



CS 348

Computer Networks

Lec 2

Spring 2020 IIT Goa

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Disclaimer: These slides are adapted from Computer Networking: A Top-down Approach by Kurose & Ross, 6th ed. For copyright information visit: <http://www-net.cs.umass.edu/kurose-ross-ppt-6e/>

Guiding Questions

- What are the Physical Components of the Internet?
- What is the "Structure" of the Internet?

Hosts/End-systems

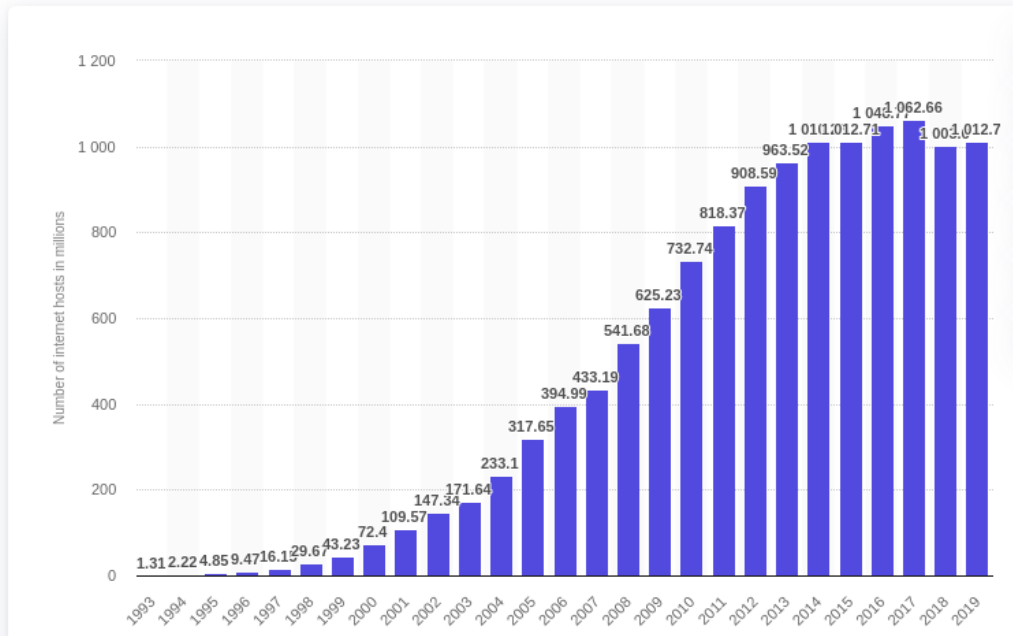


Image source:

<https://www.comp.nus.edu.sg/~ooiwt/cs2105/1314s2/lec01-intro.pdf>

<https://tkssharmagitbook.io/devops-training/basic-networking/network-architecture>

