COMPUTER NETWORK SCE 4303

Overview of the Course

Dr. Yahaya Coulibaly

Overview of the Course

The Goal :

Gain general view of the course and be familiar with terminologies

The Approach:

Throughout the course Internet is used as example

Topics Covered :

- What is Internet?
- What is a protocol?
- Network edge; hosts, access network, physical media
- Types of Network core: packet/circuit switching, Internet structure
- Network Performance Metrics: loss, delay and throughput
- Security Issues
- Protocol layers, service models
- Brief History

In this note, only parts of the contents will be covered

Interested readers are encouraged to register for this subject to get more in-depth understanding of the subject

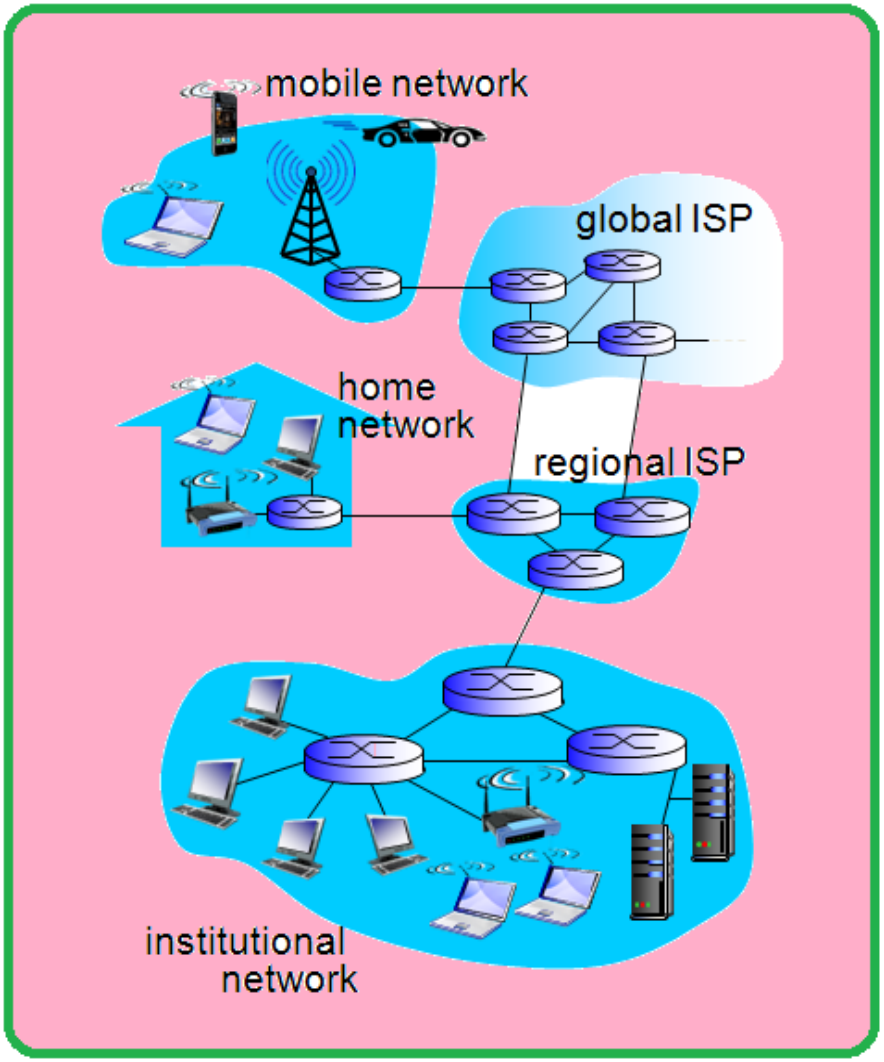
1. What is the Internet?

