UNIT I
Chapter 3

INTERNET PRINCIPLES

IP

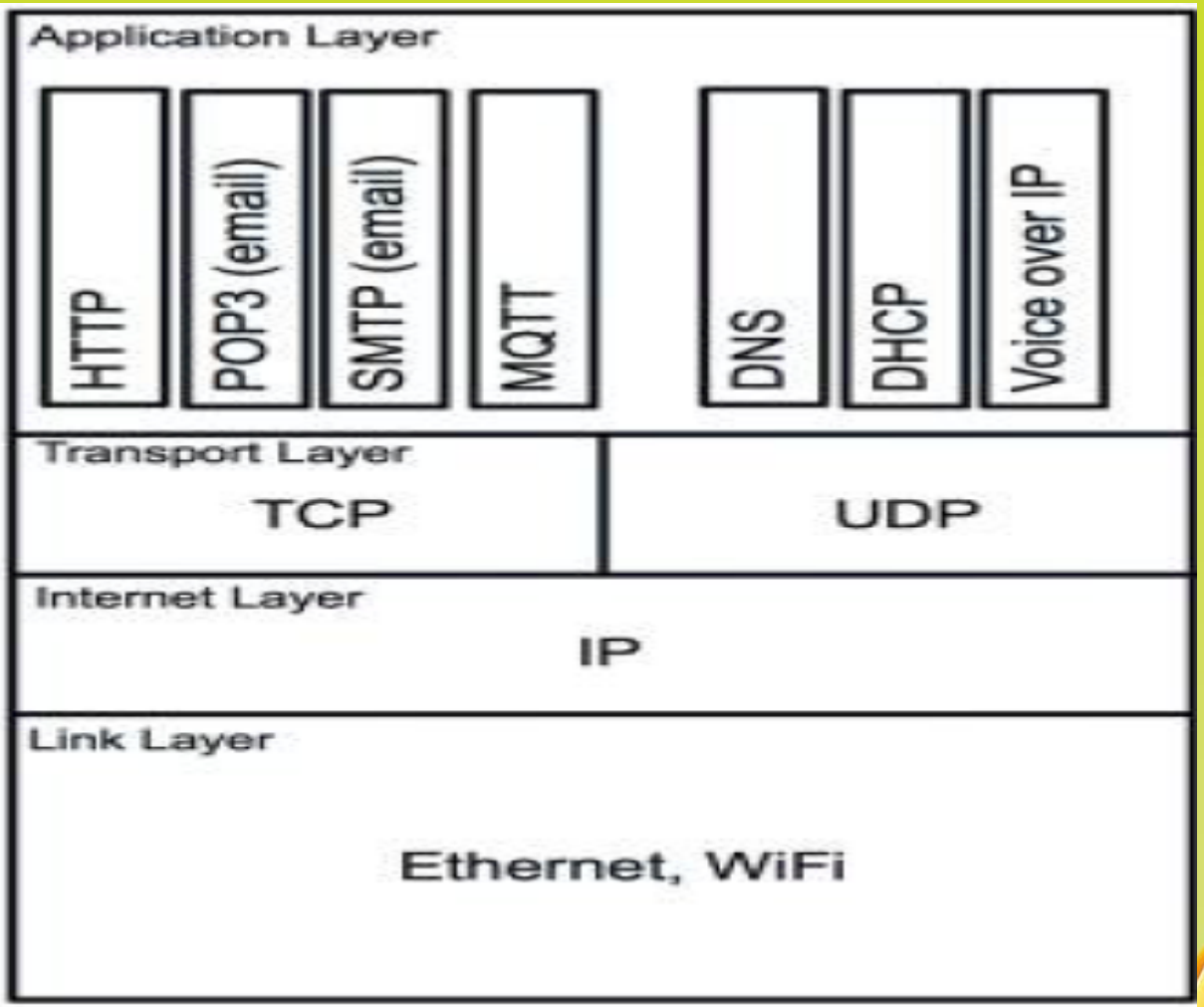
- Data is sent from one machine to another in a packet, with a destination address and a source address in a standardized format (a “protocol”).

TCP

- What if you wanted to send longer messages than fit on a postcard? Or wanted to make sure your messages got through?
- TCP is built on top of the basic IP protocol and adds sequence numbers, acknowledgements, and retransmissions.

THE IP PROTOCOL SUITE (TCP/IP)

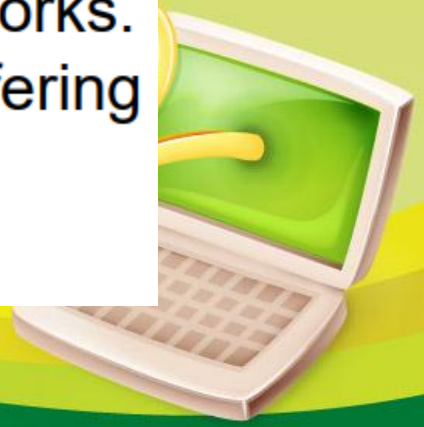
- The **low-level protocols** at the *link layer* manage the transfer of bits of information across a network link. This could be by an Ethernet cable, by WiFi, or across a telephone network, or even by short-range radio standards
- The ***Internet layer*** then sits on top of these various links and abstracts away the gory details in favor of a simple destination address.
- Then TCP, which lives in the ***transport layer***, sits on top of IP and extends it with more sophisticated control of the messages passed.
- Finally, the ***application layer*** contains the protocols that deal with fetching web pages, sending emails, and Internet telephony



The Internet Protocol suite.

Introduction

- TCP and UDP works in Transport Layer of OSI Model as well as TCP/IP Model
- TCP (Transmission Control Protocol) enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.
- UDP (User Datagram Protocol) a connectionless protocol that, like TCP, runs on top of IP networks. Provides very few error recovery services, offering instead a direct way to send and receive datagrams over an IP network.




TCP
ARE YOU GETTING ALL OF THIS?
NO, SLOW DOWN SO I CAN SAVE ACCURATELY!


UDP
ARE YOU GETTING ALL OF THIS?
WHO CARES JUST SEND IT FASTER!
SKULLBOX.NET

Where are they used? Why?

