PO10, PO12, PSO04 – CO Strength 3,3,2,3,3,2]

Application Layer: Address Resolution: Domain Name System (DNS). WWW: Hyper Text Transfer Protocol (HTTP) and HTTPS with SSL. Web Service. Email: SMTP, MIME, POP3 and Webmail. File Transfer: FTP, Dynamic Logical Addressing: Dynamic Host Control Protocol (DHCP), Design, development and evaluation of scalable enterprise application using communication and service frameworks. **[4 Hrs]**

Why Domain Name System?

DNS is used to map a name to an address, other way round an address to a name.

When Internet was small it was done using host file.

Name Address

Today by considering the size of Internet, host file is not a good solution.

One solution is to keep entire information on one centralized computer and allow access to others. But it will create enormous traffic.

Another solution, the one used today, is to divide this huge information into smaller parts and store each part on a different computer at different location.

The host that need mapping can contact to closest/nearest computer.

This method is called DNS.

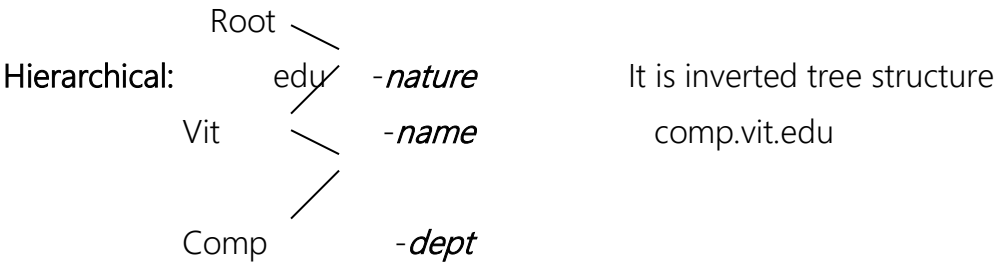
Name Space

Name space should be chosen very carefully and should have complete control over names and addresses.It should uniquely map the names to addresses. There are two methods

1. Flat and 2. Hierarchical

Flat Name: Simply a sequence of characters without any common structure.

Problem: Avoiding ambiguities

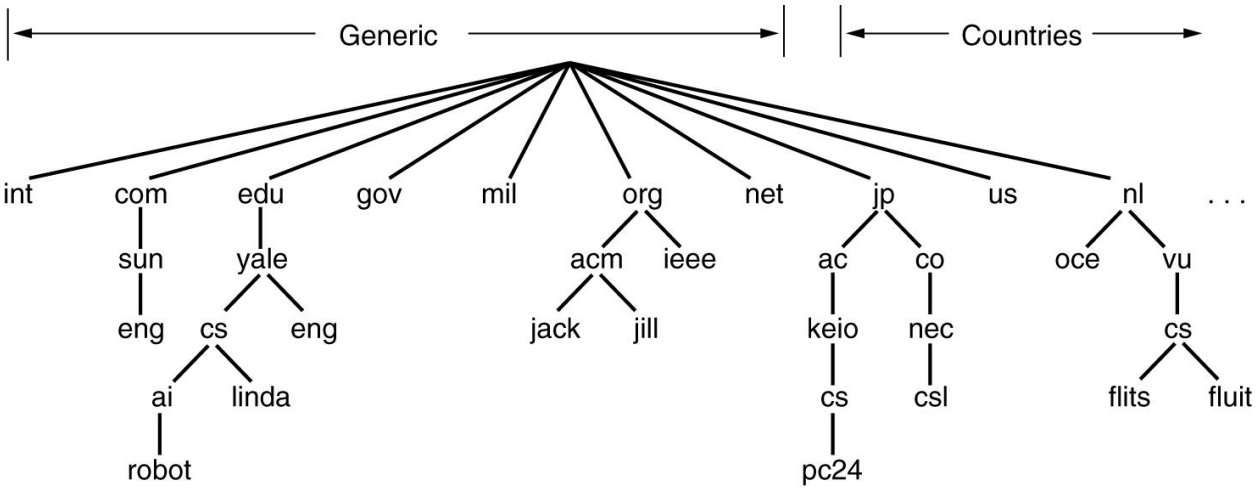


Vit/edu/mit are called labels and the maximum length of each label can be 63 characters

Fully Qualified Names: www.comp.vit.edu it is sequence of labels and terminated by null string.

Partially Qualified names: vit not terminated by null string. It is used only on client side. Prefix and suffix can be resolved by local server

Domain Name is a subtree of domain name space.