Number of hosts on the Internet: About 1 Billion

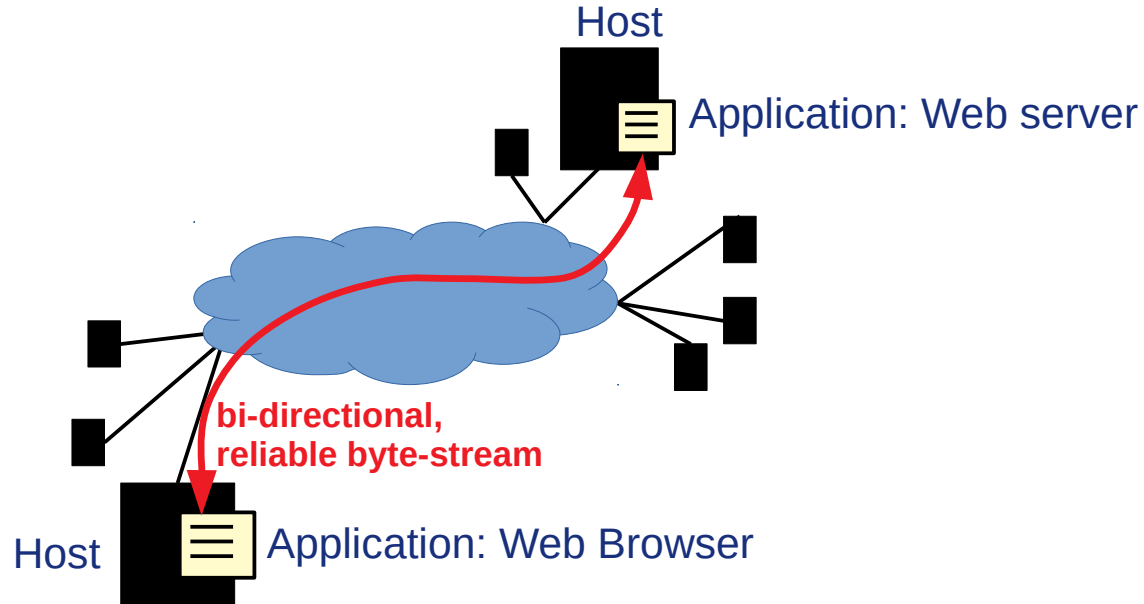


- Number of Internet users (humans) worldwide: 4.48 Billion

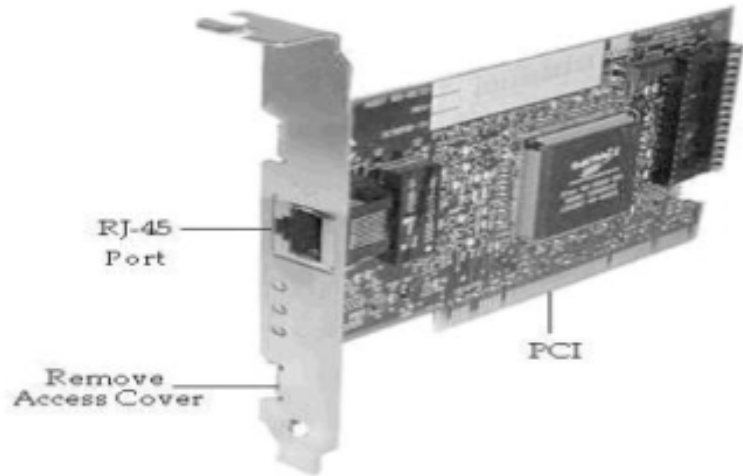
Image source:

- <https://www.statista.com/statistics/264473/number-of-internet-hosts-in-the-domain-name-system/>

Applications running on hosts communicate with each other over the Internet by exchanging messages.



Network Interface Card: physical interface of a computer to a wired network

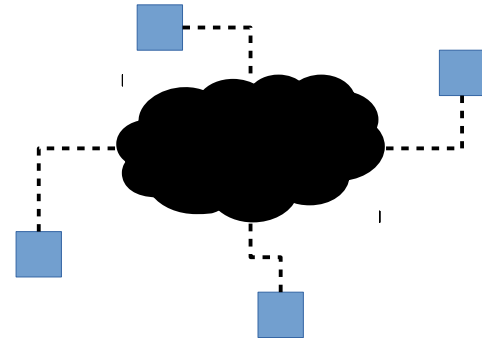


Communication Links

- Point-to-point Links
 - Example: cables



- Broadcast
 - Examples: Wireless, Cellular, Bluetooth, Radio, ...

