Networking Basics: A Review

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- Historically, there have been two different philosophies guiding the design, operation, and evolution of communication networks
  - the "telco" view (i.e., telecommunications networks to support voice telephony and other emerging services, such as fax, data, location, etc.)
  - the "data networking" view (i.e., the Internet)
- While the two approaches share some similar goals and challenges (e.g., scale, geography, heterogeneity), they often have quite different underlying assumptions

- Over 100 years old

- Circuit-switched network

- Designed for transmission of human voice

- Twisted pair copper wire for residential access
  - "cheap", adequate bandwidth, easy to handle…

- Aggregation of multiple calls at toll office for multiplexing/demultiplexing using TDM

- Low bandwidth required per call (e.g., 64 Kbps)

- Fixed bandwidth required per call

- Call routing and circuit allocation decided once per call at time of call arrival

- End to end path allocation, with dedicated circuit (reserved bandwidth) per active call

- All bits travel same path; stay in same order

- Call state information crucial in network switches

- Busy signal if no path possible (blocking <= 2%)

- Billing model based on time used (in minutes)

- Single class of service; high reliability (99.99%)

- New services: faxes, modems, mobility, …

- About 50 years old
- Packet-switched network
- Variable size packets permitted
- Designed for transmission of data
- Wide range of access technologies
- Wide range of user and application behaviour
- Bursty, variable bandwidth required per call
- Aggregation of traffic at routers/switches
- Transmission links shared on stat mux basis

- Connection-less network layer protocol (IP)

- "Best effort" datagram delivery model

- Packet routing decided on a per packet basis

- No end to end path allocation; no reserved bandwidth per active call

- Packets can travel any path; packets can be delayed, lost, duplicated, re-ordered

- Minimal state info in network switches

- Single class of service

- Billing model? (hours? pkts? bytes? bandwidth?)

- **Application:** supporting network applications and end-user services
  — FTP, SMTP, HTTP, DNS, NTP
- **Transport:** end to end data transfer
  — TCP, UDP
- **Network:** routing of datagrams from source to destination
  — IPv4, IPv6, BGP, RIP, routing protocols
- **Data Link:** hop by hop frames, channel access, flow/error control
  — PPP, Ethernet, IEEE 802.11b
- **Physical:** raw transmission of bits

Application

Transport

Network

Data Link

Physical

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Router

Application	Application
Transport	Transport
Network	Network
Data Link	Data Link
Physical	Physical