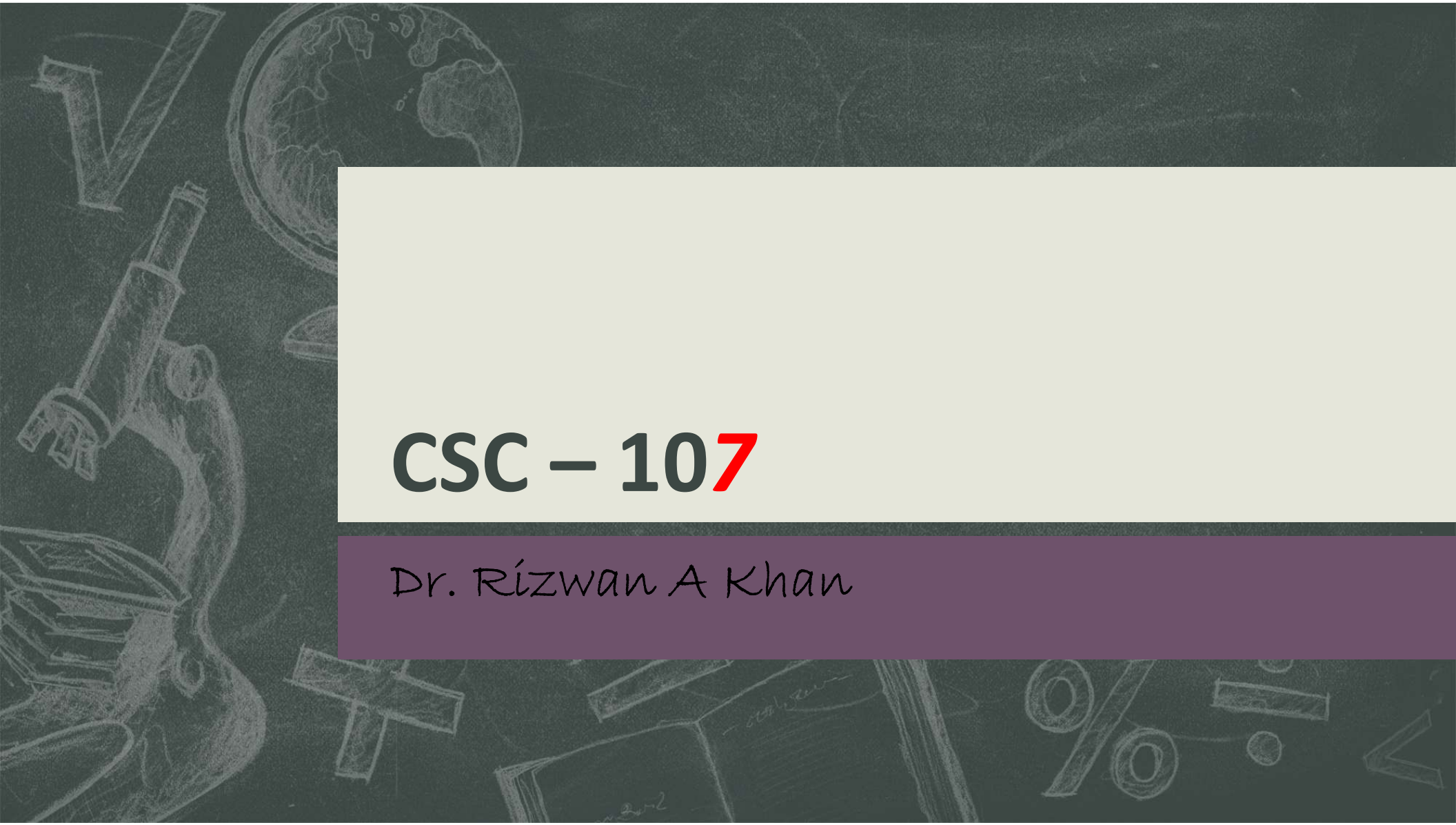


CSC – 107

Dr. Rizwan A Khan

Networks

How internet works

Introduction

- It seems that being connected 24/7 has become a necessity in our world
- For various reasons:
  - Education
  - Work
  - Entertainment
  - To communicate (friends, family)
  - Business
  - News
  - .
  - .

History

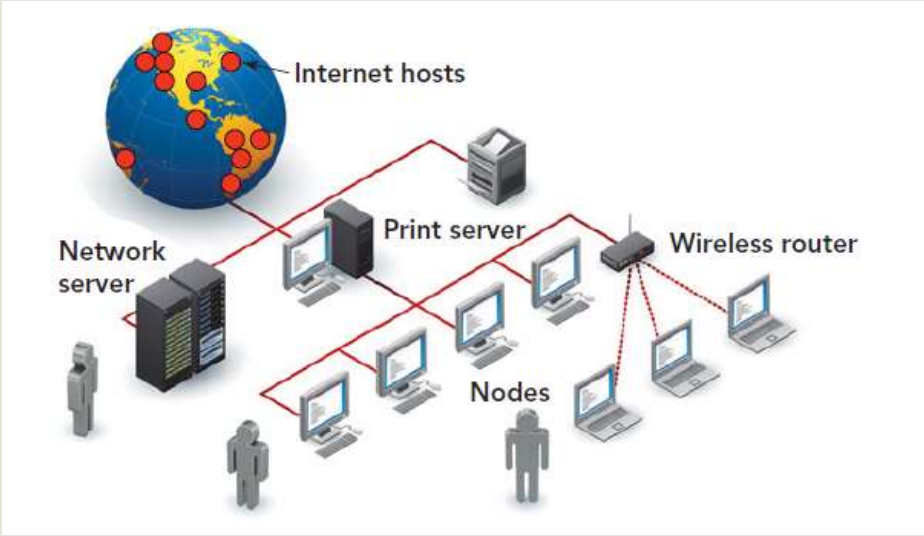
- The idea of connecting computers of different designs and over distant locations started in the 1960s

