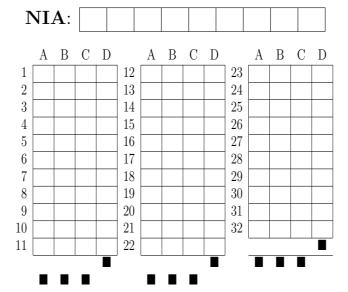# Quality of Service
Scheduling

Date: Spring
Duration: 15 min.

- There is only one correct answer for each multiple choice question.

- Each correct answer adds 1 point.

- Each incorrect answer has a penalty of $\frac{1}{3}$ points.

- No score is awarded for unanswered questions, neither positive nor negative.

- Mark out your answers with an "X". Make sure that the "X" reaches the corners of the rectangle. ⊠

- No score is awarded if you mark more than one answer.

- Pad your NIA with 0s on the left to complete the NIA field.

Write your personal data clearly.

Last name:	
First name:	
Group:	

Permutation: A

NIA:

	A	B	C	D		A	B	C	D		A	B	C	D
1					12					23				
2					13					24				
3					14					25				
4					15					26				
5					16					27				
6					17					28				
7					18					29				
8					19					30				
9					20					31				
10					21					32				
11					22									

1.- Which queuing discipline is fair in terms of number of packets transmitted?

    (a) Round Robin.

    (b) Preemptive strict priority queueing.

    (c) Deficit round robin when the length of the packets is different.

    (d) Non-preemptive strict priority queuing.

2.- The goal of the TX ring is to ...

    (a) drive the interface utilization to $100\,\%$.

    (b) prioritize small packets.

    (c) change the order of packets.

    (d) add an additional delay before sending the packet.

3.- What happens in WDRR when a queue is empty?

    (a) The deficit counter is reset to zero.

    (b) The first packet of the other queues is dropped.

    (c) The last packet of the queue with highest occupancy is moved to the empty queue.

    (d) The deficit counter is doubled.

4.- Four DWRR queues have quantums equal to 400, 300, 200 and 100 bytes. At a given point the high priority queue is empty and the other three queues are full. What is the share of bandwidth used by the lowest priority queue?

    (a) $33\,\%$.

    (b) $5\,\%$.

    (c) $16.67\,\%$.

    (d) $10\,\%$.

5.- Why fragmenting and interleaving are not used in high-speed lines?

    (a) QoS is never used in high speed lines.

    (b) High speed lines never transmit packets larger than 300 bytes.

    (c) The delay of transmitting a packet is ver short.

    (d) The fragments might break due to the high speed.

6.- Which queueing discipline can starve low priority queues?

    (a) General Processor Sharing.

    (b) Deficit round robin.

    (c) Round Robin.

    (d) Strict priority.

7.- Where can we find strict priority queues?

    (a) In the inbound direction of a router interface.

    (b) After the TX-Ring.

    (c) Before the classifier.

    (d) In the outbound direction of a router interface.

8.- If queue A contains packets of 500 bytes and queue B contains packets of 1000 bytes and we set a WRR schedules to serve the queues in the order ABA in each round, how is the bandwidth distributed? (Assume that there is always a packet to be served in each of the queues).

    (a) A: 75 %, B: 25 %.

    (b) A: 33 %, B: 67 %.

    (c) A: 50 %, B: 50 %.

    (d) A: 25 %, B: 75 %.

9.- In a WRR system with three queues A, B and C, why is the schedule ABACAB better than AAABBC?

    (a) It increases the bandwidth.

    (b) It reduces the jitter.

    (c) It reduces the packet loss.

    (d) It prevents packet re-ordering.

10.- Voice packets are directed to a queue with strict priority before being sent through a 1 Mbps line. Voice traffic is policed to a rate of 1 Mbps. Which bucket depth should we use to guarantee a delay below 10 ms? (Approximately. Assume that an interleaver is used).

    (a) 10 Kbits.

    (b) 2 Kbits.

    (c) 1 Kbits.

    (d) 5 Kbits.

11.- Which queueing discipline is used in the TX-Ring?

    (a) LIFO.

    (b) FILO.

    (c) LOL.

    (d) FIFO.

12.- How can we emulate a behaviour that is close to strict priority queueing with preemption in low speed link?

    (a) Policing VoIP traffic.

(b) Duplicating the number of queues.

(c) Using an interleaver.

(d) Policing TCP traffic.

13.- A scheduler that interrupts the processing of one packet when a higher priority packet arrives is a ...

(a) weighted round robin scheduler.

(b) non-preemptive strict priority scheduler.

(c) round robin scheduler.

(d) preemptive strict priority scheduler.

14.- Which of the following strategies allows us to control the share of bandwidth devoted to each of the queues?

(a) Non-preemptive strict priority.

(b) Weighted Round Robin.

(c) Deficit Weighted Round Robin.

(d) Preemptive strict priority.

15.- A DWRR scheduler with two queues and quantums 200 and 100 bytes for the high and low priority queues respectively. The high priority packets are 350 bytes long and the low priority packets are 1050 bytes long. What is the share of bandwith for each of the queues?

(a) $\frac{3}{4}$ for the high priority and $\frac{1}{4}$ for the low priority.

(b) $\frac{2}{4}$ for the high priority and $\frac{2}{4}$ for the low priority.