- TCP is used in HTTP, HTTPs, FTP, SMTP Telnet etc...
- UDP is used in DNS, DHCP, TFTP, SNMP, RIP, VOIP, Multi media, Online games etc…
- Consider Multi media, if we use TCP instead of UDP when ever pocket loss occurred we get long delay to continue watching/listening because TCP is retransmitting lost packets and it takes time

IP ADDRESSES

- Internet identifier including information about how to reach a network location (via the Internet routing system)
- **IPv4: 32-bit number.** Written in Dotted Decimal Notation 205.150.58.7. – 4 billion different host addresses
- **IPv6: 128-bit number.** Written in Hex Decimal Notation 2001:0503:0C27:0000:0000:0000:0000:0000 – 16 billion network addresses

IP Addresses

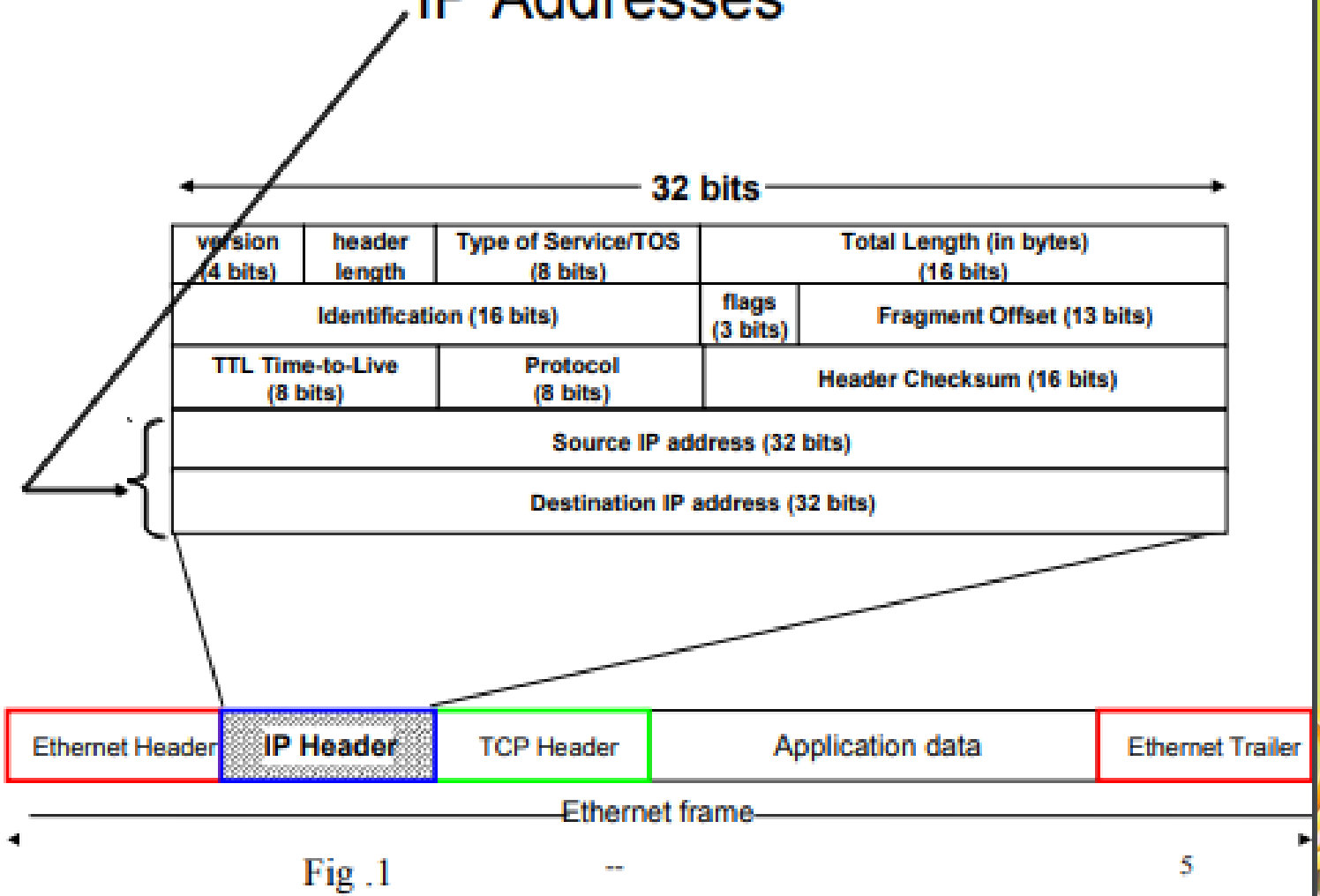


Fig .1

Network Prefix and Host Number

- The network prefix identifies a network and the host number identifies a specific host (actually, interface on the network)

- How do we know how long the network prefix is?
  - Before 1993: The network prefix is implicitly defined (see class-based addressing)
  - After 1993: The network prefix is indicated by a net mask

Dotted Decimal Notation

- IP addresses are written in a so-called **dotted decimal notation**
- Each byte is identified by a decimal number in the range [0..255]:

