LiTH, The institute of technology at Linköping University
IDA, Department of Computer and Information Science
Juha Takkinen
2010-01-17

Written examination in TDTS06 Computer Networks 2010-01-15 at 8–12

Rooms

T1 and T2.

Support materials

A basic calculator with memory erased and an English dictionary (not electronical) are allowed. Also four pages with *handwritten* notes on standard *lined* paper, with one line of text on each line on the paper, are permitted.

Results

The results will be published at latest twelve working days after the exam.

Points

Maximum is 40 points (44 if you passed the optional assignment). For grade 3, 20 points are needed. For grades 4 and 5, 28 points and 36 points, respectively, are needed.

Teacher on duty

Juha Takkinen, 0731-50 03 93, will visit the hall around 9 p.m. and at 11 p. m.

Instructions

Write clearly. Motivate your answers, if not told otherwise. State assumptions that you make, if any, in addition to what is written in the question, but you are not allowed to change the question. Keep the same order on your answers as the questions in the exam. *Please observe that only one page of each paper will be graded.* You can answer in either Swedish or English. Also, see the wrapper for the common instructions for exams at LiTH.

"There are three kinds of death in this world. There's heart death, brain death, and there's being off the network." —Guy Almes

Good luck!

1. Protocols

a. List four of the many services that a layer can offer to the layer above it. (2 p.)

b. Assume five layers in the network architecture, as discussed in the course. Explain in one to two sentences maximum if it is possible that one or more of the services that you listed in a) could be performed by two or more layers. (1 p.)

c. Once again, assume five layers in the network architecture. Which layers does a LAN switch process? Which layers does a host process? (2 p.)

2. Networking basics

a. List two typical types of delay in a computer network. (1 p.)

b. Suppose host A wants to send a large file to host B. The path from host A to host B has three links, of rates R_1 = 500 kbps, R_2 = 2 Mbps and R_3 = 1 Mbps, with routers inbetween.

i. Assuming no other traffic or delays in the network, what is the average throughput for the file transfer? (1 p.)

ii. Suppose the file is 4 MB large. How long will it take to transfer the file to host B, assuming no other traffic in the network? (1 p.)

iii. Suppose R_2 = 100 kbps instead of 2 Mbps in i) above. What is the new average throughput for the file transfer? How long does it take to transfer a 4 MB large file form host A to host B? (2 p.)

3. Applications

a. Suppose Alice, with a web-based e-mail account such as gmail, sends a message to Bob, who accesses his e-mail from his mail server via an e-mail client, such as mozilla thunderbird. Discuss how the message gets from Alice to Bob by listing all the application layer protocols that are used to move the message between the two hosts. (3 p.)

b. Which four fields are typically found in a DNS resource record? Give and example that involves the usage of all of them. (2 p.)

4. TCP

a. Regarding TCP's calculation of the value of its retransmission timer, suppose SampleRTT is constant and never changes between sender and receiver and that this is known to the sending TCP entity. Would a retransmission timer still be necessary in TCP, assuming that packets can be lost? Motivate your answer. (2 p.)

b. Suppose host A sends four TCP segments for the first time and back-to-back to host B over a TCP connection. The first segment has sequence number 90. The second segment has sequence number 110. The second and third segment are both 110 bytes large, while the fourth segment is 60 bytes large. (continues on next page)

i. Suppose that the first and third segments are lost but the second and fourth segments arrive safely at host B. In the acknowledgment sent from host B to host A, what will

be the acknowledgment number? (1 p.)

ii. When host A sees the acknowledgment from host B above, how much data will it be sending to host B? (1 p.)

c. Explain what the purpose of the congestion window is. (1 p.)