- U.S. Department of Defense, project called **ARPANET** (Advanced Research Projects Agency Network). The purpose of the project was:
  - to create a form of secure communication for military and scientific purposes

- The outcome of the project was a network that consisted of four computers located at
  - The University of California Los Angeles
  - the University of California at Santa Barbara,
  - the University of Utah,
  - and Stanford Research Institute

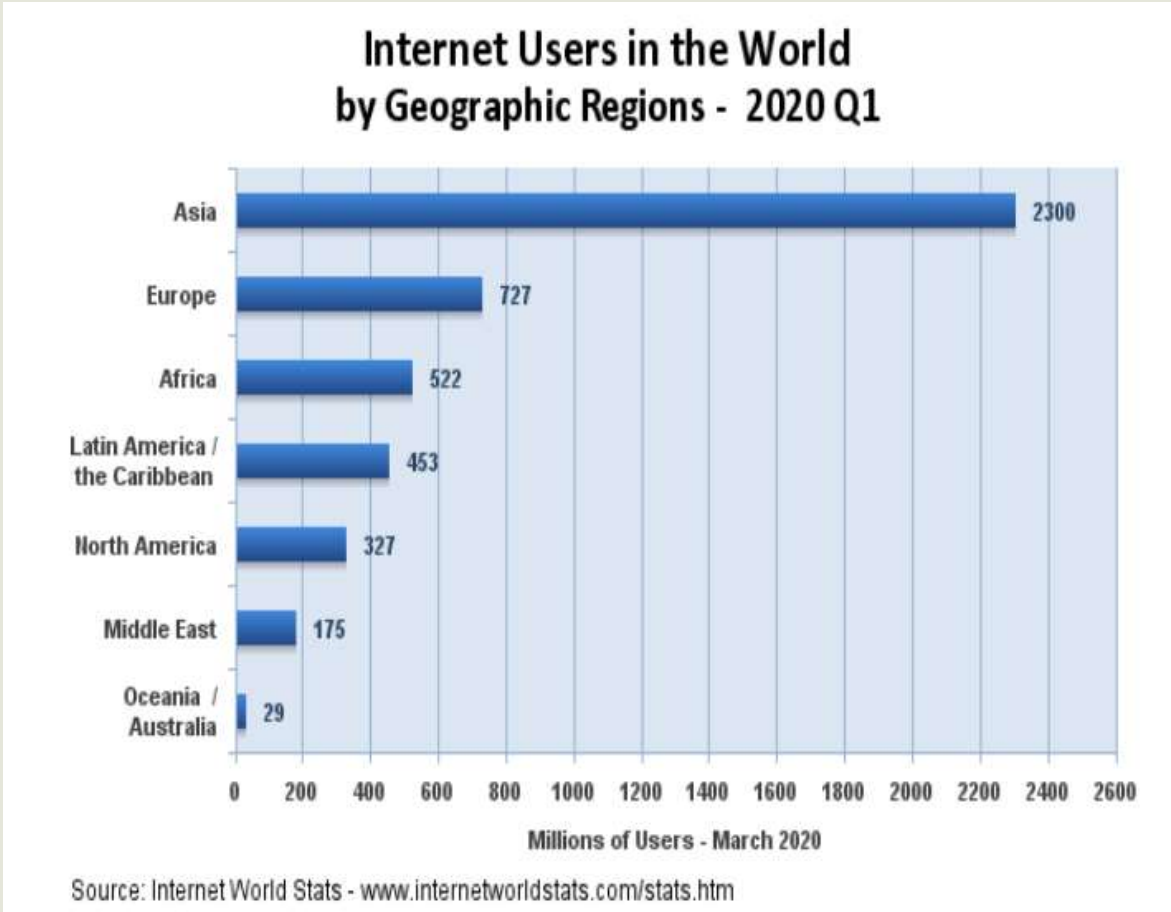
History

- The Internet is the offspring of the ARPANET project
  - To know more: https://www.internetsociety.org/resources/doc/2017/brief-history-internet/
- Today, the Internet is composed of more than 750 million host
  - Host is a computer that has two-way access to other computers; it can receive requests and reply to those requests.