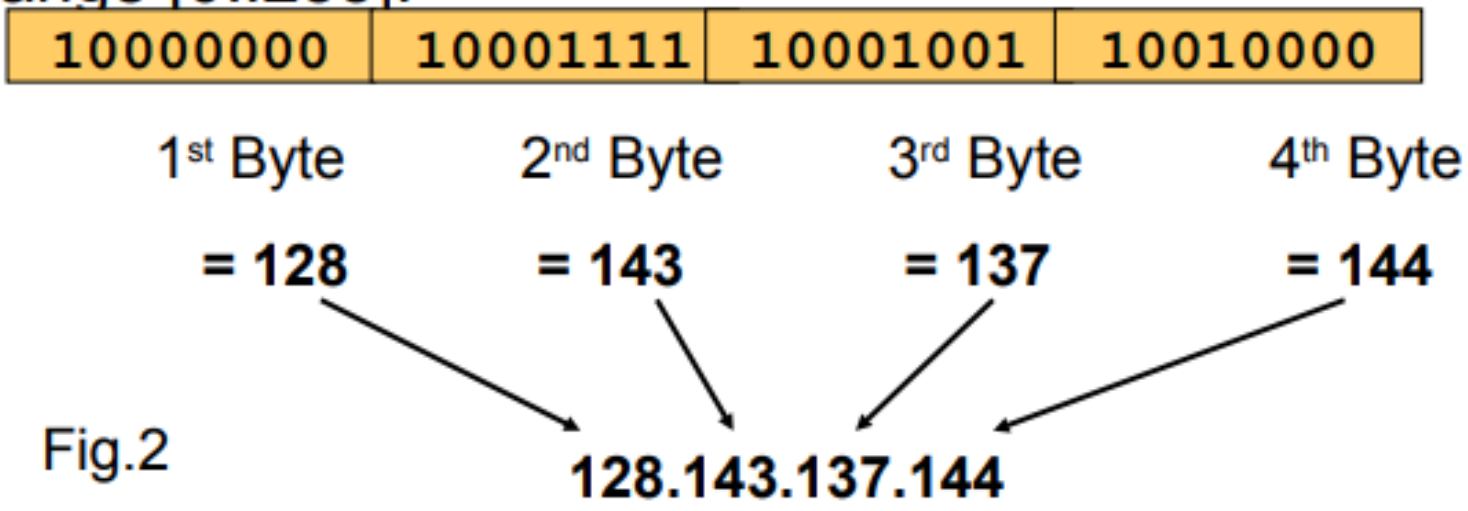


Fig.2

IP Address

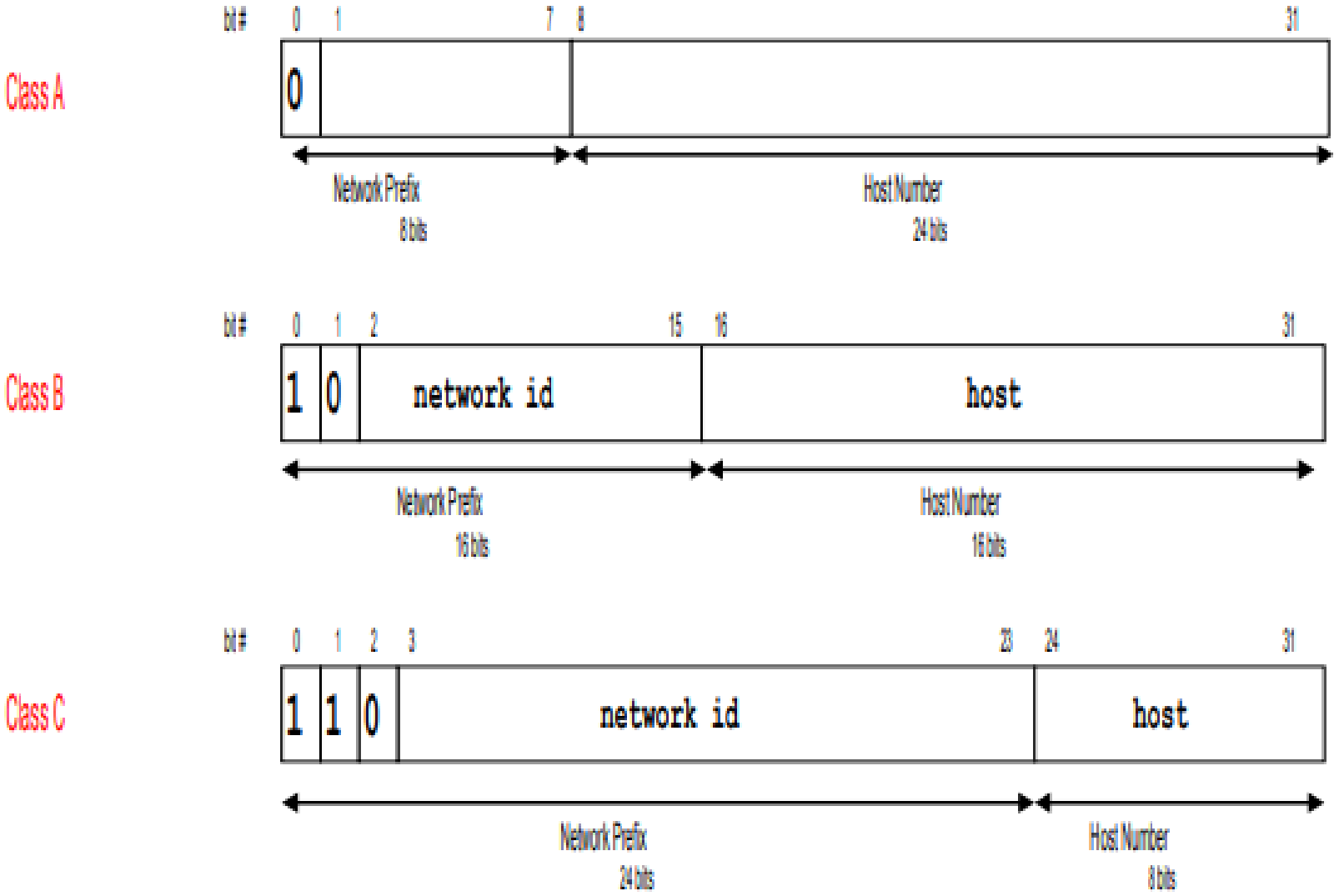
- Every interface have a unique Internet address (IP address)
- Consist of 2 parts – network id and host id
- 32-bit address
- 5 Classes
  - A – 0.0.0.0 to 127.255.255.255 (2^{24} nodes)
  - B – 128.0.0.0 to 191.255.255.255 (2^{16} nodes)
  - C – 192.0.0.0 to 223.255.255.255 (2^{8} nodes)
  - D – 224.0.0.0 to 239.255.255.255
  - E – 240.0.0.0 to 247.255.255.255

IP Address contd….

- When Internet addresses were standardized (early 1980s), the Internet address space was divided up into classes
  - **Class A:** Network prefix is 8 bits long
  - **Class B:** Network prefix is 16 bits long
  - **Class C:** Network prefix is 24 bits long

- Each IP address contained a key which identifies the class
  - **Class A:** IP address starts with “0”
  - **Class B:** IP address starts with “10”
  - **Class C:** IP address starts with “110”

