CS 168
Fall 2017

Introduction to the Internet
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Discussion 2: Packets in Flight

1 True or False

(1) On a fast cross-continental link ($\approx$ 100Gbps), *propagation delay* usually dominates *end-to-end packet delay*.

(2) On the same cross-continental link ($\approx$ 100Gbps), when transferring a 100GB file, *propagation delay* still dominates end-to-end file delivery.

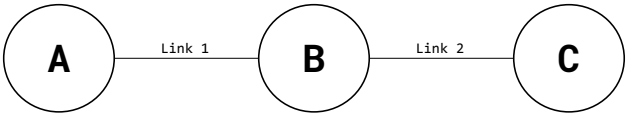
(3) On-demand circuit-switching is adopted by the Internet.

(4) The aggregate (i.e., sum) of peaks is usually much larger than peak of aggregates in terms of bandwidth usage.

(5) Bursty traffic (i.e., when packet arrivals are not evenly spaced in time) always leads to queuing delays.

2 End-to-End Delay

Consider the diagram below. Link 1 has length L_1 m (where m stands for meters) and allows packets to be propagated at speed $S_1 \frac{\text{m}}{\text{sec}}$, while Link 2 has length L_2 m but it only allows packets to be propagated at speed $S_2 \frac{\text{m}}{\text{sec}}$ (because two links are made of different materials). Link 1 has transmission rate $T_1 \frac{\text{bits}}{\text{sec}}$ and Link 2 has transmission rate $T_2 \frac{\text{bits}}{\text{sec}}$.



Assuming nodes can send and receive bits at full rate and ignoring processing delay, consider the following scenarios:

(1) How long would it take to send a packet of 500 Bytes from Node A to Node B given $T_1 = 10000$, $L_1 = 100000$, and $S_1 = 2.5 \cdot 10^8$?

(2) Compute RTT (round trip time) for a packet of B Bytes sent from Node A to Node C (packet gets transmitted back from Node C immediately after Node C receives it).

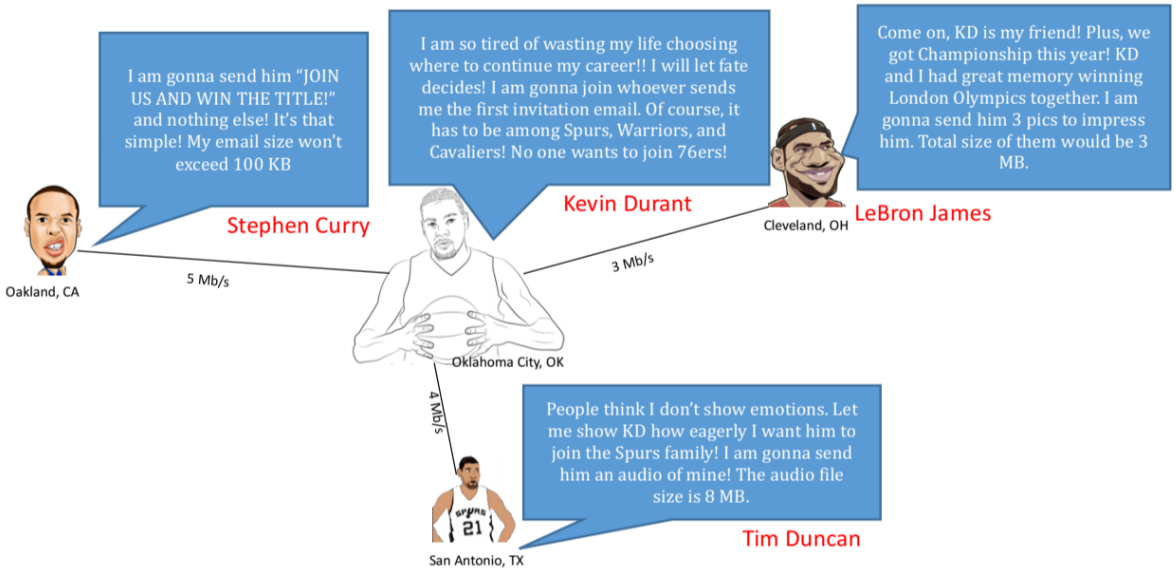
(3) At time 0, Node A sends packet P_1 with D_1 Bytes and then it sends another packet P_2 with D_2 Bytes immediately after it pushes all bits of P_1 onto Link 1. When will Node C receive the last bit of P_2?

(4) Find the variable relations that need to be satisfied in order to have no queuing delays for part (c).

3 You Have No Clue Why Kevin Durant Joined Us

This summer Golden State Warriors got Oklahoma Thunder superstar Kevin Durant onboard. Exciting, huh?! Lots of rumors have already been spread across the Internet about KDs motivation. Luckily, we got one league source insider in our TA crew. Lets follow the leaked information (this question) to explore why Kevin Durant chose us!

Tim Duncan, LeBron James, and Stephen Curry all sent invitation email to KD, trying to persuade him to join their team (Spurs, Cavaliers, and Warriors).



Source insiders told us that they are all old school players and use very slow internet speed at home (transmission rate provided in the diagram above), when KD announced that he would love to receive invitation emails to help him make the decision. Stephen, Tim, and LeBron all got notified and decided to send their prepared invitation emails. They clicked Send button almost at the same time (within a 5-second range). Given it takes magically no time for emails to propagate so we only need to consider transmission times, explain why KD signed the contract with Golden State Warriors.