Perspective

- The Internet has come a long way since its inception as a communication and file-exchange network for government agencies



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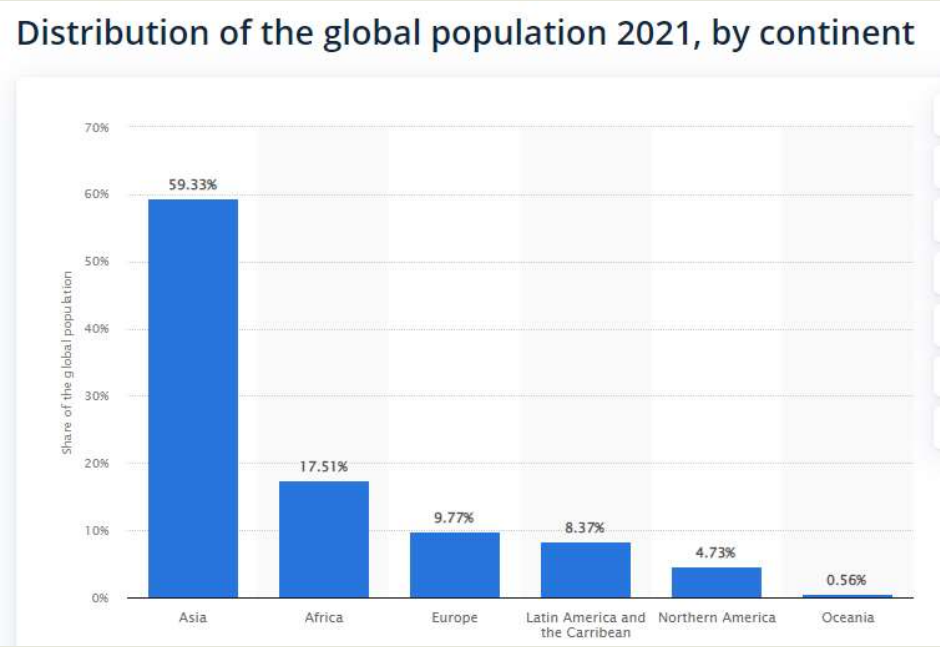