IP address contd…



IP Address contd…

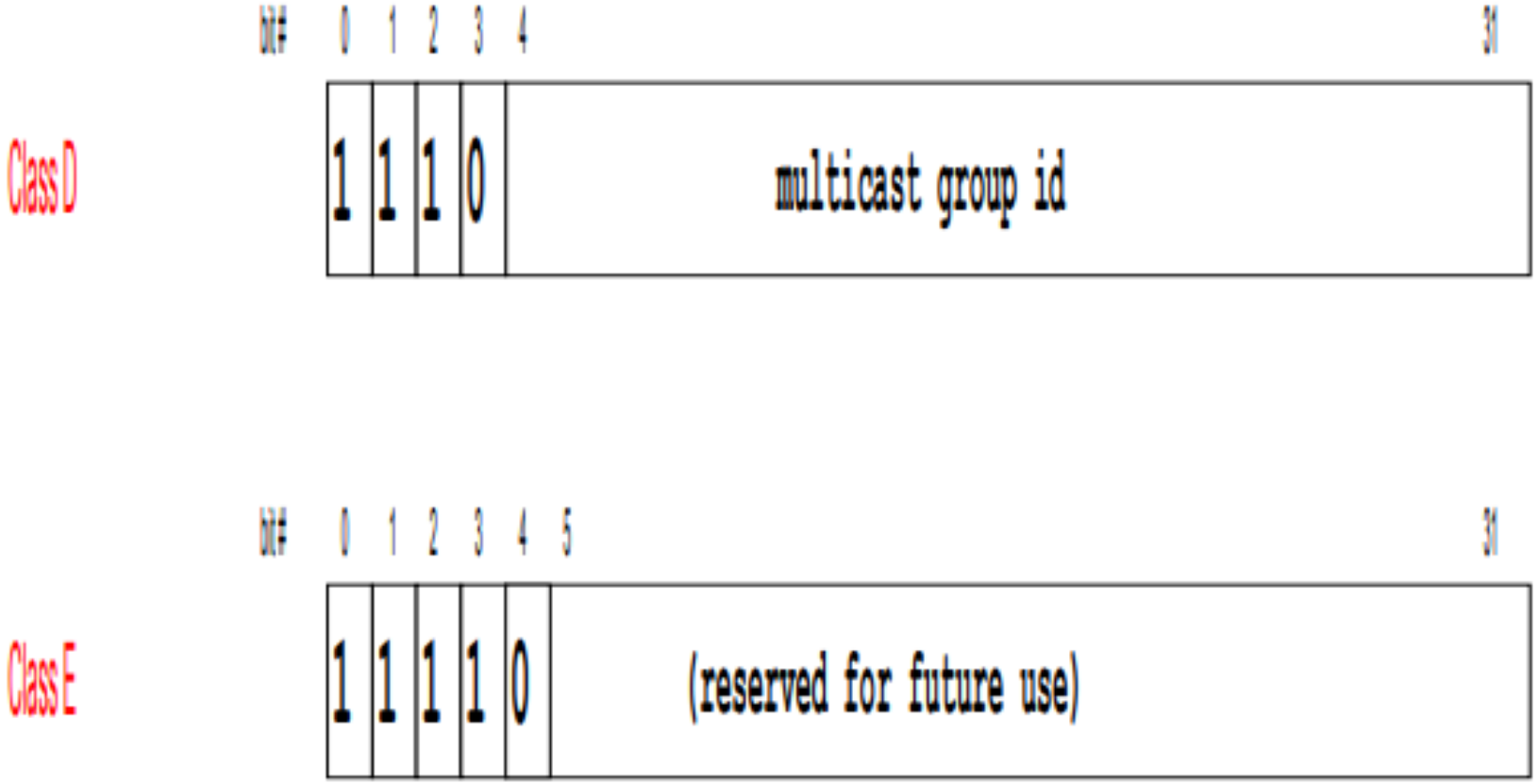


Fig .4

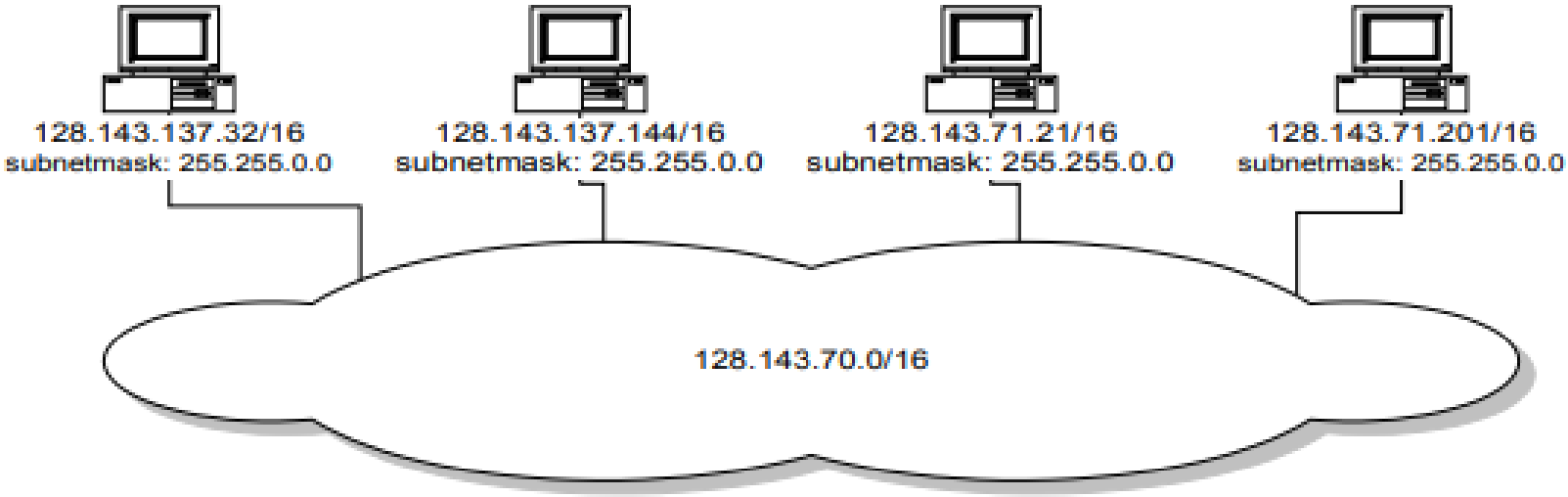
Special IP Address

- All 0's is reserved to refer to a network number

- All 1's is reserved to refer to a broadcast address

No Sub-netting

- All hosts think that the other hosts are on the same network



With Sub-netting

- Hosts with same extended network prefix belong to the same network

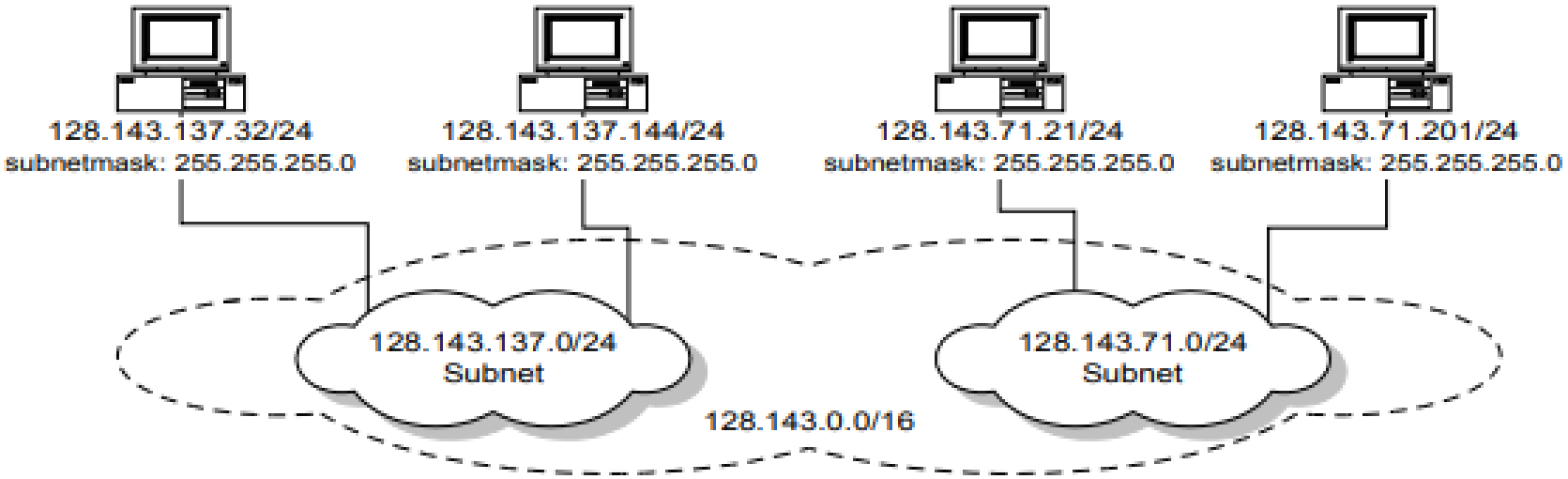
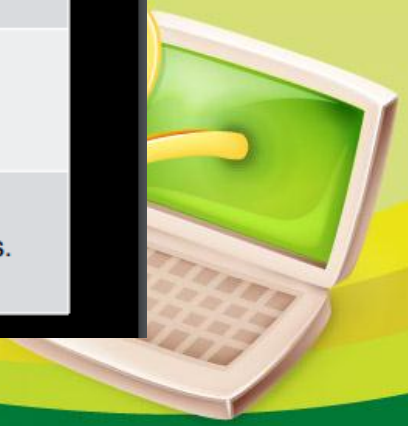