Distributed Name Space: It is set of DNS servers.

Server and its Zones (Area)

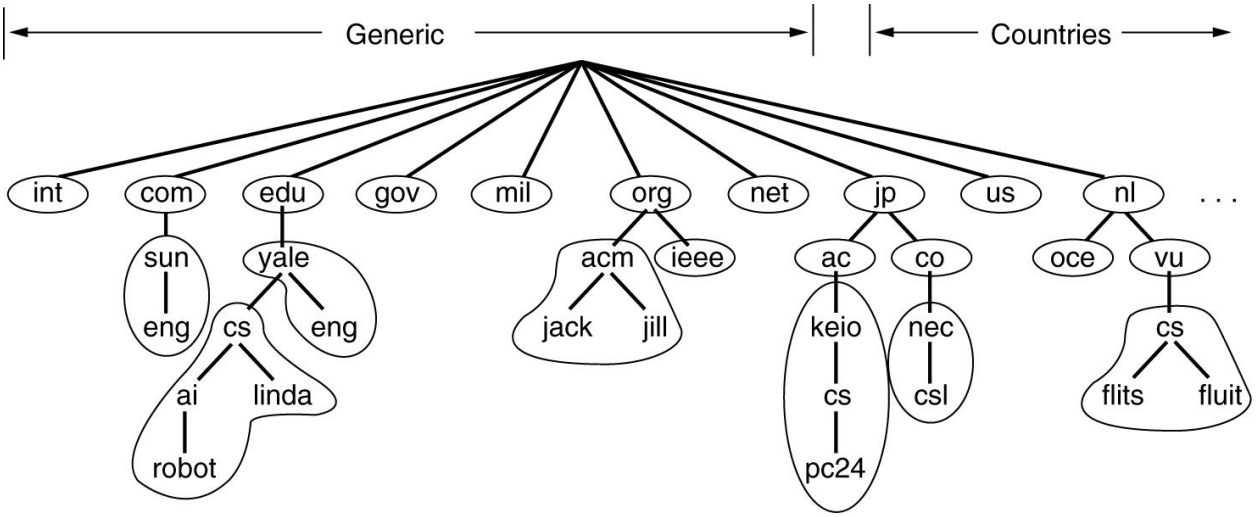


Fig: Part of the DNS name space showing the division into zones

Root Server: Covering whole domain name space. Does not store anything

Primary Server: Authority of zone file. Responsible for creating, maintaining and updating the zone files.

Secondary server: Backup and zone file transfers

DNS in the Internet

Generic: com, org,edu,gov,net, mil

Inverse: Address to name conversion

Country domain: in,us,uk,

Resolution: Name to address or address to name

Recursive Resolution: -> ->->

Client -> Server -> parent server -> another server

Client <- Server <- parent server <- another server

Iterative

Client -> server if not sends IP of another server

Client -> contacts another server, if not sends IP of further server and so on

Caching can be used to speed up

DNS Messages: Query and Response

Response

Header
Question Section
Answer Section
Authorities Section
Additional section

Header Format

Identification 16-bits	Flags 16-bits

Number of question records	Number of answer records
Number of authoritative records	Number of additional records

Flags

QR	Opcode	AA	TC	RD	RA	Three 0's	rCode

Q-Query

R – Response

Query types are

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

E-mail

Most popular application program

Message include : text, image, audio, video

Message can be sent to one or more at a time

Basic functions

- Composition
- Transfer
- Reporting
- Displaying
- Disposition

Terminologies

UA – User Agent -> Compose, read msg, reply msg, forward message

Examples are : sendmail, mail, pine , Eudora, NetScape, MS Outlook

MTA – Mail Transfer Agent -> Mail Transfer Protocol Example : SMTP

MAA – Mail Access agent -> To read mail from mail box Example : POP, IMAP

Sending Mail : Enevelope -> Sender and Receiver Address
Message -> S,R, Subject, Data

Receiving Mail : Mail Notification

e-Mail Address : localpart@domainname

Architectures :

Alice *Bob*

User Agent	Server			User Agent
UA	MTA Client	Internet	MTA Server	UA
UA and MTA Client	LAN Server MTA Server MTA Client	Internet	MTA Server	UA
UA and MTA Client	LAN Server MTA Server MTA Client	Internet	MAA Server MTA Server MTA Client	MAA Client UA

MIME – Multipurpose Internet Mail Extensions

Problems with international languages:

- Languages with accents
  (French, German).
- Languages in non-Latin alphabets
  (Hebrew, Russian).
- Languages without alphabets
  (Chinese, Japanese).