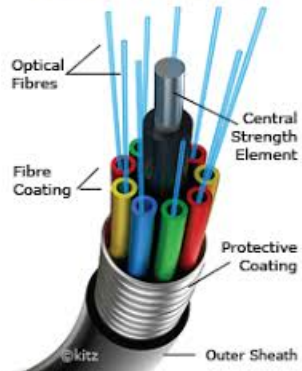


Communication Links

- Some network cable types:
 - Unshielded Twisted Pair (UTP)
 - Shielded Twisted Pair (STP)
 - Fibre Optic cable
 - Coaxial Cable



Fibre Optic Cable



UTP Cable



STP Cable

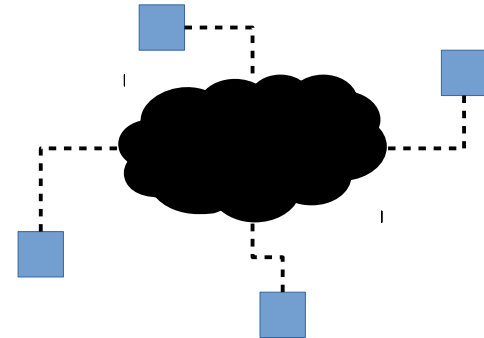
Communication Links

- Point-to-point Links
 - Example: cables



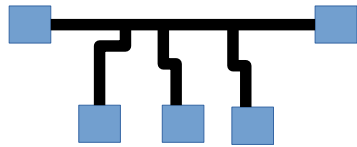
How do we create a network with more than two hosts?

- Broadcast
 - Examples: Wireless, Cellular, Bluetooth, Radio

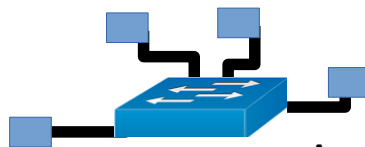


Communication Links

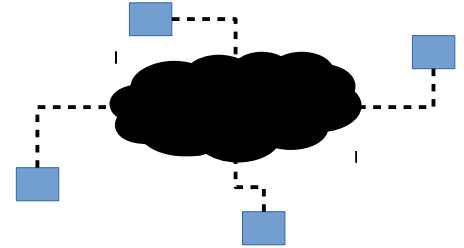
How do we create a network with more than two hosts?



Classic ethernet



A switch



- Need an **address** for every host
- **MAC** address
 - just a unique identifier for a network interface (analogy: Aadhar number)
 - conveys no information about location or route
 - some addresses reserved for broadcast and multicast

- Each packet consists of a “payload” and a “header”
- Header contains fields such as
 - source MAC address
 - destination MAC address

A Packet



Switch

- A Switch:
 - has multiple ports
 - “remembers” which port is connected to which MAC address
 - ***forwards*** incoming packets to one or multiple output ports based on the packet’s destination MAC address



Symbol
of a switch



Network switches



LAN (Local Area Network)

- An interconnection of hosts within a limited area (such as building, campus etc) that uses a single link technology



- How can we interconnect different LANs?

Inter-networks

- We need a different addressing scheme that makes it easy for “routing” packets
- IP address:
 - hierarchical (analogy: PIN code)
 - IPv4 address: 32 bit long, written as 4 octets

Example: 10.107.90.91
- An interface typically has **both** an IP address and a MAC address.

Router

- A device that can connect multiple networks together
- Figures out the output link to forward a packet meant for distant networks (makes **routing** descisions)
- **Forwards** incoming packets to one or multiple output ports based on their **destination IP address**



Symbol
of a router



WiFi
router



Ethernet router



A core router

Packet switch:

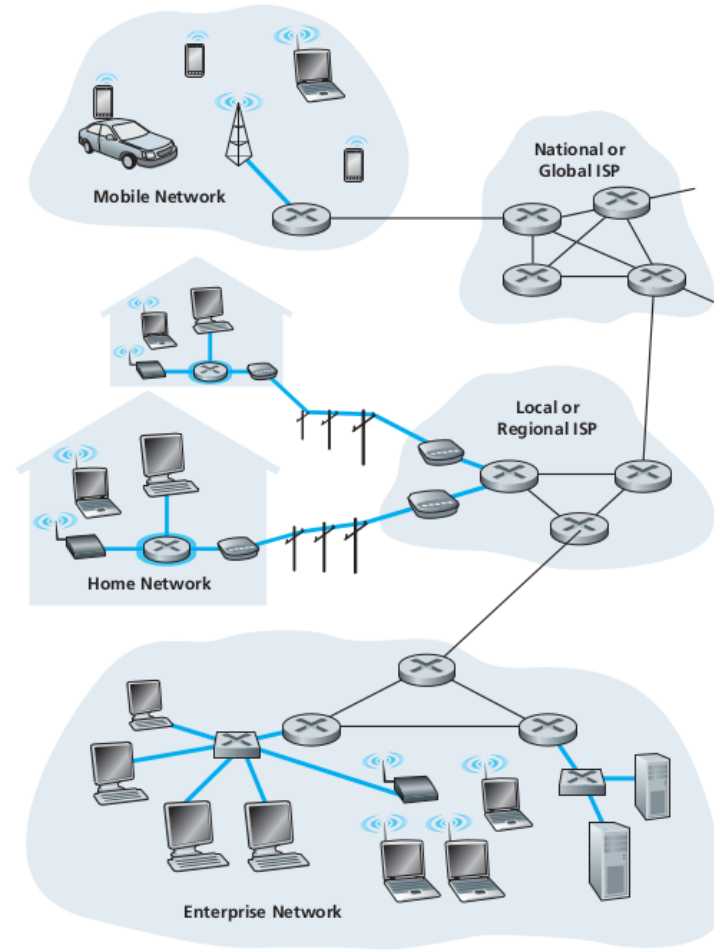
- A generic term for a Router or a Switch
- A device that forwards packets

Structure

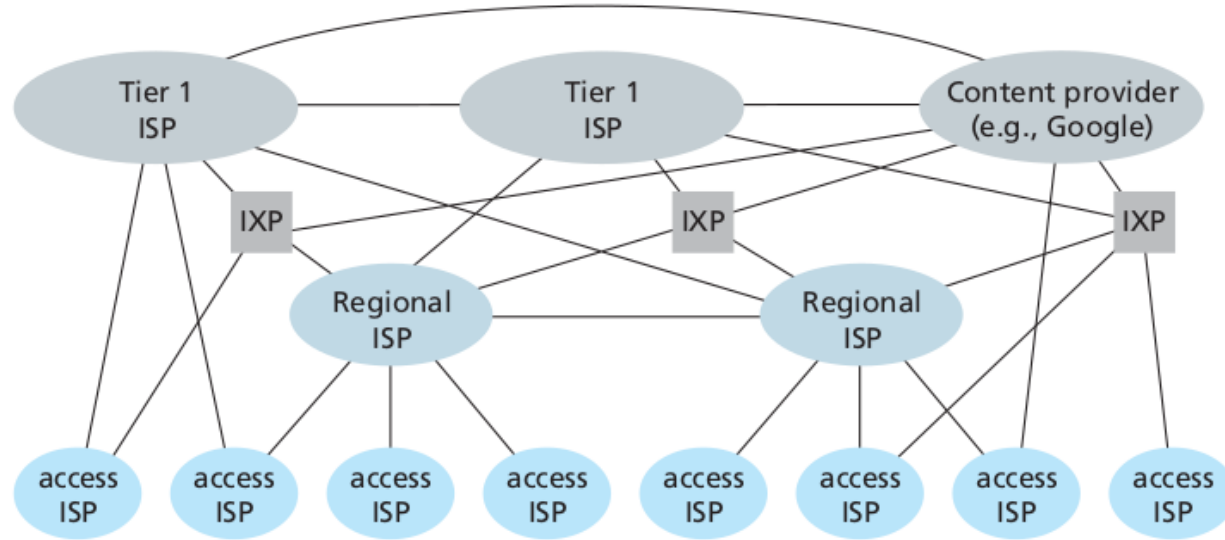
- **Access Networks**
 - Residential
 - Institutional
 - Mobile (3G, 4G..)
- **Network Core**
 - ISPs (Internet Service Providers)

How are the ISPs interconnected?

Who owns the network core?

