CS168 Midterm 1

DSL = digital subscriber line

cable

ethernet → local → aggregate
switch switch

on-demand = statistical multiplexing better than reservations
for bursty

reservations – circuit switching = per connection

on demand – packet switching – per packet, w/ buffer

delay

bandwidth = bits sent/received per time) x
prop delay = time to move through link) =
bandwidth-delay product = bits in flight
transmission delay = push bits of packet onto link
= packet size / transmission rate

propagation delay = link length / prop speed

queuing delay = time in buffer before processed

$L = A \times W$ L = length of queue (packets in queue each sec)
W = waiting time
A = average rate

processing delay – how long to process packet

E2E

IP "best effort"

reliability @ TCP.

forwarding = "data plane" – directing one data packet, local forwarding

routing : "control plane" – computing forwarding tables that guide packets, computing routes

global forwarding state valid if produces forwarding decisions that deliver packets to destination
no dead ends, no loops

convergence delay – time link-state database – detect failure, flood info, recompute forwarding tables
lost packets, looping packets, out of order packets

least cost routes = spanning tree , avoid loops
Dijkstra's, flooding / Bellman-Ford – together, exchange vector / decentralized estimate = Distance vector, exchange

intra-domain: link state (OSPF) + distance vector (RIP)

inter-domain – path vector (BGP)

counting to infinity – take other way when forwarding broken
poisoned reverse – if 2 routes through y, 2 advertises that 2 → dist = ∞

state = small forwarding tables of routes

churn = limited rate of change in routing tables

IP

address networks – 2^x hosts ≥ 9

multihoming problems (multiple providers)

export
customers → everyone
peer → customers
provider → customers

AS PATH
LOCAL PREF
MED

header!
payload
MTU
header

frag offset = first byte of ... / 8

host { Application
Transport

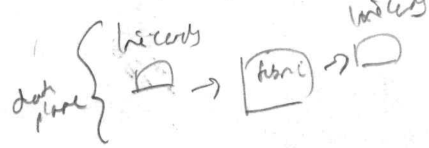
all { network – global packet
data link – local packet
physical

SMTP HTTP DNS NTP
TCP UDP
IP
ethernet FDDI PPP
optical copper radio PSTN

eBGP – [illegible]
iBGP – [illegible]

route control – forwarding tables to linecards

data plane



transport – communication between app processes
add-on to services for apps

	UDP	TCP
data	packets (datagrams)	stream of bytes of x length
service	best-effort (IP)	reliability, in-order delivery, congestion control, flow control
apps	video, audio	files, chat

Reliability
– checksums (error detection)
– timers (loss detection)
– acks (feedback)
cumulative – all up to x
selective – x
– sequence #s – duplicates, ordering
– sliding windows – efficiency

RTT varies b/c congestion, change in routing path

– fast retransmit
– throttles at sender / threshold
receiver.
header

3-way handshake

A SYN → B
SYN ACK
ACK data

TCP buffer packet until all packets before it have arrived + receiver app consumed avail. bytes

"advertised window" = right hand edge of window sender not exceed
– expression of sending window.