Fig .6

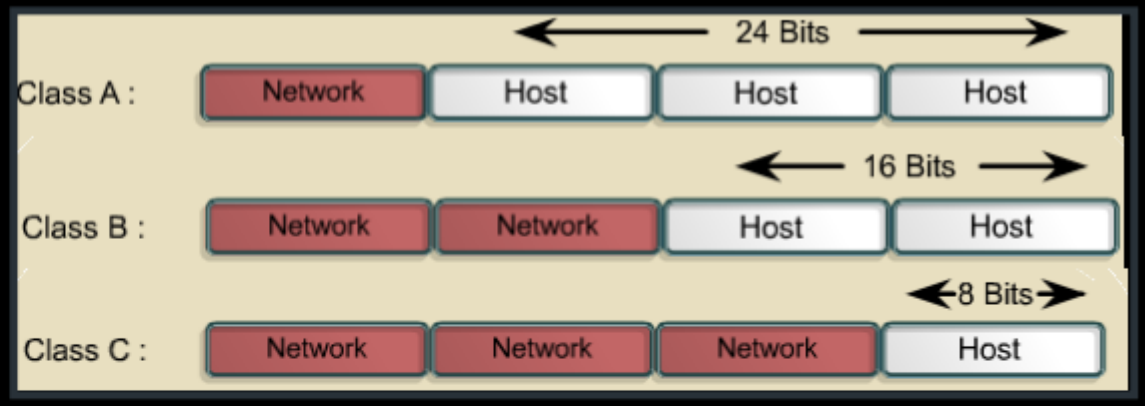
DNS

IP ranges

Class	Address Range	Supports
Class A	1.0.0.1 to 126.255.255.254	Supports 16 million hosts on each of 127 networks.
Class B	128.1.0.1 to 191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.
Class C	192.0.1.1 to 223.255.254.254	Supports 254 hosts on each of 2 million networks.
Class D	224.0.0.0 to 239.255.255.255	Reserved for multicast groups.
Class E	240.0.0.0 to 254.255.255.254	Reserved for future use, or Research and Development Purposes.



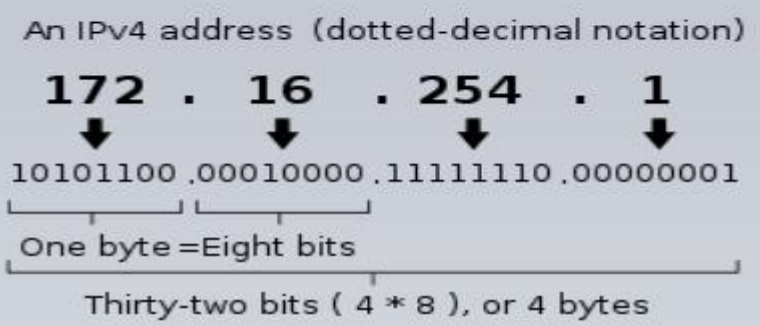
IP addresses are divided into classes A,B and C to define large, medium, and small networks.



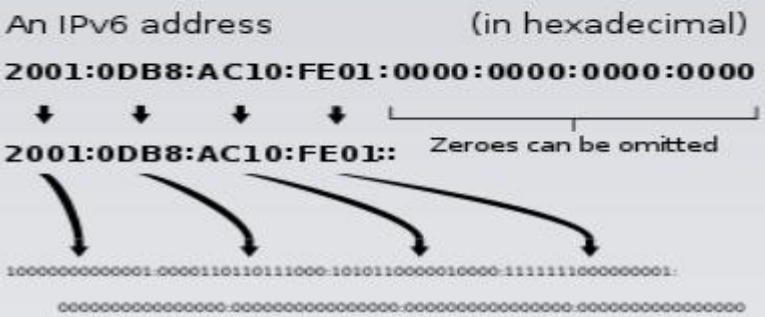
Address Class	High-Order Bits	First Octet Address Range	Number of Bits in the Network Address	Number of Networks	Number of Hosts per Network
Class A	0	0-127	8	126	16,777,216
Class B	10	128-191	16	16,384	65,536
Class C	110	192-223	24	2,097,152	254
Class D	1110	224-239	28	N/A	N/A