- Messages not containing text at all
  (audio or images).

Mime allows ASCII and Non-ASCII data to send over network

Mime defines the nature of the data which is helpful for coding

Header	Meaning
MIME-Version:	Identifies the MIME version
Content-Description:	Human-readable string telling what is in the message
Content-Id:	Unique identifier
Content-Transfer-Encoding:	How the body is wrapped for transmission
Content-Type:	Type and format of the content

Type	Subtype	Description
Text	Plain	Unformatted text
	Enriched	Text including simple formatting commands
Image	Gif	Still picture in GIF format
	Jpeg	Still picture in JPEG format
Audio	Basic	Audible sound
Video	Mpeg	Movie in MPEG format
Application	Octet-stream	An uninterpreted byte sequence
	Postscript	A printable document in PostScript
Message	Rfc822	A MIME RFC 822 message
	Partial	Message has been split for transmission
	External-body	Message itself must be fetched over the net
Multipart	Mixed	Independent parts in the specified order
	Alternative	Same message in different formats
	Parallel	Parts must be viewed simultaneously
	Digest	Each part is a complete RFC 822 message

Mime Version : 1.0

Content Transfer Encoding: 7-bit ASCII, 8-bit non-ASCII, Binary, Base-64

Content Description: Audio, Video, Image, Text …

SMTP – Simple Mail Transfer Protocol

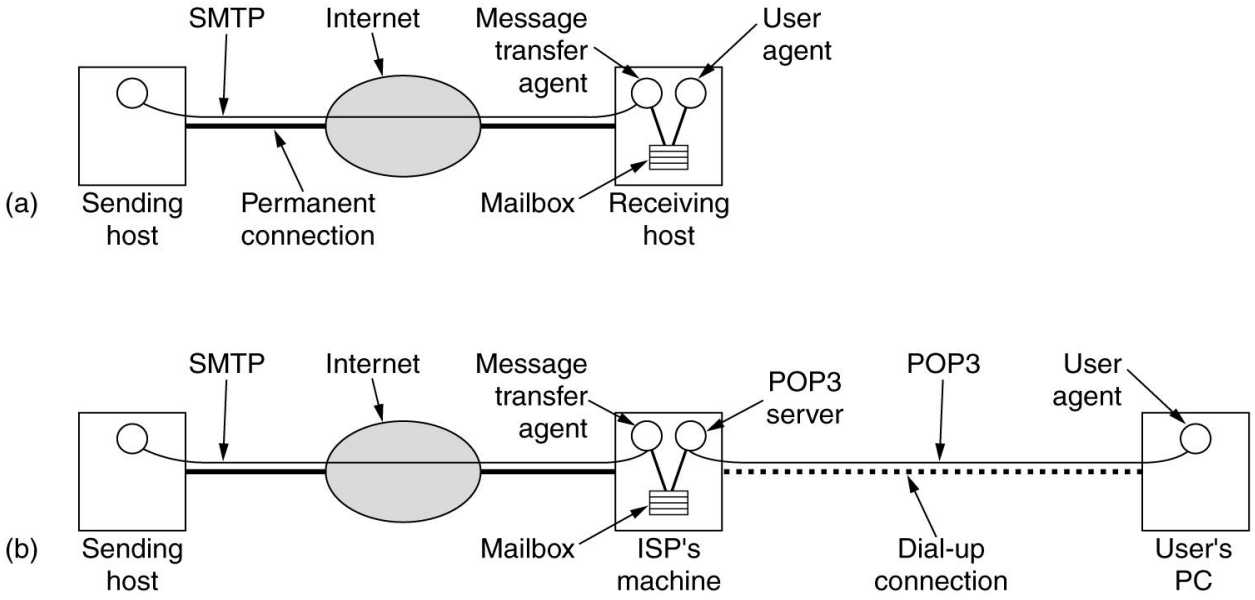


Fig (a) Sending and reading mail when the receiver has a permanent Internet connection and the user agent runs on the same machine as the message transfer agent. (b) Reading e-mail when the receiver has a dial-up connection to an ISP.

