

Network Overview

What is the question you concern about networks?

- “Faster” networks
 - The speed of the networks sometimes is a very general measure. Typically, if we just talk about network speed itself, it refers to transmission rate. The rate is measured in bitrate (bits/second, bps), and it's usually measured as kbps (103), Mbps (106), Gbps (109), and Tbps (1012).
 - However, we sometimes link the network speed unintentionally with the experience of using a network application or opening a website. Therefore, the speed includes more than just the transmission rate. For example, faster networks (a.k.a. network applications or websites) have lower latency, as the server responds more quickly to a request; fast networks have lower error rates, such as bit error rate or packet loss probability, so there will be fewer retransmissions, and the networks are faster; or the network has higher availability, so the network is more reliable and is less likely to be down, letting users feel that the networks are fast.
- Ubiquity
 - the service can be provided everywhere
- Lower monetary cost
 - can access fast and reliable networks everywhere with low cost
- Improved user experience (low complexity)
 - easy to use

Categories of Networks

- Wide Area Network (WAN)
 - A computer network spanning a large geographical distance (regions, countries, world)
- Local Area Network (LAN)
 - A computer network that extends over a limited area, such as a residence, school, laboratory, university campus, or office building.
 - Its network equipments and interconnections are locally managed.
- Access Network
 - The network that physically connects a host to the first router on a path from the end system to any other distant end system (aka, connect the subscribers to the service providers)
 - Host: desktop, laptop, smartphone, tablet, TV, watch, eye glasses, ...
 - two most prevalent types: DSL (digital subscriber line, provided by the same local telephone company that provides local phone access, using exiting phone line) and cable

(using the cable television company's existing cable television infrastructure), speed in Mbps

- two new types: FTTH (fiber to the home): up-and-coming technology, high speed (in Gbps), provide an optical fiber path directly to the home; 5G fixed wireless: high-speed residential access without installing costly and failure-prone cabling from the telco's center office to the home. beam-forming technology, data is sent wirelessly from a provider's base station to a modem in the home.
- Core Network
 - backbone, network that interconnects networks (e.g., LANs or subnetworks).
- Cellular Data Networks
 - extending the Internet to cellular subscribers
 - smartphones are able to connect to Internet
 - cellular technology generation
 - 1G: designed exclusively for voice-only communication (extinct now)
 - 2G: designed for voice
 - 2.5G: extension of 2G, support data and voice (e.g. Internet), not success
 - 3G: support voice and data, with an emphasis on data capabilities and higher-speed radio access links (> 1Mbps)
 - 4G: system deployed today based on LTE (Long-Term Evolution) technology, voice and data are all packed in IP datagrams, higher speed (> 10 Mbps), wider area access
 - 5G: faster, 20 Gbps download speed. Why is 5G so important if it's just faster than 4G? Why does speed matter?
- Datacenter Networks
 - Data Center
 - Internet companies, like Google, Microsoft, Facebook, and Amazon have their own data center.
 - A data center is composed of 10's to 100's of thousands of hosts, concurrently supporting many distinct cloud applications (e.g., search, email, webpages, videos, mobile app content)
 - Hosts are worker bees in a data center. They include CPU, memory, and disk storage.
 - Those companies have their own datacenter network that interconnects its hosts with each other and interconnects the data center with the Internet.
 - Data centers serve three purposes (Amazon): Amazon e-commerce pages to users, massively parallel computing infrastructures for Amazon-specific data processing tasks, cloud computing to other companies (e.g., Airbnb runs its entire web-based services in the Amazon cloud, AWS—Amazon Web Services)
- Personal Area Networks (PAN)
 - A network used for data transmission among devices over a short range.

- Bluetooth
 - A network operates over a short range, at low power, and at low cost.
 - Typically less than 10 m (WiFi typical 100 m), transmission rate over 1 Mbps
 - It is essentially for interconnecting a computer with its wireless keyboard, mouse or other peripheral devices; cellular phones, speakers, headphones, and many other devices.
- Zigbee
 - Lower-powered, lower transmission rate than Bluetooth (10/20/40/100/250 Kbps)
 - E.g., Home temperature and light sensors, security devices. Applications that do not need faster transmission rate and the consequent rate.
- ...

Disclaimer: Notes adapted from the textbook and online resources.