Department of Computer Science	Computer Networks
Vrije Universiteit	03.06.2005

Always explain your answers concisely and be sure to be to-the-point.

Part I

This part covers the same material as the midterm exam.

1a Why does the 802.3 (Ethernet) description also specify what the maximum segment length is? *5pt*

1b Gigabit Ethernet allows for *carrier extension* and *frame bursting*. What do these techniques establish and why are they necessary? *5pt*

1c For a switched Gigabit Ethernet connection, there is no maximum segment length specified. Why not? *5pt*

2a If τ is the propagation speed of a signal, and ρ the transmission rate, how many bits can a wire of length L contain? *5pt*

2b Consider a token ring network without any artificial delays, operating at a transmission rate ρ. Each computer in the ring introduces a delay of δ seconds. With a propagation speed over the wire of τ, and a token length of R bits, what is the minimum ring length? *5pt*

3a What is the necessary and sufficient condition for constructing a k-bit error detecting code? *5pt*

3b Consider the following 2-dimensional parity code (see the example below). A string of $b_1 b_2 \ldots b_n$ of n bits is split into k parts of l bits, i.e., $n = k \cdot l$. The string is then represented in a $k \times l$ matrix, where the i-th row contains bits $b_{l(i-1)+1} \ldots b_{li}$, and the j-th column contains bits $b_j b_{j+l} \ldots b_{j+(k-1)l}$. The i-th row is extended with a 1 if that row contains an odd number of bits, and with a 0 otherwise. Likewise, the j-th column is extended with 1 or 0, respectively. Show by example that this a 1-bit error-correcting code. *10pt*

original string	encoding	transmitted string
	1 0 1 | 0	
	1 1 0 | 0	
1 0 1 1 1 0 1 1 1	1 1 1 | 1	1 0 1 1 1 0 1 1 1 0 0 1 1 0 0
	---------	
	1 0 0 |	

4 Limited-contention protocols dynamically adapt to traffic intensity. What problem do they solve by such an adaptation? *5pt*

Part II

5a Explain the difference between integrated and differentiated services as provided by the Internet IP layer. *5pt*

5b Explain how fair queuing works in routers and which problem it solves. *5pt*

5c Multi-Protocol Label Switching (MPLS) is popular for multimedia streaming in wide-area networks. Why? *5pt*

6a What does the 3-way handshake in TCP establish? *5pt*

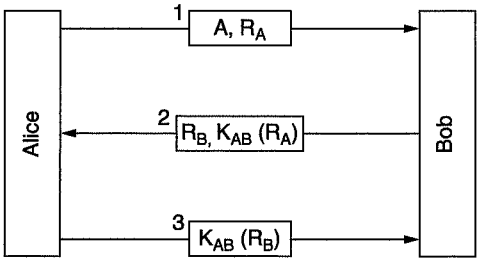
6b When a client sets up a TCP connection, it may request a buffer size at the server that is larger than its congestion window size. Does this make sense? *5pt*

6c Explain what is meant by the silly window syndrome. *5pt*

7 Below is the ouput of querying a DNS server for MX records for the `vu.nl` domain. What does it tell us? *5pt*

```
seuss % dig MX vu.nl

; <<>> DiG 9.2.5 <<>> MX vu.nl
;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 59633
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 3, ADDITIONAL: 7

;; QUESTION SECTION:
;vu.nl.                         IN      MX

;; ANSWER SECTION:
vu.nl.                  60      IN      MX      20 mail2.vu.nl.
vu.nl.                  60      IN      MX      10 mail.vu.nl.

;; AUTHORITY SECTION:
vu.nl.                  86400   IN      NS      ns1.surfnet.nl.
vu.nl.                  86400   IN      NS      star.cs.vu.nl.
vu.nl.                  86400   IN      NS      ns.vu.nl.

;; ADDITIONAL SECTION:
mail.vu.nl.             86400   IN      A       130.37.129.161
mail2.vu.nl.            86400   IN      A       130.37.129.165
ns.vu.nl.               86400   IN      A       130.37.129.4
ns1.surfnet.nl.         168     IN      A       192.87.106.101
ns1.surfnet.nl.         168     IN      AAAA    2001:610:1:800a:192:87:106:101
star.cs.vu.nl.          86400   IN      A       130.37.24.6
star.cs.vu.nl.          86400   IN      A       192.31.231.42

;; Query time: 322 msec
;; SERVER: 130.37.20.3#53(130.37.20.3)
;; WHEN: Fri May 27 11:43:48 2005
;; MSG SIZE  rcvd: 255
```

8a Show that the following protocol is subject to a reflection attack. *5pt*



8b Explain how you can digitally sign and send a message *m* that is allowed to be sent as plaintext. *5pt*

Final grade: *(1) Add, per part, the total points. (2) Let T denote the total points for the midterm exam ($0 \leq T \leq 45$); D1 the total points for part I; D2 the total points for part II. The final number of points E is equal to* $\max\{T, D1\} + D2 + 10$.