Commands :

HELO – Sender host name – vit.edu

Mail FROM

RCPT TO

DATA

QUIT

RESET

VRRY

NOOP

TURN

HELP

Message Access Protocol

Feature	POP3	IMAP
Where is protocol defined?	RFC 1939	RFC 2060
Which TCP port is used?	110	143
Where is e-mail stored?	User's PC	Server
Where is e-mail read?	Off-line	On-line
Connect time required?	Little	Much
Use of server resources?	Minimal	Extensive
Multiple mailboxes?	No	Yes
Who backs up mailboxes?	User	ISP
Good for mobile users?	No	Yes
User control over downloading?	Little	Great
Partial message downloads?	No	Yes
Are disk quotas a problem?	No	Could be in time
Simple to implement?	Yes	No
Widespread support?	Yes	Growing

Response Codes

220 <domain> Server is ready

421<domain> Server is not ready

354 Start sending mail input data/message

250 OK Requested Action Completed

451 – Service is not available

500 – Syntax error in command

550 – mailbox is not accessible

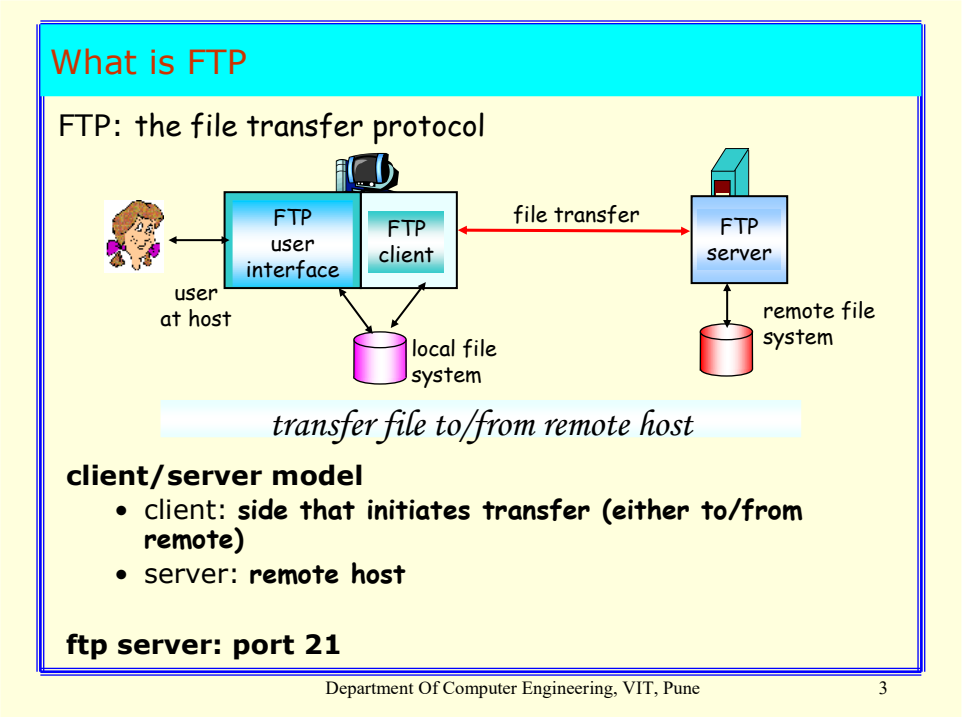
551 <forward path> user is not local

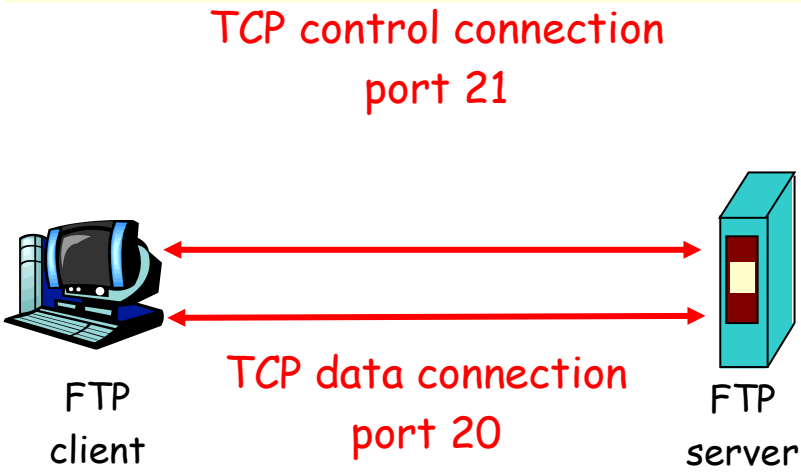
552 action aborted due to storage exceeded

FTP

- What is FTP
- Ways to transfer files with FTP
- What do you need to know
- File Types
- FTP Commands
- Mode of Transfer
- Directory Related Command
- Upload and Download Files
- Other Supporting Commands

Why FTP?





