Department of Computer Science **Computer Networks**
Vrije Universiteit **25.05.2004**

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 What is the difference between a *network service* and a *network protocol*? Is it possible to have different implementations of the same protocol? *5pt*

1b While considering traditional POTS modems, Bob claims that "...it is unusual to use a 2400 baud modem. Modems usually support 56 kbps." What is wrong with this statement. Motivate your answer. *5pt*

1c What type of multiplexing is used for ADSL? Explain your answer. *5pt*

2a Explain why bit stuffing is needed, and how it works. *5pt*

2b The physical layer sends data as a "continuous" stream of bits. The data link layer uses chunks of bits, called *frames*. Why switch to frames? *5pt*

2c Data link protocols almost always put the checksum in a trailer, rather than in a header. Why? *5pt*

3a Explain the difference between *go-back-N* and *selective repeat*. *5pt*

3b Let W denote the receiver's window, and M the maximal sequence number, explain why $W \leq \frac{1}{2}M$. *5pt*

3c Why is it useful to have a large window size when dealing with slow connections such as with satellites? *5pt*

Part II

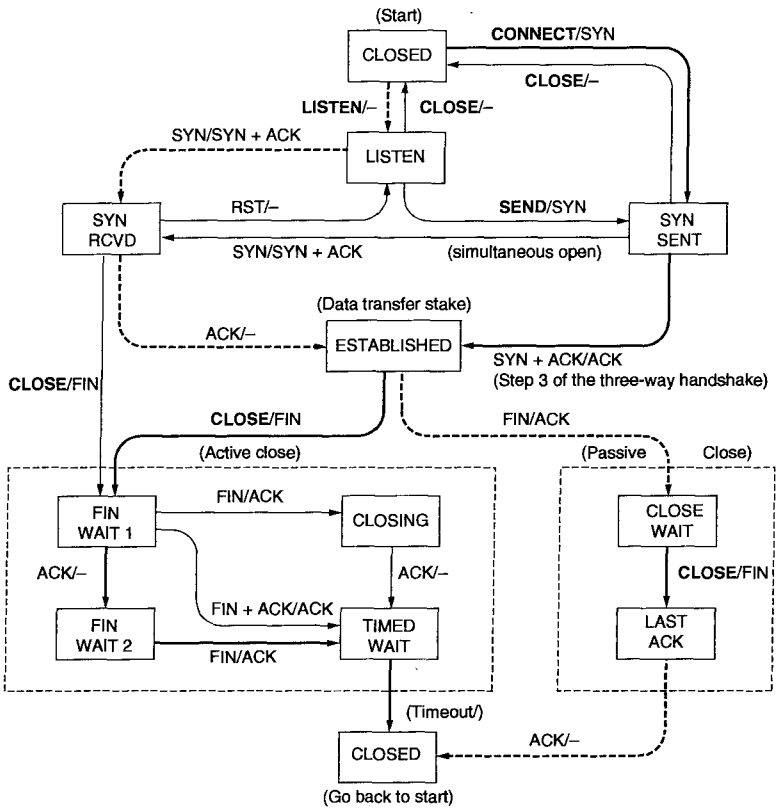
4c When a router receives an IPv4 packet, it lowers the packet's time-to-live (TTL) value by one. If the TTL value drops to zero, the packet is discarded and an ICMP message is returned to the sender. How can this mechanism be used to trace the route a packet will follow when going from A to B? *5pt*

4b Peer-to-peer routing is generally efficient in terms of the number of hops, but not in terms of the distance that is travelled in the underlying network. What is meant by this statement? *5pt*

5a The difference between UDP and IP packets is minimal. Why shouldn't applications use IP directly? *5pt*

5b Running TCP across wireless networks may lead to performance problems. Why? *5pt*

5c The figure below shows the state-transition diagram for setting up and tearing down a TCP connection. The thick dashed line represents the normal path for a server; the thick solid line that of a client. What happens according to this diagram when the ACK sent by the client when changing state from "SYN SENT" to "ESTABLISHED," is lost? What happens normally in TCP? *5pt*



6a What is the role of DNS when sending mail to *steen@cs.vu.nl*? Be precise! *5pt*

6b To offload servers, DNS makes extensive use of *caches*. When will DNS caching *not* be effective? *5pt*

7a Explain how authentication with public/private key pairs can be established. *5pt*

7b Construct a certificate issued by an authority *CA*, telling that E_A is the public key of *A*. Explain the content of your certificate. *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* $\max\{T, D1\} + D2 + 10$.