UNIVERSITÄT
BERN

HS2020: 11072 Advanced Networking and Future Internet

Theoretical Exercises

Jesutofunmi Ademiposi Ajayi
Lucas Pacheco
October 8, 2020

Submission

Upload a PDF file with the solutions to the corresponding assignment on the ILIAS "theoretical exercises" folder. *Do not submit handwritten answers.*

Question 1 (1 point)

Q1. Explain why a router would implement a Non-work conserving scheduler, and how applications could benefit from this strategy and what are the downsides?.
R1. In a non-work conserving scheduler, the scheduler may prioritize providing packets at a stable rate. This improves the predictability of the network, reduces jitter, and thus may benefit use cases such as MPEG-DASH reducing bitrate fluctuations.

Question 2 (1 point)

Q2.1 Consider a Work-conserving scheduler, describe what does it mean to be work-conserving?
R2.1 – It means that whenever there are active connections, *i.e.,* there are packets to be served, the scheduler is not idle. Whenever there are active connections, the scheduler is serving some of the packets on the queues.

UNIVERSITÄT BERN

Question 2

Q2.2 For said scheduler, consider the flows below sharing a 150Mbps link, before and after applying a certain scheduling policy, what is the new queue delay for flow D?

Flow	Bandwidth Utilization (Mbps)	Queue Delay
A	5	0.4
B	10	0.6
C	7	0.5
D	5	0.4

Table: Before

Flow	Bandwidth Utilization (Mbps)	Queue Delay
A	5	0.3
B	10	0.7
C	7	0.4
D	5	?

Table: After

Question 2

R2.2 – In work conserving queues, we can expect a constant sum of the products between utilization and queue delay across all active connections. Thus, for the first case, we have the sum corresponding to:

$$S = \frac{5}{150} \times 0.4 + \frac{10}{150} \times 0.6 + \frac{7}{150} \times 0.5 + \frac{5}{150} \times 0.4 = 0.09 \tag{1}$$

The sum for the first three flows on column 2 is

$$S_2 = \frac{5}{150} \times 0.3 + \frac{10}{150} \times 0.7 + \frac{7}{150} \times 0.4 + \frac{5}{150} \times delay_d = 0.09 \tag{2}$$

Thus, solving for $delay_d$ gives us 0.44000.

UNIVERSITÄT BERN

Question 3 (2 points)

Q3. Consider a certain queue that applies a RED packet dropping scheme with the parameters below, in each moment from t_0 to t_7 a packet arrives and the router must decide if it gets dropped of not, when a probability must be calculated use the one listed:

TH_{min}	10
TH_{max}	15

Table: Parameters

Moment	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7
Queue Length Exp. Avg.	13.3	12.7	13.8	15.4	12.2	9.6	11.8	13.9
Drop Prob.	0.59	0.33	0.8	0.4	0.06	0.84	0.02	0.29

Question 3

Q3. For each of the exponential averages listed, consider the drop probability for the packet being considered, given TH_{min} and TH_{max}, in which moments are packets dropped by the router? Explain your conclusions.
ps. Consider that a probability > 0.5 means a drop.

UNIVERSITÄT BERN

Question 3

R3 – Packets dropped

- t0 $\rightarrow$ Packet arrives when queue length is between TH_min and TH_Max and the probability given was above the threshold.
- t2 $\rightarrow$ Packet arrives when queue length is between TH_min and TH_Max and the probability given was above the threshold.
- t3 $\rightarrow$ Packet arrives when queue above TH_Max.
- t4 $\rightarrow$ Packet arrives when queue length is between TH_min and TH_Max and the probability given was above the threshold.

Question 4 (1 point)

Q4. Describe the advantages of using early packet dropping instead of late dropping, especially in the case of TCP connections.

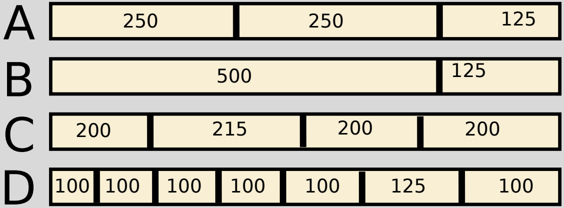
R4 – In the case of TCP connections, random early dropping causes packet losses, to which TCP responds by updating its bitrate. If no dropping scheme is applied then packets may be indefinitely delayed, and the TCP update and synchronization would happen less often, and the delay incrases for the connection.

UNIVERSITÄT BERN

Question 5 (4 points)

Q5. Consider the queues below, what is the output when considering the schedulers? Also describe which flows benefit from each scheduling policy and why.

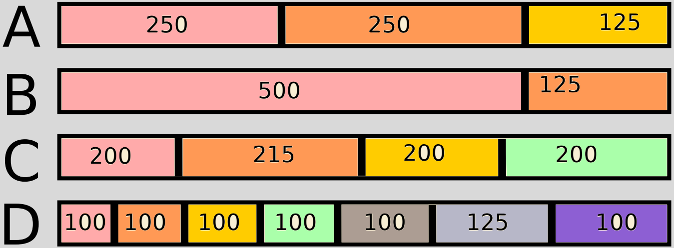
1. RR (1pt)
2. DRR (1pt)
3. WFQ (2pt)



Quantum: 215

Question 4

Round Robin:



Quantum: 215

Order of Packets: A1 B1 C1 D1 A2 B2 C2 D2 A3 C3 D3 C4 D4 D5 D6 D7

Question 4
Deficit Round Robin

Conn / Round Number	R1	R2	R3	R4	R5	R6	R7
A	215	A1 180	A2 145	A3 235			
B	215	430	B1 145	B2 235			
C	C1 15	C2 425	C3 215	C4 230			
D	D1 115	D2 230	D3 345	D4 460	D5 575	D6665	D7 780

Table: Deficit Counter for Each Connection on a Given Time

Order of Packets: C1 D1 A1 C2 D2 A2 B1 C3 D3 A3 B2 C4 D5 D6 D7

Question 5

Weighted Fair Queue

Order of GPS: D1 C1 D2 A1 D3 D4 C2 A1 B1 D5 C3 A2 B2 D6 D7 C4

Question 5

Calculation of finish number

- Round number at the arrival of thr packet is number of rounds in a bit-by-bit scheduler.
- Finish number is Packet size / weight + max(FN of last packet in queue, round number)

Finish number for first packets in each connection are:

- A $\rightarrow$ 250 + max(0.25, 0)
- B $\rightarrow$ 500 + max(0.5, 0)
- C $\rightarrow$ 200 + max(0.75, 0)
- D $\rightarrow$ 100 + max(1, 0)

Meta-Questions?

Contact me:

- lucas.pacheco@inf.unibe.ch