FTP client contacts FTP server at port 21, specifying TCP as transport protocol

Client obtains authorization over control connection

Client browses remote directory by sending commands over control connection.

When server receives a command for a file transfer, the server opens a TCP data connection to client

Operations of FTP Connections

Communication Over Channels

Ways to transfer files with FTP

From the PC FTP program:

- WS_FTP

- FTP
- SmartFTP
- Rapid Filer

From a Web Browser :

- ftp://anonymous_ftp_site_address

From Time Sharing computers (UNIX/VMS):

- #/$ ftp name-of-anonymous-ftp-computer
- Vsftp – very smart ftp

What do you need to know?

The name of the ftp site (host computer).
For example,

ftp://mld.vit.com

The name of the file to be transferred.

Sort.c

The directory path where the file is stored. For example,

ftp://mld.vit.com/linuxprograms

File Types

ASCII files or text files are files created with a text editor like Pico or Notepad.
Binary files are files containing graphical images, word processing documents, spreadsheet files, executable files .

.exe	executable file
.txt	text file
.zip	compressed file
.xls	Excel spreadsheet
.doc	Word document
.gif or .jpg	graphical image

.wav	sound clip
.ppt	PowerPoint

!	delete	literal	promt	send
?	debug	ls	put	status
append	dir	mdelete	pwd	trace
Ascii	disconnect	mdir	quit	type
Bell	get	mget	quote	user
binary	glob	mkdir	recv	verbose
Bye	hash	mls	remotehelp	
Cd	help	mput	rename	
Close	lcd	open	rmdir	

Mode of Transfer

- bin Change to binary mode transfer
- ascii Change to ascii mode transfer

FTP command Syntax

type mode of transfer

Ex. type binary
type ascii

Directory Related Command

dir give a directory listing
cd name of directory change remote directory
lcd name of directory change local directory
ls list files in remote directory
!ls list the files in local directory
pwd print working directory

cdup move up a remote directory
mdir list multiple dir from remote m/c
delete name of file delete file from remote m/c
mkdir name of directory create directory on remote m/c
rmdir name of directory remove directory on remote m/c

get file.to.retrieve receive file from remote machine
put file.to.place place file on remote machine
Similar commands are **recv** and **send**

mget *.* receive group of files using wild card from remote machine

mput *.* place group of files using wild card
on remote machine

? list all commands
help command request help on command
prompt Set prompting on or off
quit Finish ftp session
bye To quit ftp site

To avoid getting the prompt for each file, enter "prompt off" prior to issuing the mget command.

ftp> **prompt off**
ftp> **mget *.txt**

Ftp Speed Depends on

- Your connection speed.
- Server connection speed.
- Your computer's load.
- The server load.
- General Internet traffic.
- Restraints your ISP puts on you.

Anonymous ftp

- Some sites don't require logins

-Similar to downloading from website without logging in

- Login as anonymous
- Send email address as password
- You may not get access to everything.
  Example: ftp>ftp.sf.net
- Anonymous logins not available always.
- You cannot always write files to the server.
- However, there may be an "incoming" or "uploads" directory where you can post files.

SNMP Protocol

Host Configuration: BOOTP and DHCP

Any host on TCP/IP n/w requires following

IP address
Subnet Mask
Address of router/gateway
IP of name server

How to get it diskless workstation?
Computer booting first time?

ROM = OS + networking software

BOOTP : Bootstrap Protocol

Different from : RARP : datalink layer, only IP, runs on same n/w

Client/server model to provide above four pieces of information

Application Layer program

Works on same or different network

BOOTP Server (UDP port 67) ---------- Bootp client (UDP Port 68)

Static in nature

Maintains table Hardware address + ip

Different n/w

BOOTP Client -------- Relay agent ------- router ------ bootpserver

Client ----------------- 67 passive open bootpserver
Client 68 -------- request ------ 67 server
Client --- reply ----- server

00000 in source address and 1111 in destination address

FORmat

Operation code(8) Hardware type(8) H/w length(8) HOP count(8)
1 0r 2 1- for Ethernet 6-byte 1/2/3/
Transaction id (32)
Number of seconds (16) Unused
Client IP(32)
Your IP
Server IP
Gateway IP
Client h/w address
Server name
Bootfile name
Options (64) : Tag, length , data

subnet mask, time offset, default routers, time servers, dns servers, print servers, host name, bootfile size, vendor specific, end of list 255

DHCPDISCOVER
DHCPOFFER
REQUEST
DECLINE

ACK

NACK

RELEASE