Infrastructure and Hardware view of the Internet

- Millions of computing devices are connected to the Internet:
  - *These devices are known as hosts or end systems and they are the one which run*

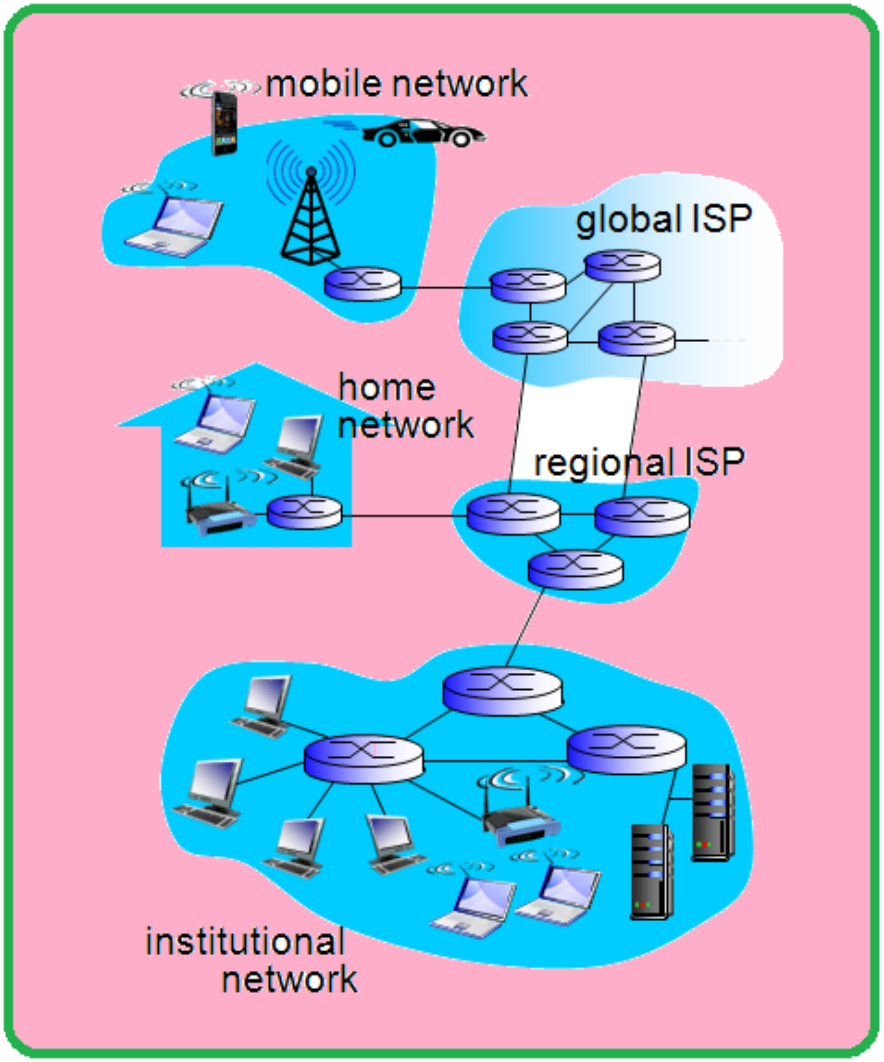
❖ *These devices are interconnected using communication links:*
- fiber, copper, radio, satellite
- transmission rate also known as *bandwidth (bits/s) differentiates these media*

❖ *Packet switches (routers* and *switches) are used to* forward packets from device to device.



