

Protocols

define format, order of messages sent and received among network entities, and actions taken on message transmission, receipt

network structure

access networks, physical media: wired, wireless communication links

TDM = time division multiplexing time divided into frames fixed duration fixed number time slots

network core: •interconnected routers•network of networks

FDM = frequency division multiplexing: diff CHs transmitted in diff frequency bands

Equations

4 Sources of packet delays

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

d_{proc} : processing, check bit errors, determine output link

d_{queue} : queuing delay, time waiting at output link for transmission, depends on congestion of router

d_{trans} : how long it takes to get on link

L (bits)/ R (bps)

d_{prop} : propagation delay

d (m)/ s

Stacks

IP application(http), transport(TCP), network(IP), link(WiFi), physical(bits)

ISO/OSI app, session(checkpointing), transport, network, link, physical

TCP / UDP

transmission control protocol

user datagram protocol

reliable transport, flow control, congestion control, DNP(timing, minimum throughput guarantee, security), connection-oriented

unreliable data transfer, DNP

1 IP & 1 port

streaming, DNS (domain name system)