(c) $\frac{2}{3}$ for the high priority and $\frac{1}{3}$ for the low priority.

(d) $\frac{1}{4}$ for the high priority and $\frac{3}{4}$ for the low priority.

16.- A queue typically stores ...

(a) the data contained in the packet.

(b) the headers of the packet.

(c) pointers to the memory where packets are stored.

(d) the checksum of the packet.

17.- Where can we find a TX-ring

(a) Between the marker and the meter.

(b) Between the scheduler and the transmission line.

(c) Between the policer and the shaper.

(d) Between the classifier and the queues.

18.- What is a work conserving scheduler?

(a) A scheduler that never empties the queues.

(b) A scheduler that wastes transmission time when it serves an empty queue.

(c) A scheduler that keeps serving packets as long as there is any packet in one of the queues.

(d) A scheduler that does not work when there are more than two packets in a queue.

19.- What are the following commands?

(a) The installation and verification of a stochastic fair queue in linux.

(b) The installation of a strict priority queue in a switch.

(c) The configuration of a RR queueing system in a firewall.

(d) The configuration of a GPS in a Cisco router.

```
# tc qdisc add dev ppp0 root sfq perturb 10
# tc -s -d qdisc ls
qdisc sfq 800c: dev ppp0 quantum 1514b limit
128p flows 128/1024 perturb 10sec
Sent 4812 bytes 62 pkts (dropped 0,
overlimits 0)
```

20.- In front of a 10 Mbps line there is a DWRR queueing system with quantums 50 bytes, 30 bytes and 20 bytes for its three queues. The high priority traffic is policed at 1 Mbps with a bucket size of 10 Kbits. Which are the delay guarantees offered by this system for the high priority traffic? (Approximately. Assume that an interleaver is used.)

(a) 200 ms.

(b) 20 ms.

(c) 20 us.

(d) 2 ms .

21.- In stochastic fair queueing, there is a large number of queues. A hash of the source and destination port, source and destination IP and layer 4 protocol (TCP or UDP) is used to send the packets to different queues. Then the queues are served in a round-fashion. What's the purpose of this queueing system?

(a) Prioritize UDP traffic.

(b) Offer per-flow fairness.

(c) Offer per-IP fairness.

(d) Prioritize TCP traffic.

22.- Each of the queues of a queing system is ...

(a) LIFO.

(b) FILO.

(c) LILO.

(d) FIFO.

23.- What is an advantage of strict priority queueing?

(a) The prioritized class is protected from high delay and jitter, as long as the prioritized traffic is a small fraction of the interface bandwidth.

(b) All the traffic classes are protected from high delay and jitter, even if the offered load exceeds the interface bandwidth.

(c) If a packet misbehaves, it is immediately policed.

(d) A single queue is needed and the order of the packets is changed according to their priority.

24.- What may happen if we double the quantum for each of the queues in a DWRR scheduler?

(a) The jitter may increase.

(b) The bandwidth allocation of the different queues may increase.

(c) The router CPU consumption may increase.

(d) The relative priorities of the different queues may change.

25.- QoS-aware tools are ...

(a) hardware queues.

(b) distributed queues.

(c) cloud queues.

(d) software queues.

26.- Why is the General Processor Sharing approach not used in practice?

(a) Because it is an idealized fluid model and packets cannot be treated as fluid.

(b) Because it is a fluid model and packets might leak from one queue to another.

(c) Because it requires a digital input.

(d) Because it is not fair.

27.- Imagine a system with four queues Q1, Q2, Q3, Q4. The value of the deficit counter (in bytes) is 100, 50, 200 and 800. The quantums are 800, 600, 400 and 200. Finally, the sizes of the head-of-line (HOL) packet are 1000, 500, 300 and 900. Which queues will be served in the next round?

(a) Q1 and Q4.

(b) Q1 and Q2.

(c) All the other answers are wrong.

(d) Q2, Q3 and Q4..

28.- In one of the queueing disciplines that we have seen in class, the traffic that enjoys the highest priority is completely undisturbed by other kinds of traffic. In which one?

(a) DWRR.

(b) Strict non-preemptive priority.

(c) WRR.

(d) Strict preemptive priority.

29.- What should we do to prevent packet re-ordering?

  (a) Distribute the packets of a class of service among the different queues.
  (b) Map all the packets of the same class of service to the same queue.
  (c) Use a policer to control the amount of traffic that is directed to each of the queues.
  (d) Have a different queue for each class of service.

30.- Four packets, labelled P1, P2, P3 and P4, contiguously arrive to a router with empty queues to be transmitted for the same interface. P1 is the first packet to arrive and P4 the last one. The outgoing interface have two queues and the high priority queue has strict priority over the low priority queue. P1 and P2 are low priority packets. The interface has a transmission ring with room for three packets. In which order are the packets transmitted?

  (a) P3, P4, P1, P2.
  (b) P3, P4, P2, P1.
  (c) P1, P2, P3, P4.
  (d) P4, P3, P2, P1.

31.- The queue size is typically specified in ...

  (a) bits.
  (b) bytes.
  (c) packets.
  (d) milliseconds.

32.- What queueing strategy it is recommended to prioritize real-time (e.g. VoIP) traffic?

  (a) General Processor Sharing.
  (b) Weighted Deficit Round Robin.
  (c) Strict priority queueing.
  (d) Deficit Round Robin.