Computer Networks and the Internet

What is the internet?
- Host/End System
- Protocols
  - FTP
  - HTTP
  - SMTP
  - A protocol defines the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.
- TCP/IP
- RFC — Standariserte regler
- Apps

The Network edge
- Hosts
  - Clients
  - Servers
- Data center
- Access Networks
  - Mobile Network
  - Home network
  - Enterprise network
- Access technology
  - DSL — DSLAM
  - Cable
  - FTTH(Fiber)
  - Dial-Up
  - Satelite
  - Ethernet(Home, Enterprise)
  - WiFi(Home, Enterprise)
  - 3G , 4G(LTE) (Wide-Area Wireless Access)
- Physical media
  - Guided media
    - Twisted-Pair Copperwire
    - Coaxial Cable
    - Fiber optics
  - Unguided Media
    - Terrestrial Radio Channels
    - Satelite Radio Channels

The Netwok Core
- Packet Switching
  - Link layer switches
  - Routers
  - Store-and-forward transmission
  - Forwarding tables and routing protocols
  - More users than circuit switching (56-57)
- Circuit switching
  - Reserved Resources
  - Connection = circuit
  - Dedicated end-to-end connection
    - Dedicated circuits are idle during silent periods
  - Multiplexing
    - Frequency-division multiplexing (FDM) — Each circuit continuously gets a fraction of the bandwith.
    - time-division multiplexing (TDM) — Each circuit gets all of the bandwith periodically during brief intervals of time
  - Less users than packet switching (side 56-57)
- Network of Networks
  - ISP(side 58-61)
    - Regional
    - Tier-1
    - Provides internet to peasants
    - IXP (Internet eXchange Point)
    - POP (Point of Presence)
      - Lady Gaga
      - Katy Perry
    - Multi-homing
    - Content provider networks

Delay, Loss and Throughput in Packet-switched networks
- Delays
  - Transmission
    - Packet Length = L bits
    - Transmission rate = R bits pr sec
    - $d\_trans = L/R$
  - Propagation — Time it takes to propagate from one end of the link to the other
    - Link distance = D m
    - Links speed = S m/s
    - $d\_prop = D/S$
  - Queue — Packet loss (when full drops packet)
    - Buffer
  - Processing
  - Total nodal delay — $d\_trans + d\_prop + d\_queue$ à d_proc
  - $d\_endToEnd = N(d\_proc + d\_trans + d\_prop + d\_queue)$
    N = antall noder
- Traffic intensity
  - Packet length = L
  - Average packet arrival rate = a
  - Link transmissionrate = R
  - Trafic intensity = La/R
  - If La/R > 1 => Packet loss
- Traceroute — TTL
- Throughput
  - Average througput
    - File consist of F bits
    - It take T second to transfer the entire file
    - Average throughput = F/T bits/sec
  - Instantaneous througput
  - Bottlenecks — The network will never be better than it's weakest link
    - min(R_1, R_2, R_3 ...)

Protocol Layers and Their Service Models
- Layered Architecture
- Protocol Stack
- A protocol belongs to a layer
- Layer provide services to layers above it (Service model)
- Layers in the internet
  - Application Layer — Messages
  - Tranportation Layer — Segments
    - TCP
    - UDP
  - Network Layer — Datagrams
  - Link Layer — Frames
  - Physical Layer — Bits
- OSI model — Same as internet model but added between Application and transportation we have
  - Presentation
  - Session
- Encapsulates for every layer — Message -> Segment -> Datagram -> Frame

Networks Under Attack
- DDoS
- Botnet
- Malware
  - Self-replicating
  - Viruses — Require some form of user interaction
  - Worms — Can enter device without explicit user interaction
- Sniffing
- Man in the middle — Altering packages
- IP-spoofing