Internet: Protocols and Standard

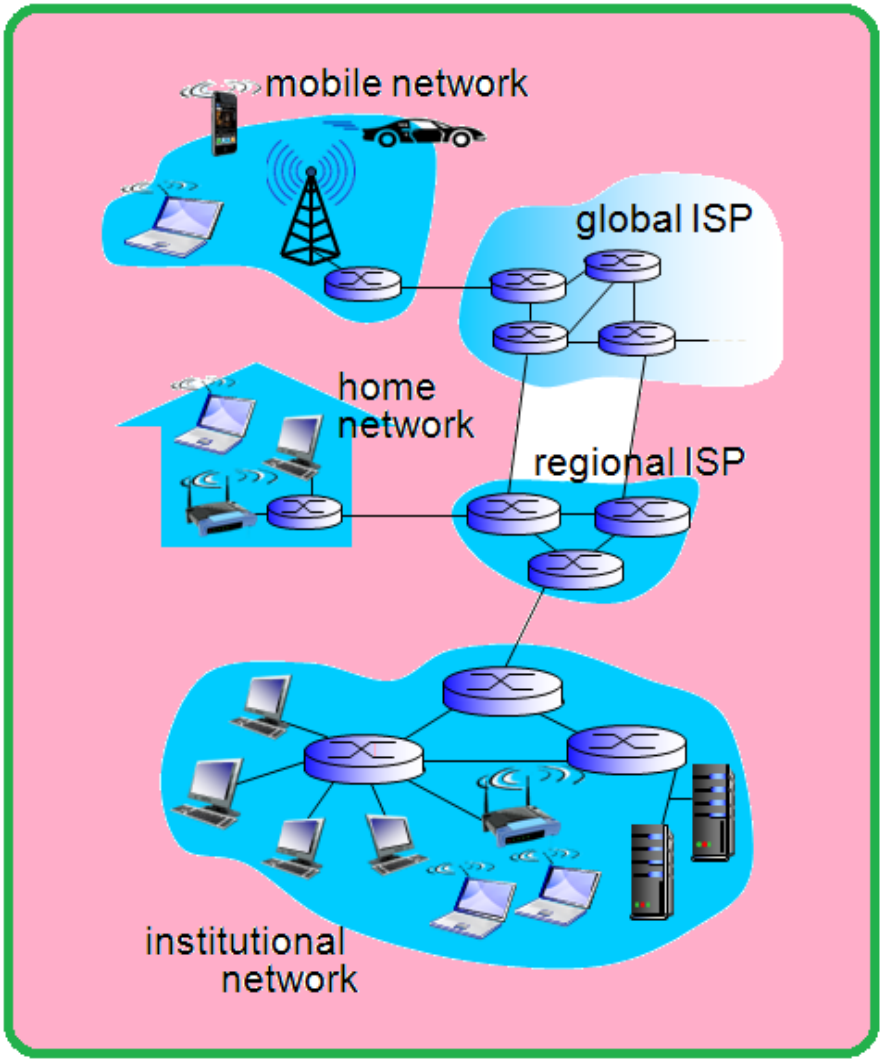
- *Internet is defined as* "network of networks" and the service is provided by Interconnected ISPs
- *Protocols* are used to control sending, receiving of messages
  - e.g., TCP, IP, HTTP, Skype, 802.11



- *Internet standards: Determine what each protocol does.*
  - e.g., IEEE 802 standards which specifies Ethernet and WiFi standards

Service View of the Internet

- *Service is the Infrastructure that provides services to applications. E.g.:* Web, VoIP, email, games, e-commerce, social nets, …
- *Service also provides programming interface to applications and they are the*
  - hooks that allow sending and receiving **application** programs to "connect" to Internet



What's a protocol?

In Computer Networks

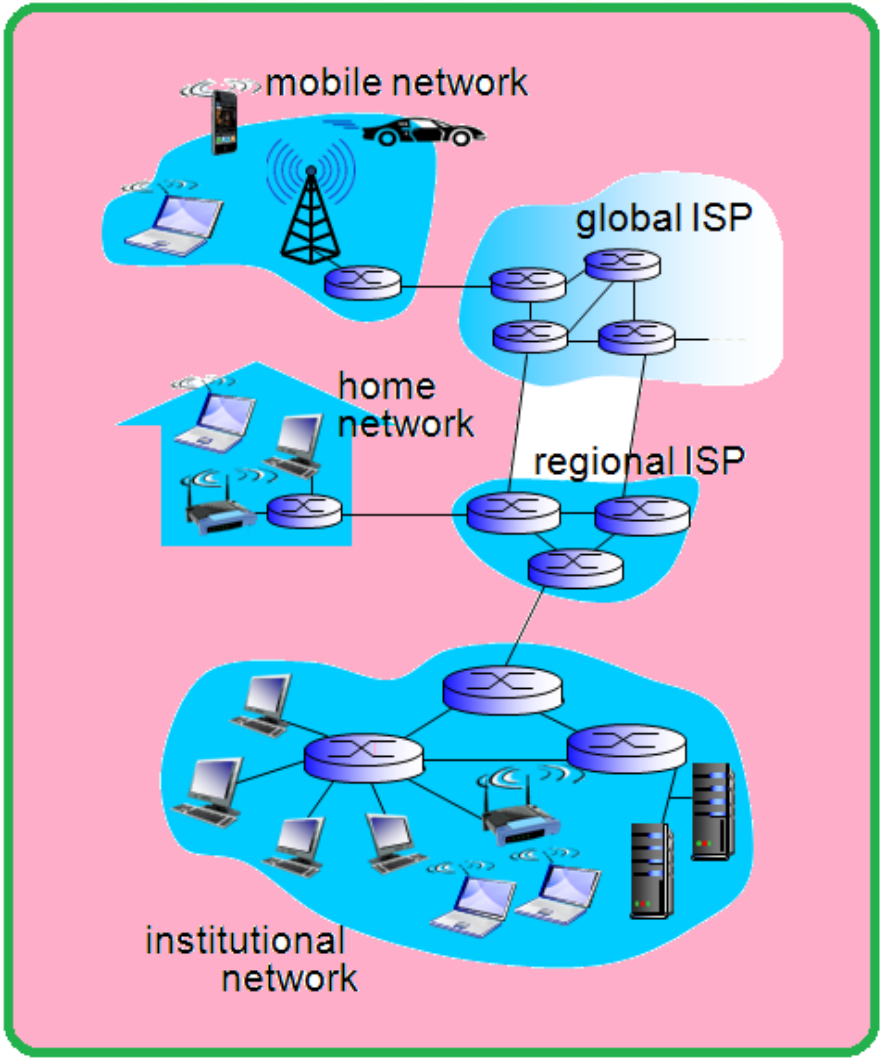
- All communication activity in Internet governed by protocols

