Introduction to Networks

* Communication Layer - ATNLP

I. Application layer: IMAP, HTTP, SMTP, exchange of message [M] - I

II. Transport layer: TCP, UDP, encapsulation with a header to create a segment

[H_t | M] - II

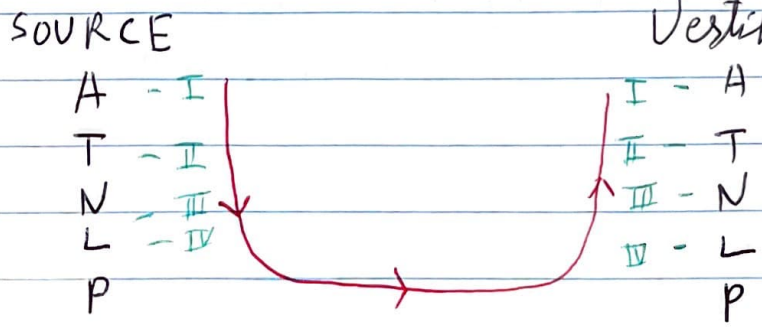
III. Network layer: IP, routing protocol, encapsulates segment with network layer header to create a datagram

[H_n | H_t | M] - III

IV. Link layer: ethernet, 802.11, encapsulates datagram with header to create link layer frame

[H_l | H_n | H_t | M] - IV

V. Physical layer: bits on the physical layer



* ISO/OSI Reference model
A P S T N L P

I. Presentation P: allows applications to interpret meaning of data e.g encryption, compression, machine specific conventions
layer

II. Session S: Synchronization, checkpointing, recovery of data exchange
layer

* Calculations

data packets of length L bits
Transmission rate R

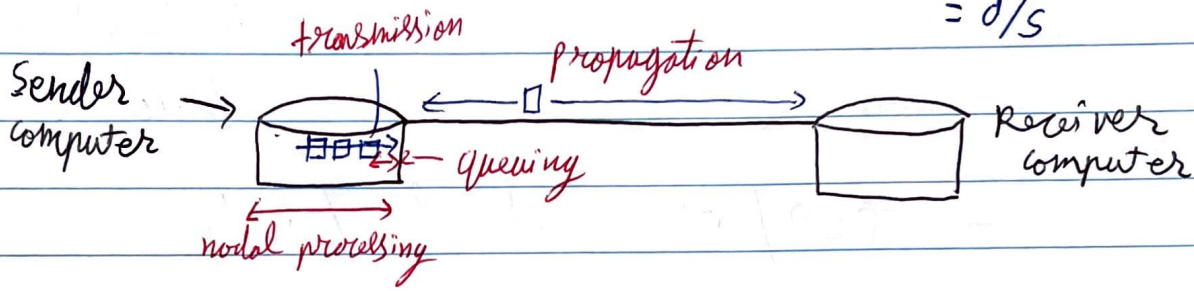
∴ packet transmission delay (sec) = time needed to transmit L bit packet into link

$$= \frac{L \text{ (bits)}}{R \text{ (bits/sec)}}$$

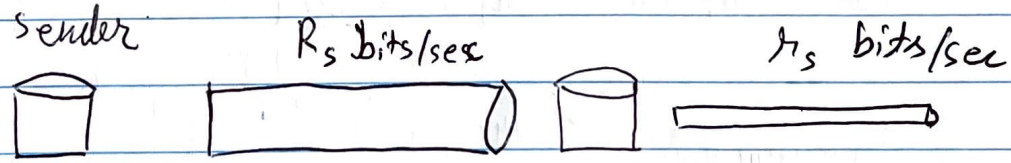
* Packet Delay: occurs when memory to hold queued packets fills up

$$d_{nodal} = d_{proc} + d_{queue} + d_{trans} + d_{prop}$$

- d_{proc}: nodal processing
- d_{queue}: waiting time for transmission
- d_{trans}: $\frac{L}{R}$
- d_{prop}: propagation delay
  - d: length of physical link
  - s: propagation speed (2×10^8 m/s)
  - $= d/s$



* Throughput : rate (bits/time unit) at which bits are being are sent from sender to receiver
  - instantaneous : rate at give point of time
  - average : rate over long period of time



let $R_s > r_s$

↳ bottleneck of r_s

* Model is not always reality
  - usually parts of physical, data link, and possibly upper layers

* Internet : "networks of networks"
Interconnected ISPs

- protocols : control sending, receiving of msgs
Eg : HTTP, TCP, IP, skype, 4G, ethernet

- Internet Standards : RFC → Request for comments
IETF → Internet engg. task force

- TCP/IP protocol family

I. Network layer : IP (Internet Protocol)
provides a naming scheme and unreliable delivery of packets from host to host

II. Transport layer : UDP (User datagram Protocol)
uses IP to provide
- unreliable data delivery from process to process

gaming, video call

TCP (Transmission Control Protocol)
uses IP to provide reliable data delivery from process to process

financial transaction, trading

- Accessed via a mix of Unix file I/O and the Sockets interface

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

specific msg sent → specific action taken → specific output returned

* Programmers View of the Internet

1. Hosts are mapped to set of 32 bit IPV4 addr.
   e.g. 34.239.29.130
2. The set of IP addresses (→ 32 bit) is mapped to a set of identifiers called Internet Domain names
   → mapped to Binghamton.edu
3. A process on one Internet host can communicate with a process on another Internet host over a connection

* DNS - mapping of IP addresses, has a database of host entries, special: localhost → refers back to the computer used

In Application layer

* Connections: I. Point to Point - connects a pair of process

II. Full duplex - dual flow at same time

III. Half duplex - only one at a time

IV. TCP - reliable conn.

* Sockets - end point of a connection
end-to-end comms

- socket address: IPaddr : port pair
to identify computer to identify process

- use instructions already designed for sources and sinks in PLs, not a physical entity

* Ports: used to identify services to the kernel

* Addressing - Intranet and Internet
in general network operators don't change
↳ Tie IP addresses to network operators
↳ Assign computer IPs as they join networks

* IPs are dynamic : owned by networks

MACs are hardware & static : owned by computers

Connecting to a network - computer leases IP from local network
- only the router knows your MAC, everyone else sees your IP

* In which layer is?

TCP - reliable transfer, transport layer

DNS - application layer

scheduling when to "talk" - data link layer

decision to route - Network layer