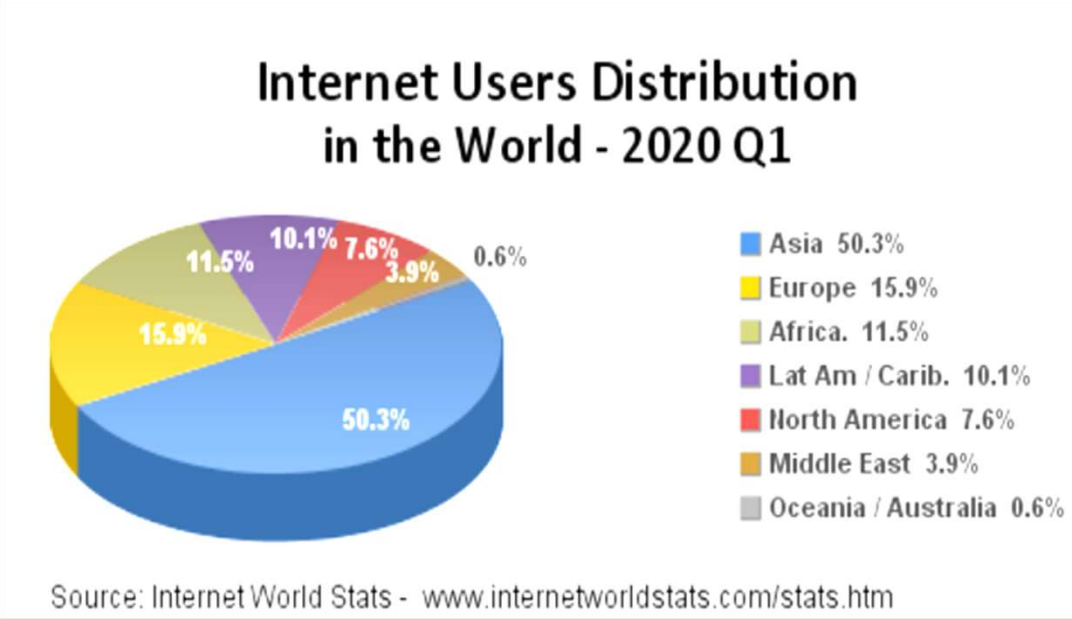

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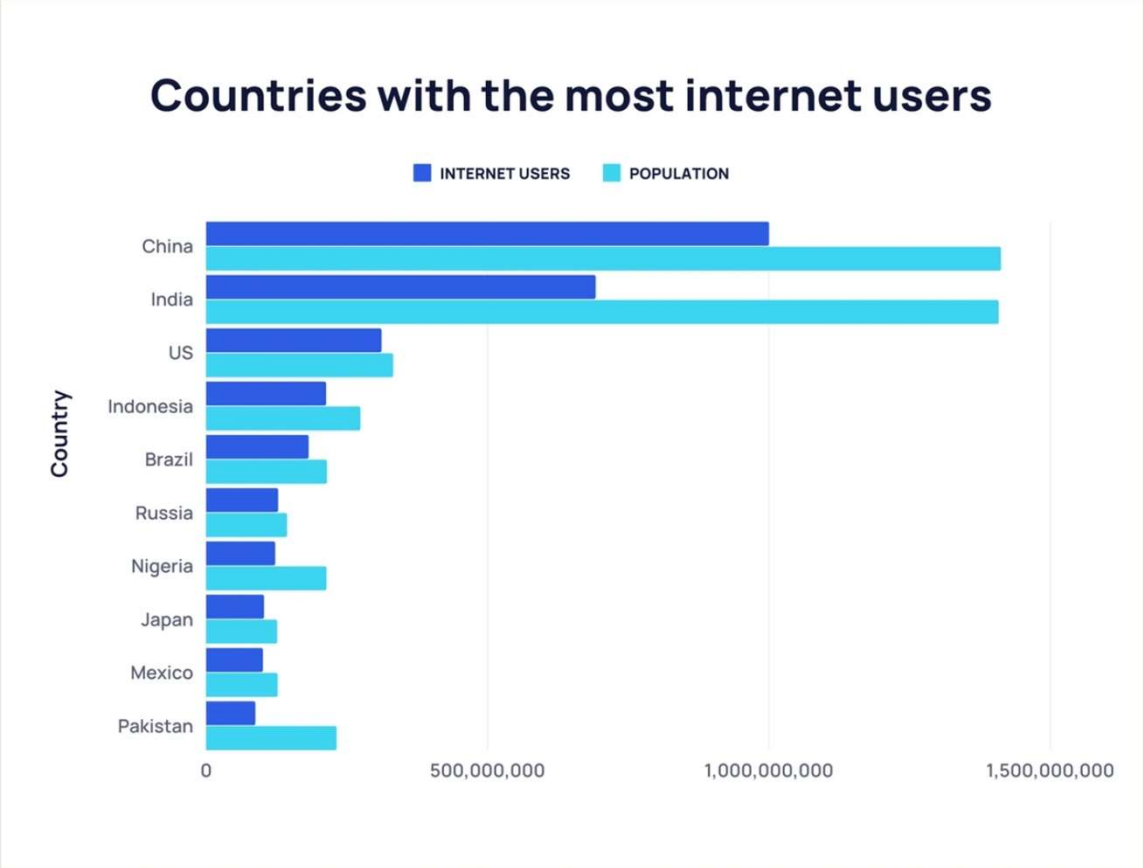


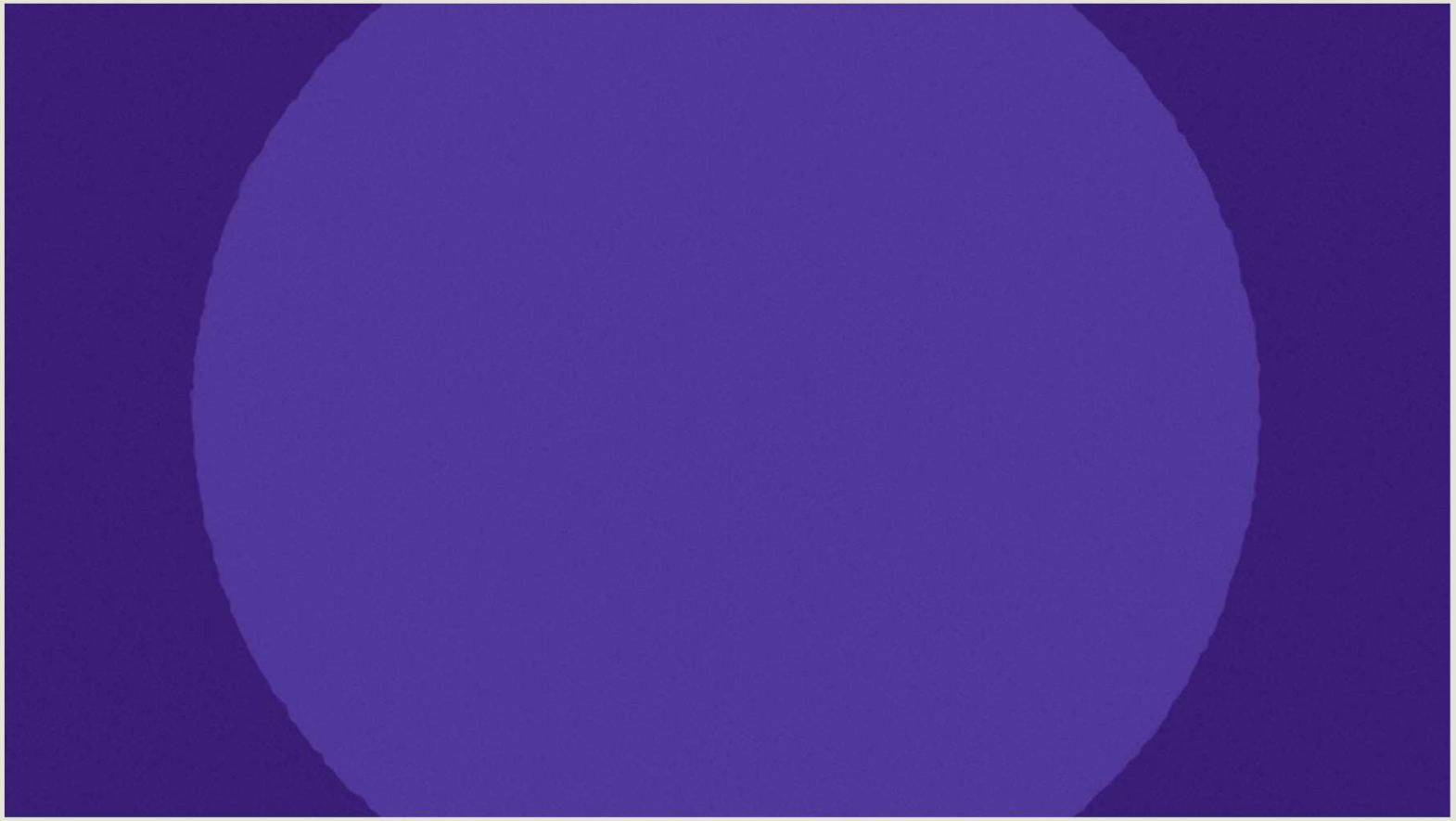
Cyberspace

- The term **cyberspace** is often used when talking about the Internet. It's an appropriate term because it captures the concept of the intangible, nonphysical territory that the Internet encompasses.