Protocols define format, order of messages sent and received among network entities, and actions taken on messages transmission and receipt

2. Network edge : End systems, Access networks and links

A closer look at network structure

- *network edge:*
  - hosts: clients and servers (found in data centers)



- *access networks, physical media that carry data and they consist of* wired, wireless communication links
- *network core consists of* interconnected routers

Access networks and physical media

Access networks (AN)connect end systems to edge router.

There are three types of (AN):

- residential access networks
- institutional access networks (school, company)
- mobile access networks

Criteria for choosing

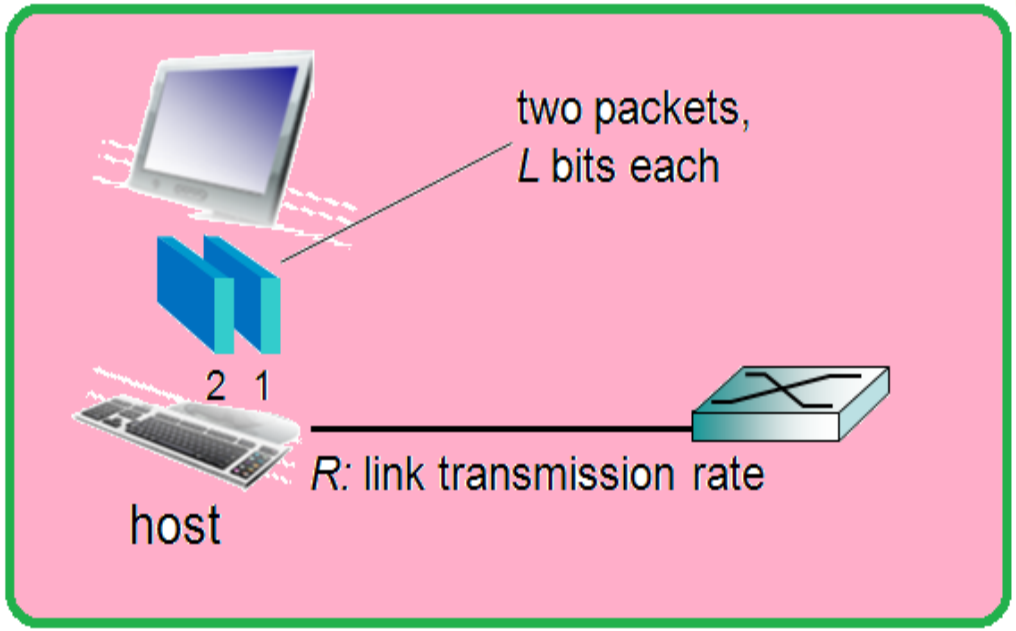
connection type:

- bandwidth (bits per second) of access network,
- shared or dedicated.

Data Transmission

How does host send data?

