CS536 Data Communication and Computer Networks

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Information

- No slides, no textbook.
- No curving for the final grade.

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1 Introduction

The lecture notes of this section is lec1 and lec2.

1.1 Components of a computer network

1. host devices (PC, server, laptop)
2. routers & switches (IP router, Ethernet switches, WiFi routers)
    - The global internet has 2 types of routing going on: 1. **Intranet**: routing within a domain. 2. **Internet**: routing between domains.
3. links (wires, fiber, quantum)
    - Confidentiality. We need to encrypt the data.
    - Authentication. We need to make sure the data is from the right source.
    - Integrity. We need to make sure the data is not modified.
    - Bounded by the speed of light. For wireless or wired today, we use eletromagnetic waves. FDM (Frequency Division Multiplexing) $\rightarrow$ OFDM (Orthogonal Frequency Division Multiplexing)
4. protocals (IP, TCP, UDP, ...). All protocals are part of an OS (in kernel mode). Protocal helps connect different parts of the network. Examples from low- to high-layer:
    - NIC: Network Interface Card. Such as Ethernet card, WALN card, etc. It is read only memory code. **Lower half of the OS**.
    - Device Drivers. **Lower half of the OS**.
    - ARP, RARP. **OS**.
    - IP. **OS**.
    - OSPF, RIP, BGP. OFPF, RIP: within organizations (intra-domain). BGP: global Internet (inter-domain). **OS**.
    - TCP, UDP. **OS**.
    - DNS, HTTP, SMTP, SNMP, SSL. **Application**.
    - SSH, web browser, PHP, P2P, YouTube etc. **Application**.
5. applications (DNS, HTTP, SMTP, SSL, ...)
6. humans and bots (spam, DoS, worm, ...)

> 1, 2 and 3 are **hardware**, 4 and 5 are **software**.

1.2 Communication

- Types of information transmition: **analog** and **digital**.
- In today's networks, the content is digital (bits), but the transmission is analog (eletromagnetic waves) $\rightarrow$ use analog information to transmit digital information.

Capability of network and end systems:

1. information aabstraction:
    - digital content representatoin: encode/decode information.

- analog rerpesentation and transmission of digital content: analog signals over physical media.

2. information protection:
   - deal with infornation corruption (bits flip). Use BER (Bit Error Rate) to measure the quality of the link.
   - deal with information loss(packet drop at routers and hosts). e.g., culprit: buffer overflow.
   - security. e.g., confidentiality, authentication, integrity, protect from infrustracture attacks such as DoS.
3. performance:
   - fast transmission: throughputs (bps), bottleneck can be software.

     Why 1Gbps Ethernet is not 1Gbps throughputs? TCP is not one-time transmission. TCP is a **reliable** protocal, which means it will make sure the data is delivered. TCP will send a packet, wait for the ACK, and then send the next packet.
   - information latency: physical distance, buffering of messages at routers and hosts. Bad for real-time applications such as video streaming, online gaming, etc.

1.3 Types of networks

1. connectivity:
   - point-to-point
   - multi-access (broadcast)
   - internetwork (network of networks such as Purdue's campus network)
2. medium:
   - wired
   - wireless
3. locaiton:
   - stationary
   - mobile

1.3.1 Point-to-point link

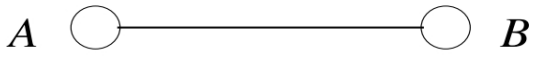

Figure 1: Point-to-point link

- NIC at A, NIC at B
- A and B don't need names in principle.

1.3.2 Multi-access link

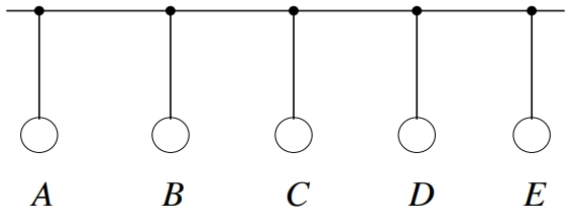

Figure 2: Multi-access link

- sometimes called bus
- names (i.e., addressing) necessary, called local area network (LAN) addresses.
- key issue of multi-access link communication: access control.
  - link is a shared resource.
  - myriad of LAN technologies and protocols.

1.3.3 Internetwork

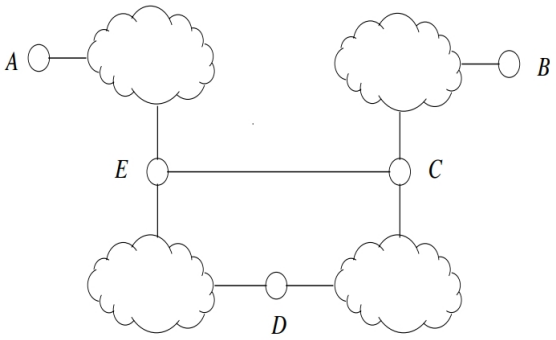

Figure 3: Internetwork

- recursive definition: network of networks.
- everything is the composition of point-to-point links and multi-access links.
- additional complications:
  - new names beyond LAN addresses: in principle, LAN addresses are unique and suffice.In practice, new names (i.e., network addresses) bring benefits despite overhead.
  - protocol translation: LANs speak different languages (e.g., Ethernet and WLAN)
  - location management: mobility. e.g., handoff of mobile host among multiple networks.