- Who owns it?

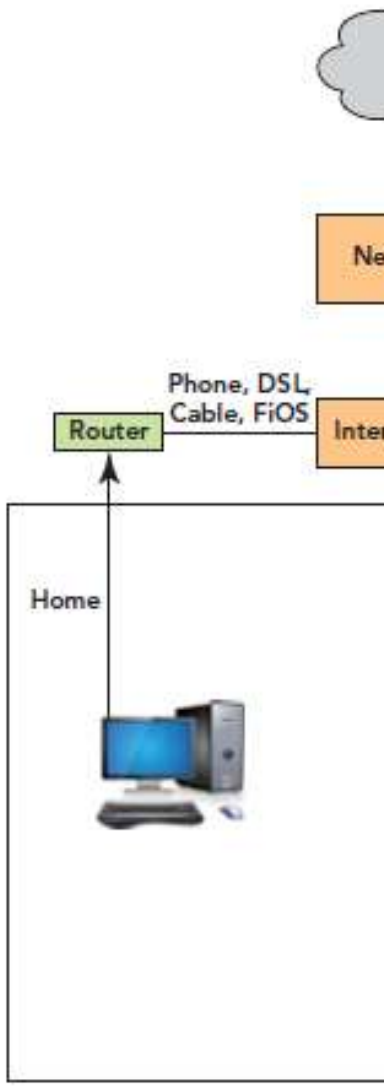
Really?

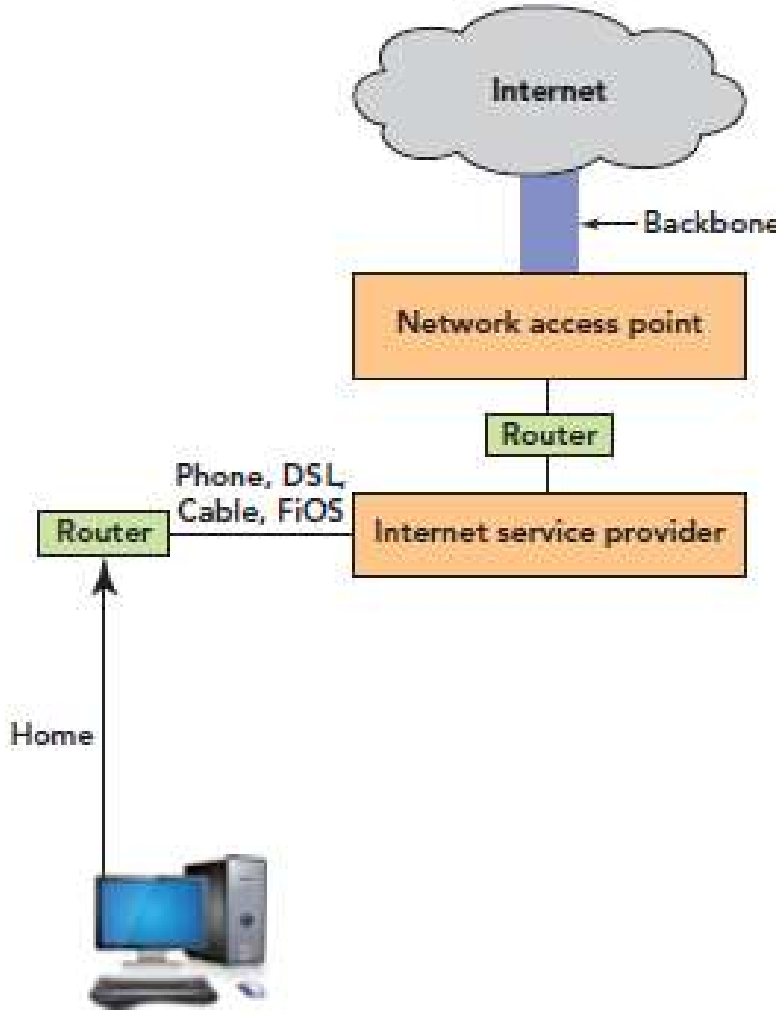
What is Internet?



Architecture

- Some times home router is required to connect to cable modem, DSL device etc.
- Its high level representation.
- But what actually is happening? How 1's and 0's are moving across the globe?