- Host takes application message and breaks it into *packets*, of length *L* bits
- Then, host transmits packet into access network at *transmission rate R as shown in this figure.*



$$\text{packet transmission delay} = \text{time needed to transmit } L\text{-bit packet into link} = \frac{L \text{ (bits)}}{R \text{ (bits/sec)}}$$

Physical Media

- It is the physical link that connects transmitter & receiver
- Used to carry data between sender and receiver
- bit: propagates between transmitter/receiver pairs through the physical medium
- Media are grouped under two categories:
  - guided media:
    - signals propagate in solid media such as copper, fiber, coax and twisted pair (TP)
  - unguided media:
    - In this type of media, signals propagate freely, e.g., radio, satellite…

Physical Media: Twisted Pair and Fiber

Twisted pair (TP)

- two insulated copper wires
  - Category 5: 100 Mbps, 1 Gpbs Ethernet
  - Category 6: 10Gbps

Fiber optic cable:

- glass fiber carrying light pulses, each pulse a bit
- high-speed operation:
  - high-speed point-to-point transmission (e.g., 10's-100's Gpbs transmission rate)
- low error rate:
  - repeaters spaced far apart
  - immune to electromagnetic noise

Physical media: radio

- signal carried in electromagnetic spectrum
- no physical "wire"
- bidirectional
- propagation environment effects:
  - reflection
  - obstruction by objects
  - interference

radio link types:

- terrestrial microwave
  - e.g. up to 45 Mbps channels
- LAN (e.g., WiFi)
  - 11Mbps, 54 Mbps
- wide-area (e.g., cellular)
  - 3G cellular: ~ few Mbps
- satellite
  - Kbps to 45Mbps channel (or multiple smaller channels)
  - 270 msec end-end delay
  - geosynchronous versus low altitude

3. Network Core : Packet Switching, Circuit Switching, and Network structure

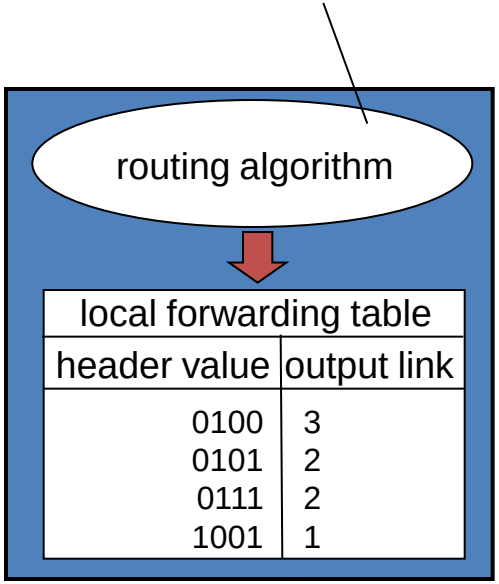
The Network core

- Consists of mesh of interconnected routers
- Basic Types:
  - packet-switching
  - Circuit Switching
- In packet switching: hosts break application-layer messages into *packets*
  - forward packets from one router to the next, across links on path from source to destination
  - each packet transmitted at full link capacity