IP versions

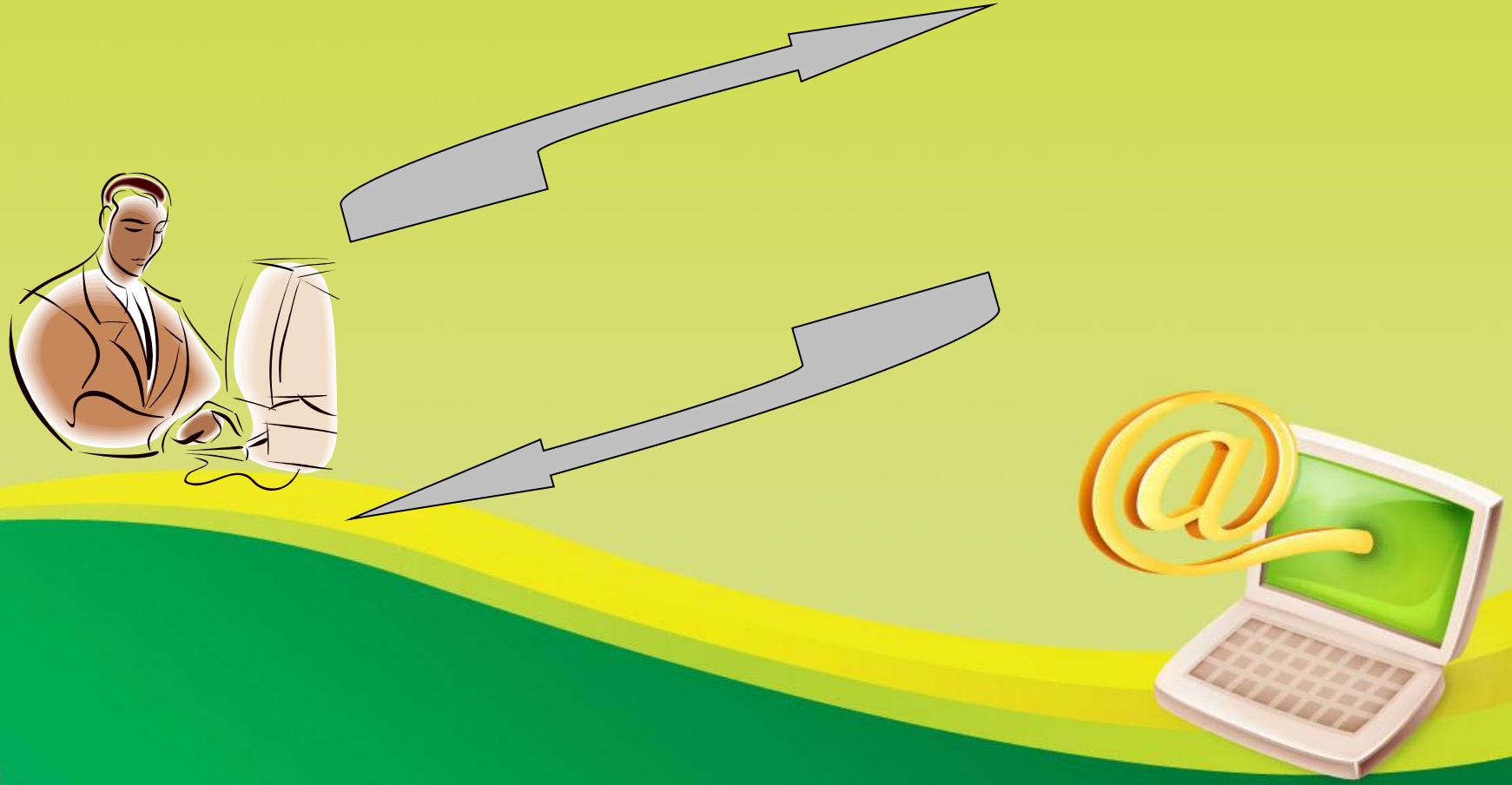
- IP version 4 addresses



- IP version 6 addresses

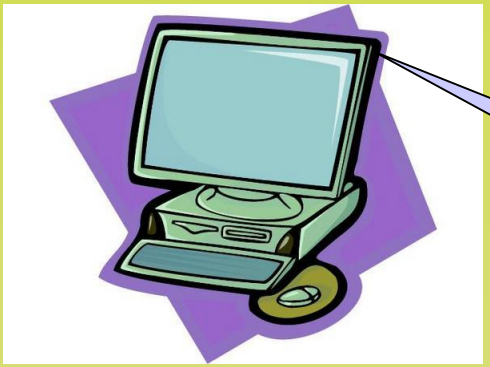


DOMAIN NAME SYSTEM



Introduction

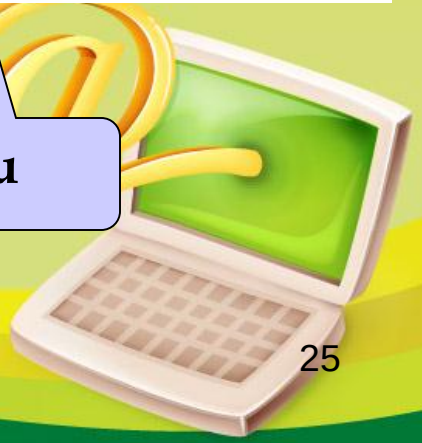
1. What is the IP address of udel.edu ?



It is 128.175.13.92

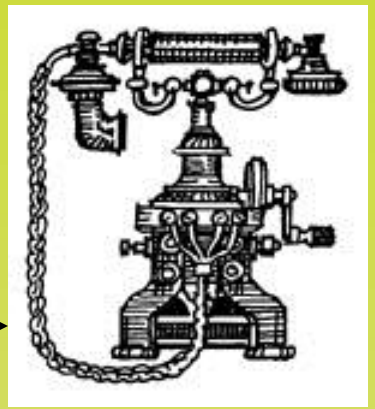
1. What is the host name of 128.175.13.74

It is strauss.udel.edu



Real Life Analogy: Telephone Example

Telephone connection



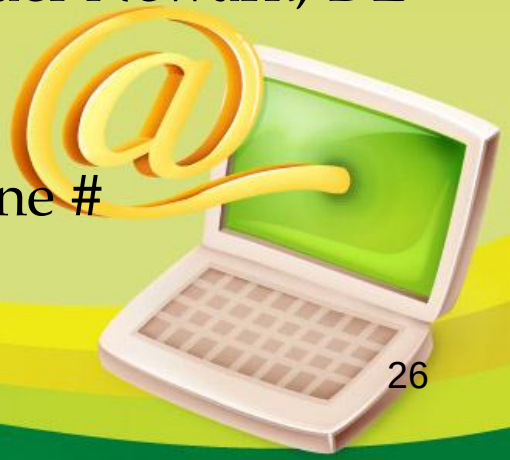
Source:
Child

Newark, DE

Destination: Dad

Udel-Newark, DE

Information Child Needs: Dad's Phone #



DNS Components

There are 3 components:

- Name Space:

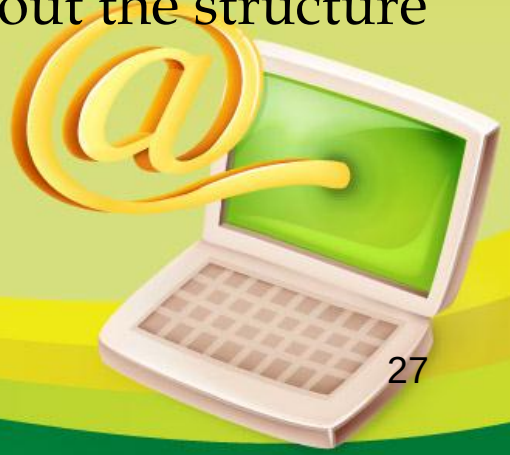
  Specifications for a structured name space and data associated with the names

- Resolvers:

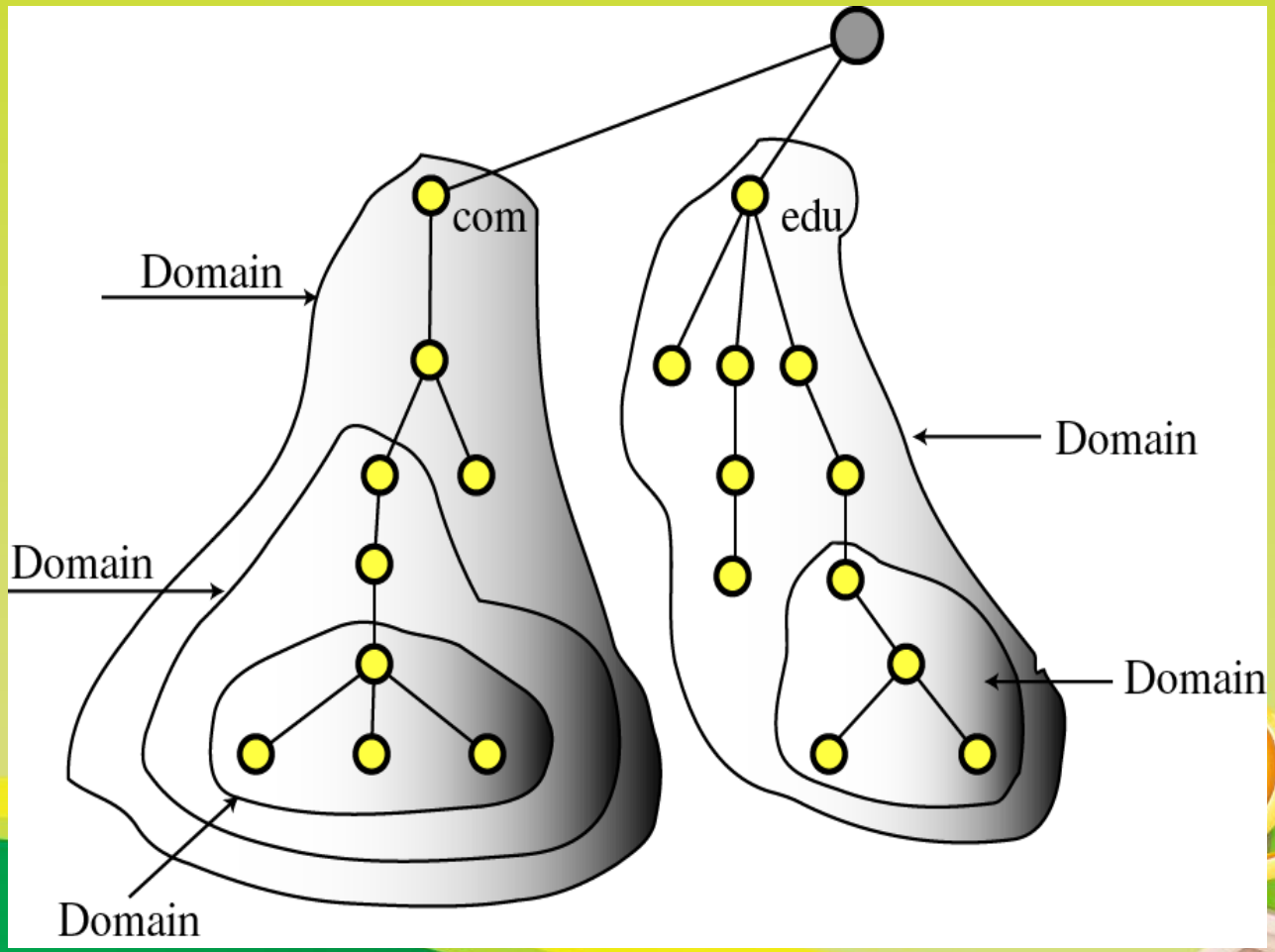
  Client programs that extract information from Name Servers.