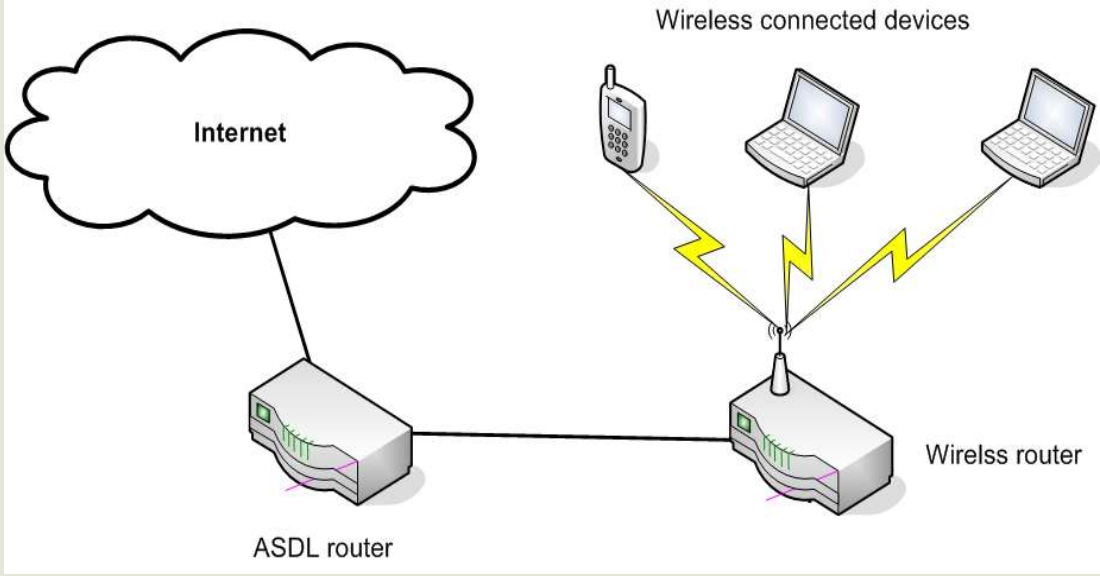
Architecture: IP Addresses

- Every computer on the internet has this:

  # . # . # . #

  IP Address or
  Internet protocol
  Address

  Its just number .
  Another number .
  Another….

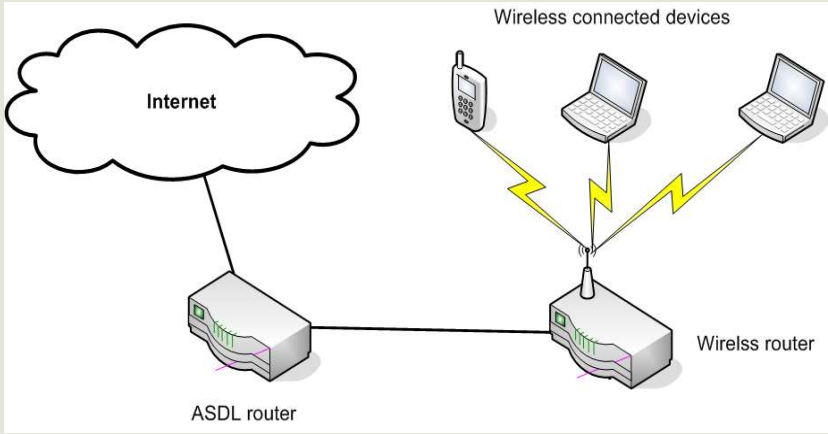


Architecture: IP Addresses

- Every computer on the internet has this:

  # . # . # . #

- So there are four numbers separated by dots.
- Each of these numbers have value between 0 -255
- Max. Value 255 , how many bits required?

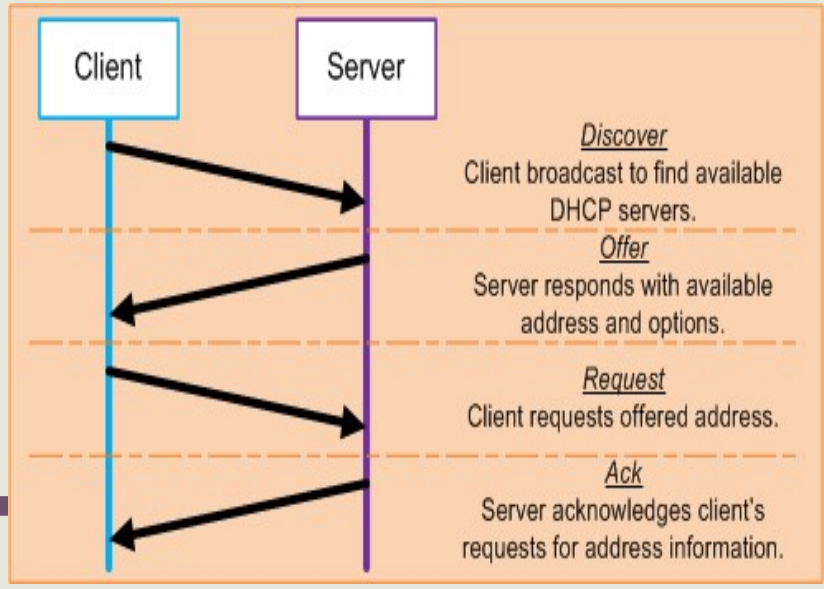


Architecture: DHCP

- So these IP address uniquely identifies computer on the internet like postal address.
- So by definition how internet works, every device i.e. phone, laptop, xbox, desktop etc. has unique IP address, that allows devices to talk.
- But from where this number (IP) comes from? Do you enter yourself this address?
- Few years back, sometimes technician from Internet Service Provider (ISP) used to come and enter it manually (configure manually).
- But now, software are intelligent. Now there is something called Dynamic Host Configuration Protocol (DHCP), which ISP runs and provide upon request unique IP address.