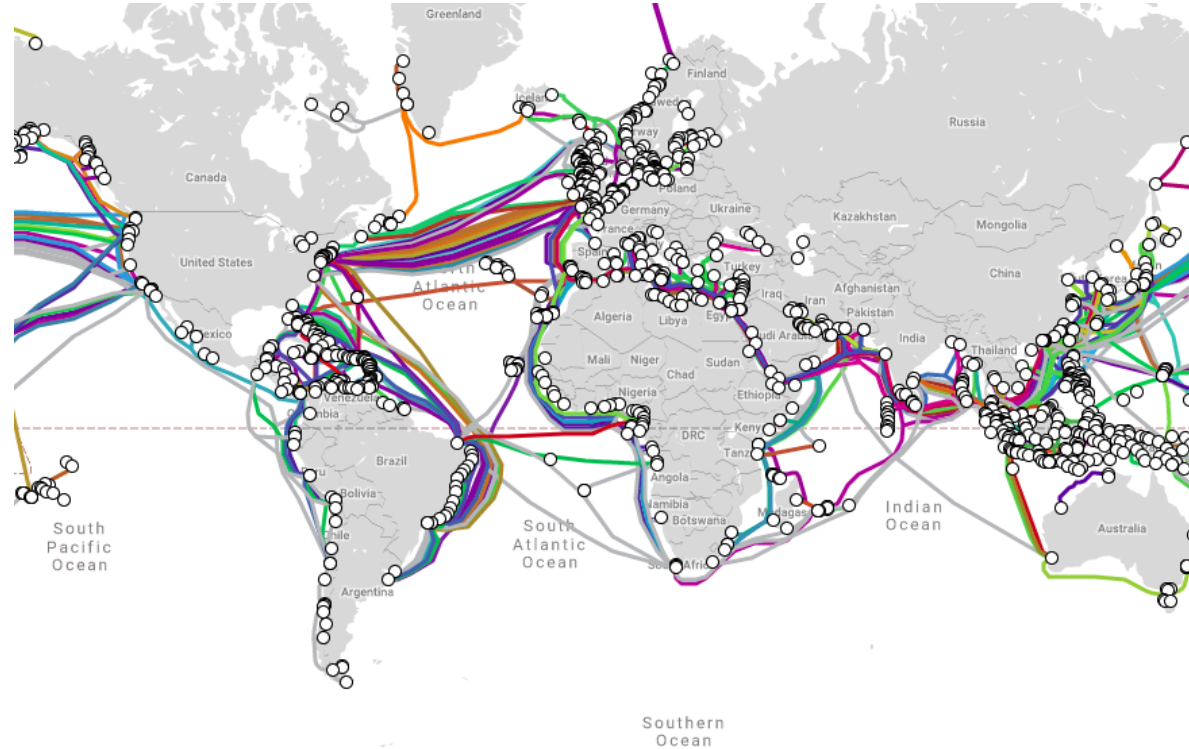


Structure



- IXP: Internet Exchange Point
- There are about 20 global Tier-1 networks. Examples: AT&T, NTT, Tata Communications
- Main factor behind this structure: **Economics**

A map of undersea network cables



Summary

- What are the **Physical Components** of the Internet?
 - Hosts/End-systems
 - Communication links
 - Packet switches (Routers, Switches)
- What is the **Structure** of the Internet?
 - Somewhat hierarchical ...

Questions

- Why is the structure of the Internet the way it is?
 - Why is it not perfectly hierarchical (a tree) ? Why not a mesh?
- How can I infer and map the structure of a network?
- How is routing done? How is the best route for a packet determined?
- How can I trace the path of a packet as it travels from my computer to some destination?

Exercise

- 1) Find out the IP address and MAC address of your computer when connected to the Internet
- 2) Find out which ISP provides Internet access to IIT Goa campus
- 3) Browse the Wikipedia entry for IEEE 802.3 (Ethernet) and IEEE 802.11 (WiFi)
- 4) Browse through some visualizations of the Internet at https://www.caida.org/research/topology/as_core_network/2008/

Reading Assignment

- Kurose and Ross: Sections 1.1, 1.2, 1.3