- Name Servers:

  Server programs which hold information about the structure and the names.



Name Space



Resolvers

A Resolver maps a name to an address and vice versa.

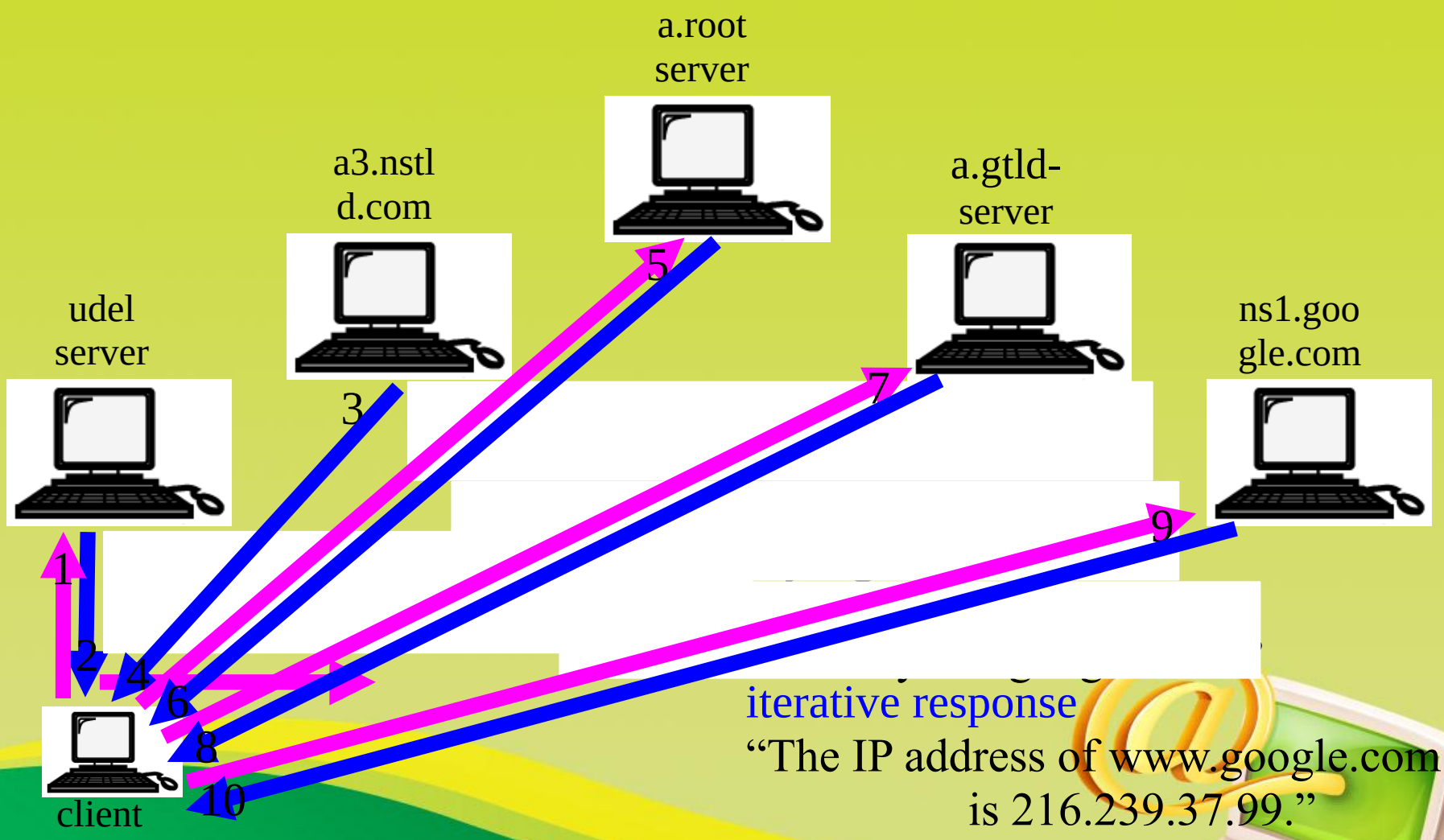
Query

Response

Resolver

Name Server

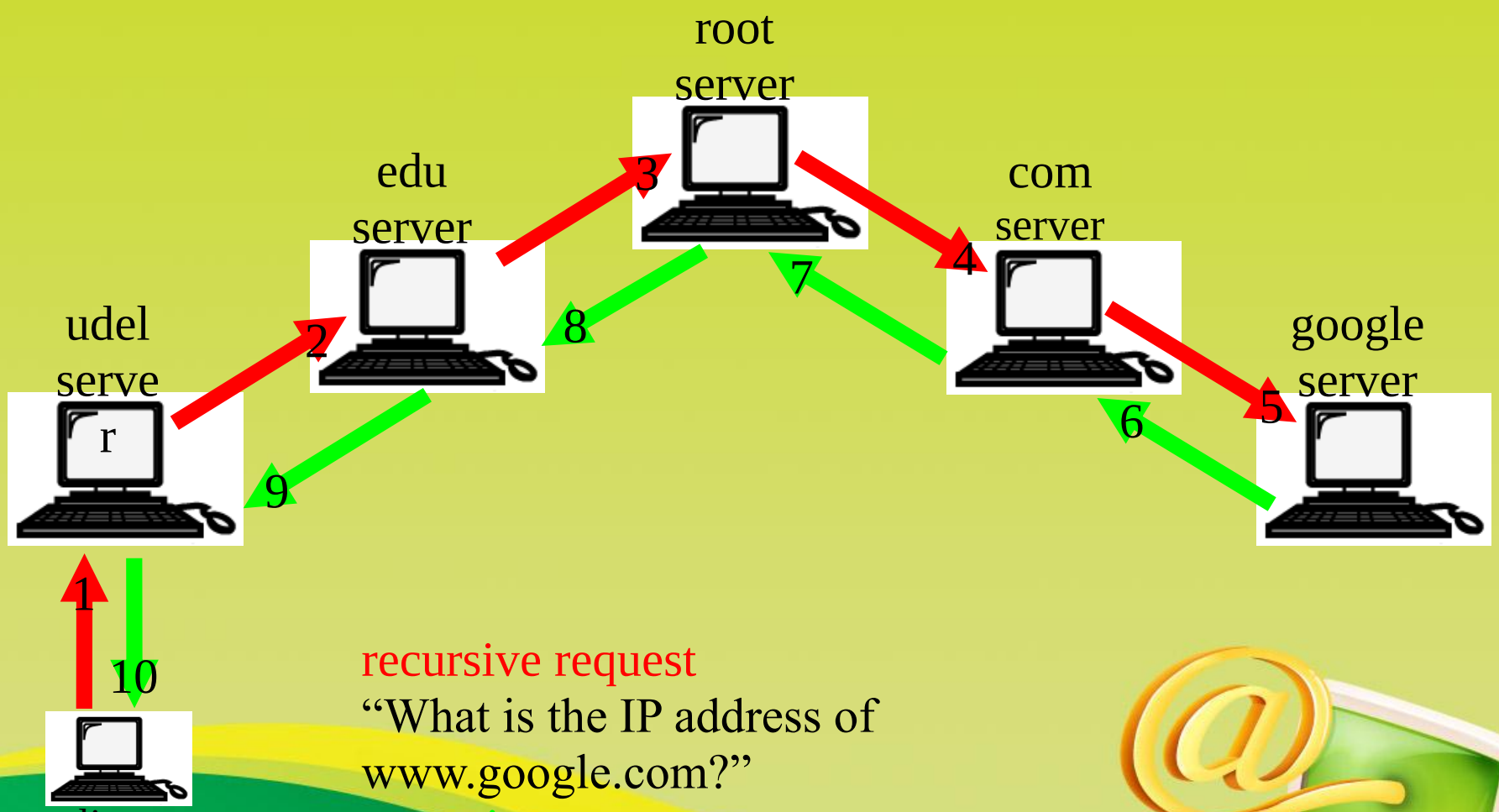
Iterative Resolution



iterative request
"What is the IP address of www.google.com?"

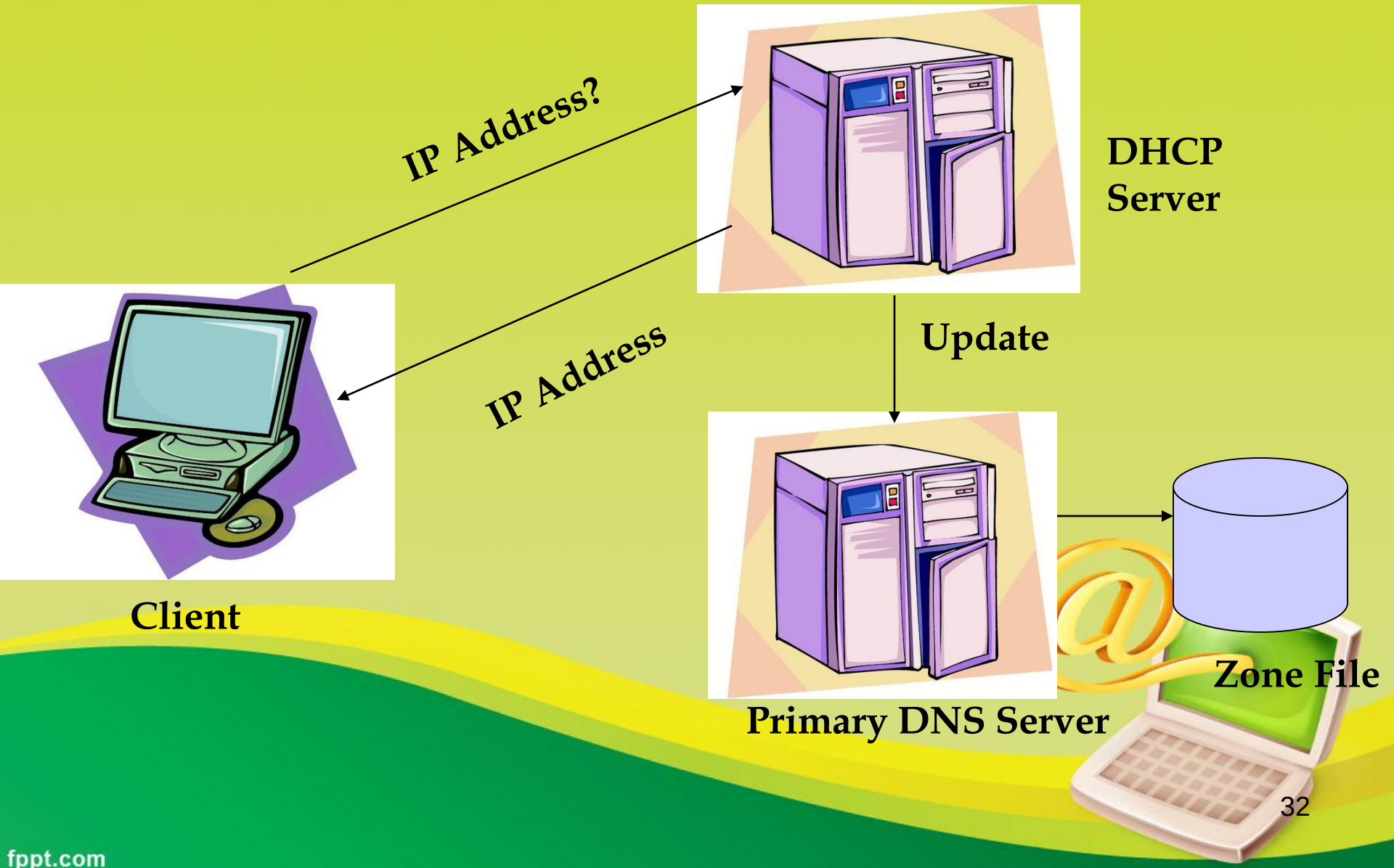
iterative response
"The IP address of www.google.com is 216.239.37.99."

Recursive Resolution



recursive request
"What is the IP address of www.google.com?"
recursive response
"The IP address of www.google.com is 216.239.37.99."

Dynamic DNS



Mac addresses(Media Access Control)

- A MAC address, or Media Access Control address, is a 48- or 64-bit address associated with a network adapter.
- While IP addresses are associated with software, MAC addresses are linked to the hardware of network adapters.
- For this reason, the MAC address is sometimes called the hardware address, the burned-in address (BIA), or the physical address

- MAC addresses are expressed in hexadecimal notation in the following format: 01-23-45-67-89-AB, in the case of a 48-bit address.
- Or 01-23-45-67-89-AB-CD-EF, in the case of a 64-bit address. Colons (:) are sometimes used instead of dashes (-)
- MAC addresses are often considered permanent, but in some circumstances, they can be changed.

AN EXAMPLE: HTTP PORTS

- If your browser requests an HTTP page, it usually sends that request to port 80.
- The web server is “listening” to that port and therefore replies to it.
- Ports 0–1023 are “well-known ports”, and only a system process or an administrator can connect to them.
- Ports 1024–49151 are “registered”, so that common applications can have a usual port number. However, most services are able to bind any port number in this range.

HTTP Request–Response cycle