Architecture: DHCP

- But, if ISP is providing one IP address then how different devices on the home network are connected?
- Each device needs its unique IP address!
- Those IP addresses also come from DHCP, but not necessarily from ISP but from a device in your home / local environment i.e. **home router**. Home router also supports DHCP.



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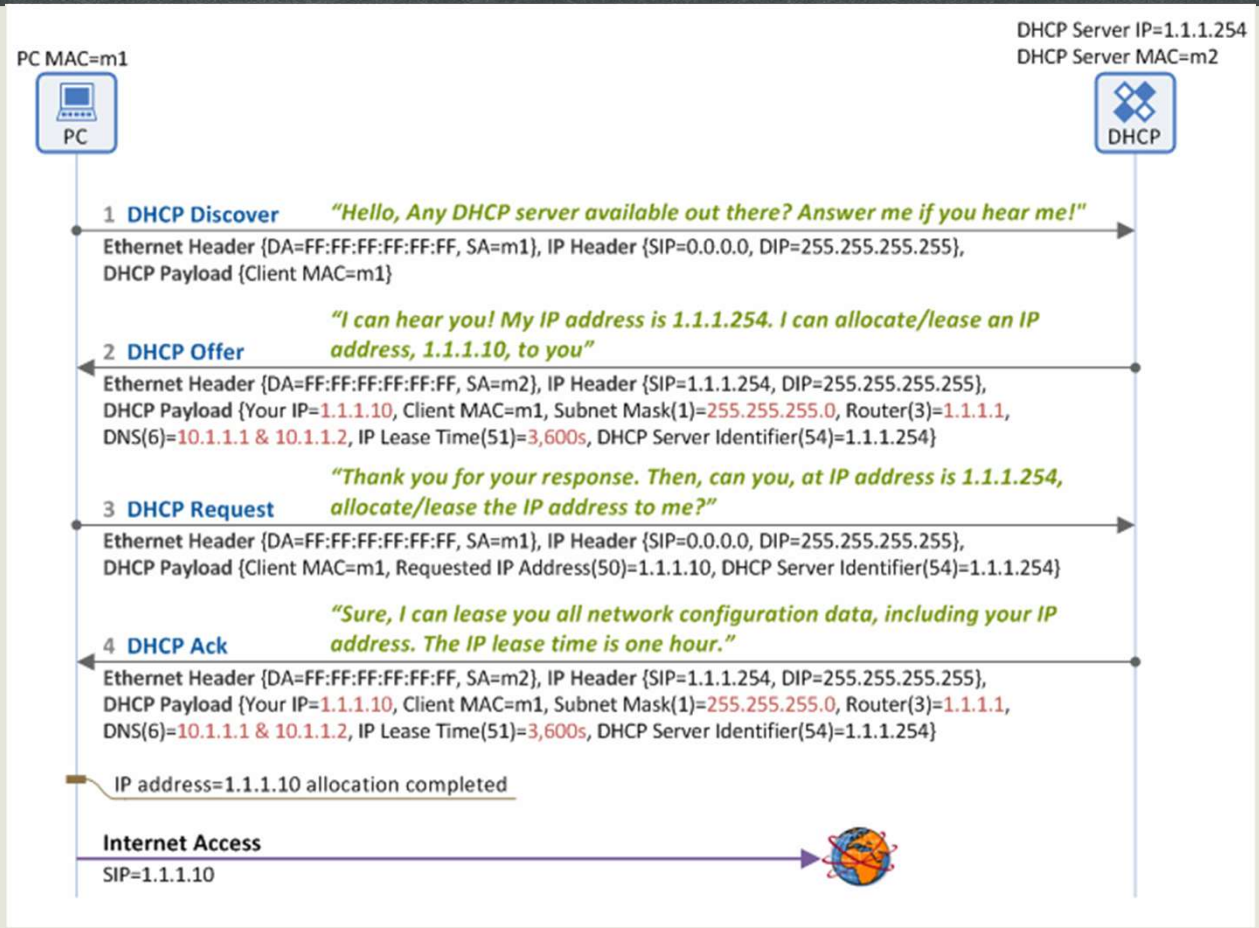


Architecture:

- Now we know that there is a unique address for each device on the internet.
- But, we don't type IP address if we want to go to:
  - Gmail
  - Yahoo
  - Facebook
  - Twitter
  - Dawn
  - .
  - .
- So how when we type "gmail.com" our computer finds where that specific computer / server is located? If there are computer with just IP address?

Architecture: DNS severs

- The Domain Name System (DNS) is the phonebook of the Internet. When users type domain names such as “google.com” into web browsers, DNS is responsible for finding the correct IP address for those sites.
- DNS servers convert domain names to IP addresses.

Intercommunication via packets

- Computers intercommunicate on the internet is by sending packets to one another.