5. IP

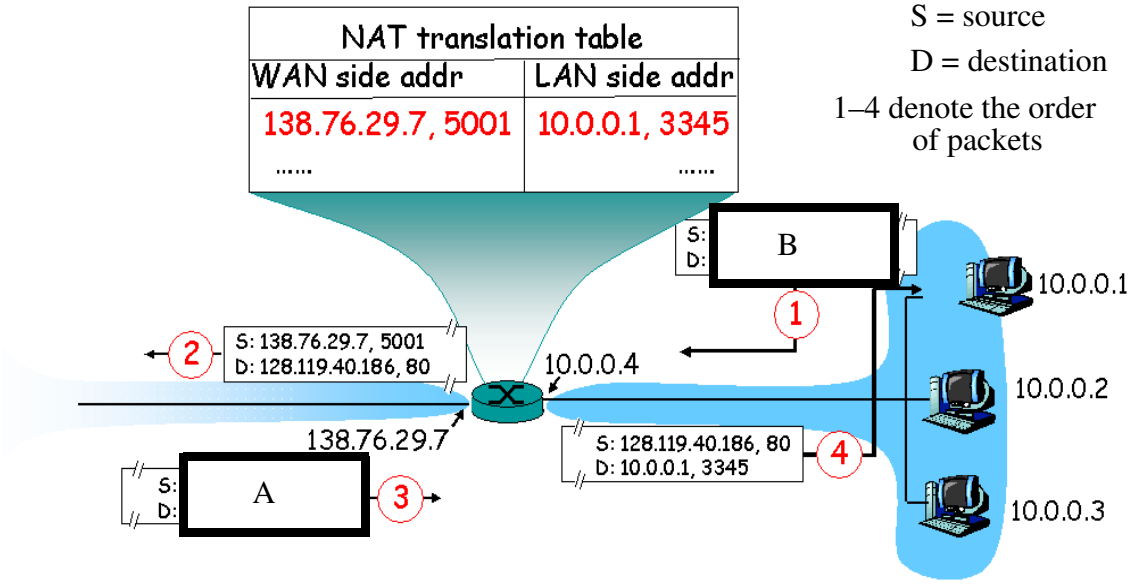
a. Suppose there are three routers along the path between host A and host B.

i. Over how many interfaces will an IP packet travel along this path? (1 p.)

ii. How many forwarding tables will be indexed in order to move an IP packet from host A to host B? (1 p.)

iii. How many subnets will be involved in the transportation of an IP packet from host A to host B? (1 p.)

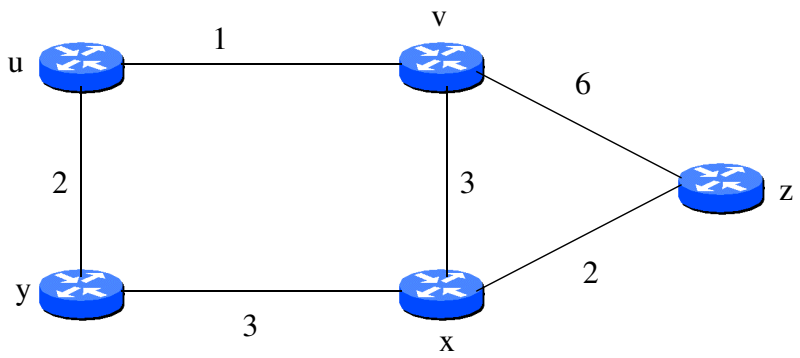
b. Suppose a NAT router is used to connect a small office to the Internet, as shown in the figure below. Assume that a web browser at host with IP address 10.0.0.1 is communicating via the HTTP protocol with a web server at IP address 128.119.40.186 to the left (the web server itself is not shown). Using these assumptions, fill in the source–destination address pairs marked with A and B in the figure below. (2 p.)



6. Routing

a. Describe how an OSPF AS can be configured hierarchically. (2 p.)

b. Consider the network shown on top of the next page, and assume that each node initially knows the cost to each of its neighbours. Consider the distance-vector routing algorithm and show the distance table entries at node z. You may use the appendix, where the initial table for z is already shown, when you hand in your solution. (3 p.)



7. LANs

a. Describe the infrastructure mode of operation that a network based on an IEEE standard for wireless communication mentioned in the course uses. (2 p.)

b. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address? (2 p.)

c. Suppose a node using CSMA/CD has experienced its third collision and selects the maximum value of K for its exponential backoff timer.
How many seconds of delay does this K correspond to on a 10-Mbps Ethernet? (1 p.)

8. Network security

a. Suppose Alice and Bob are communicating over an SSL session.
Suppose furthermore that an intruder Trudy, who does not have any of the shared keys of the SSL session, inserts a false TCP segment into the packet stream from Alice. The segment has the correct TCP checksum and TCP sequence numbers, as well as the correct IP addresses and port numbers. Will SSL on the receiving side accept the false segment or not? Motivate your answer. (2 p.)

b. Suppose an intruder Trudy has an encrypted message as well as the decrypted version of the same message. Can Trudy mount a ciphertext-only attack, a known-plaintext attack or a chosen-plaintext attack? Remember to motivate your answer. (2 p.)

c. True or false: To send a digitally signed e-mail message to Bob using PGP, Alice will transmit $K^{+}_{Bob}(H(m))$. (1 p.)

Appendix to question 6 b)

		Cost to				
		u	v	x	y	z
From	v	∞	∞	∞	∞	∞
	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

		Cost to				
		u	v	x	y	z
From	v					
	x					
	z					

		Cost to				
		u	v	x	y	z
From	v					
	x					
	z					

		Cost to				
		u	v	x	y	z
From	v					
	x					
	z					