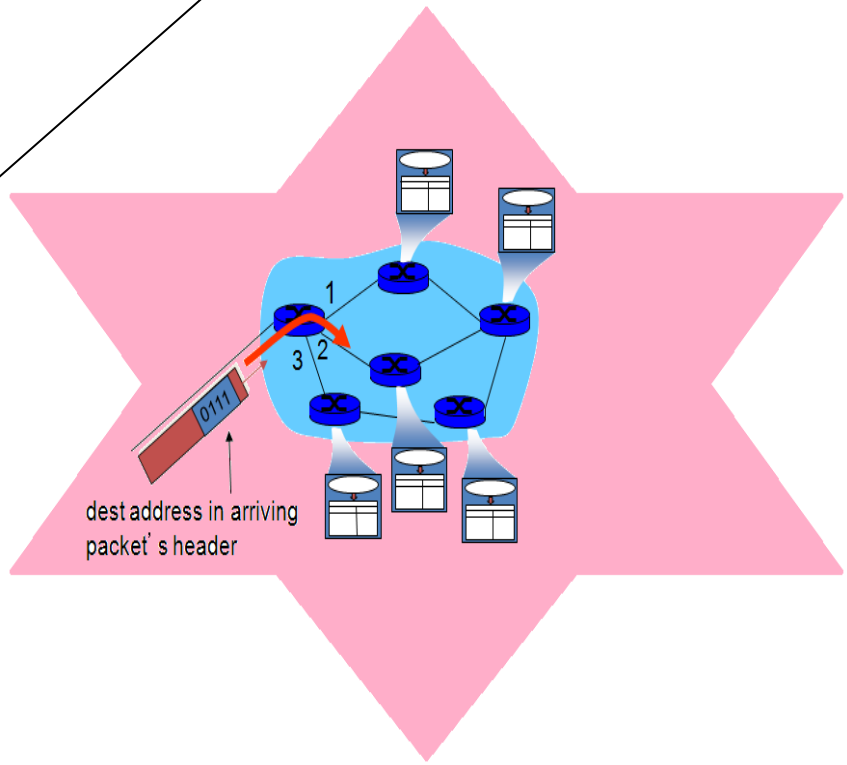
Two key network-core functions

routing: determines source-destination route taken by packets

- *routing algorithms*



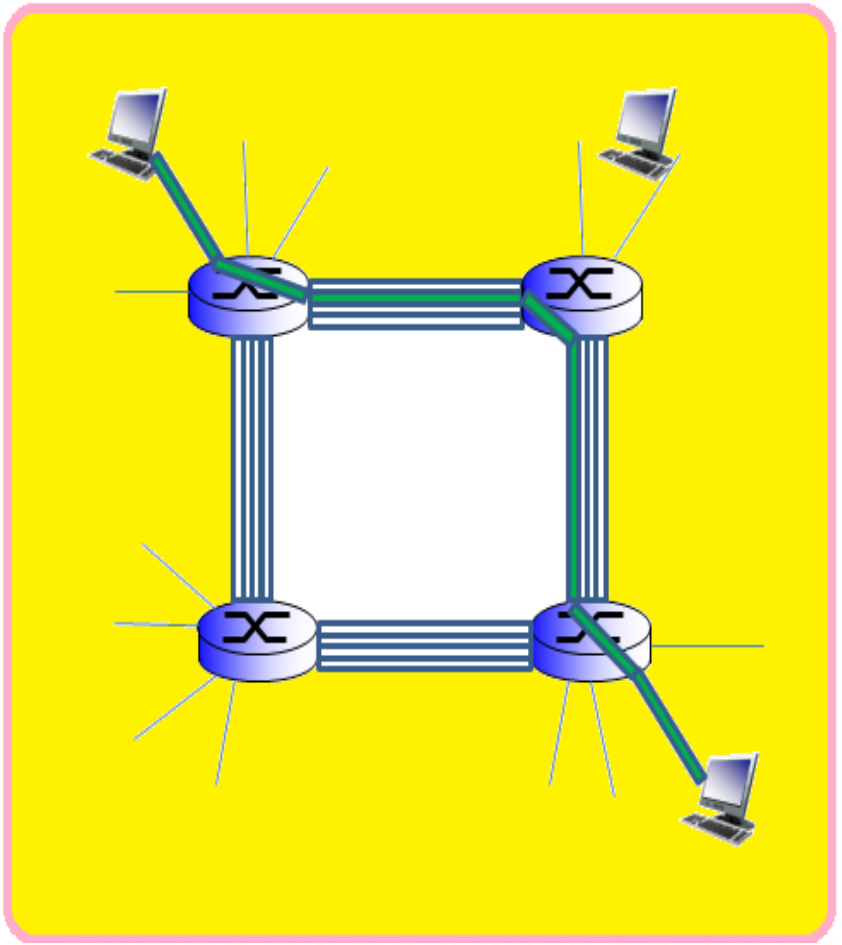
forwarding: move packets from router's input to appropriate router output



Alternative core: Circuit Switching

In Circuit switched networks:

- end-end resources allocated to, reserved for "call" between source & destination:
- In diagram, each link has four circuits.
  - call gets 2nd circuit in top link and 1st circuit in right link.
- dedicated resources: no sharing
  - circuit-like (guaranteed) performance
- circuit segment idle if not used by call *(no sharing)*
- Commonly used in traditional telephone networks



delay, loss, throughput in networks

Register for this Subject to get full access to the materials