- It is somewhat similar to writing a physical letter using postal address / Envelop
  - Receiver Address
  - Sender Address

Intercommunication via packets : virtual demo (Step 1)

- Lets say I want to search images of **McLaren F1** on the internet

1. I would say to "**Google**" server (write request, like a letter)

Intercommunication via packets : virtual demo (Step 2)

- Lets say I want to search images of **McLaren F1** on the internet

1. I would say to "**Google**" server
2. Put request in envelope

Intercommunication via packets : virtual demo (Step 3)

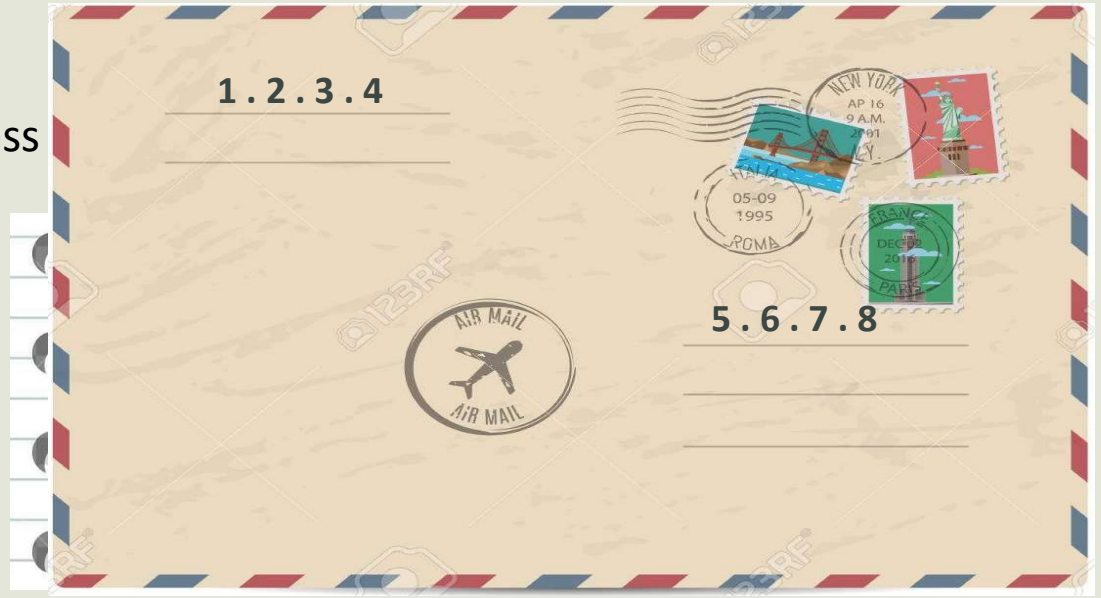
- Lets say I want to search images of **McLaren F1** on the internet

1. I would say to "**Google**" server
2. Put request in envelope
3. Find IP address

Intercommunication via packets : virtual demo (Step 4)

- Lets say I want to search images of **McLaren F1** on the internet

1. I would say to "**Google**" server
2. Put request in envelope
3. Find IP address
4. Put correct destination IP address



?

- If DNS server doesn’t know IP address of requested domain?

Intercommunication via packets : virtual demo (Step 5)

- Lets say I want to search images of **McLaren F1** on the internet

1. I would say to "**Google**" server
2. Put request in envelope
3. Find IP address
4. Put correct destination IP address
5. Send it off

   (will discuss where it goes)

Intercommunication via packets : virtual demo (Step 6)

- After some milliseconds, will get this:

Intercommunication via packets : virtual demo (Step 6)

- After some milliseconds, will get this:

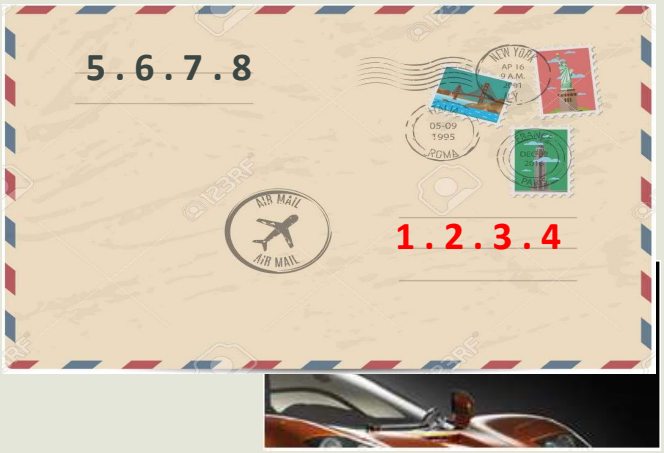
- But it will be in envelop (**one or more**) from Google

Intercommunication via packets : virtual demo

- Why in **one or more** envelop?
- **Reasons:**
  - Either data requested is too big to fit in an envelop
  - Its rude to other customers to block all the path with one big envelop
- **Solution**
  - Break data / letter into smaller parts / fragments

Intercommunication via packets : virtual demo

- Break data / letter into smaller parts / fragments
- So data / letter can arrive at destination in **random order**



Intercommunication via packets : virtual demo

- Break data / letter into smaller parts / fragments
- So data / letter can arrive at destination in **random order**
- **Is it enough for Google to put only my IP address on these envelops?**
  - **How receiver will assemble information (image in our case) if there is no clue!, SO**

Internet Protocol (IP)

- IP goes beyond addresses
- IP is a
  - Set of rules for routing and addressing packets
  - Set of convention for computers to follow so that when they communicate, they know what to expect from other and the other knows how to respond
  - IP supports fragmentation
    - But what if some packet is missing. **Let's say packet "2 of 4" is missing**, so receiver know which packet is missing but **what to do**?