Xi'an Jiaotong-Liverpool University
西交利物浦大学

MODULE CODE	EXAMINER	ACADEMIC UNIT	TEL
CAN201	Wenjun Fan	CAN	9134

_1st_ SEMESTER _2022/23 FINAL_ EXAMINATION

INTRODUCTION TO NETWORKING

TIME ALLOWED: _2 Hours_

INSTRUCTIONS TO CANDIDATES

1. **This is a _closed-book_ examination, _which is to be written without books or notes_.**
2. **Total marks available are 100.**
3. **This exam consists of _five_ questions.**
4. **Answer all questions. There is NO penalty for providing a wrong answer.**
5. **Only English solutions are accepted. Answer should be written in the answer booklet(s) provided.**
6. **All materials must be returned to the exam invigilator upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.**

Question 1 (20 points)

In packet-switched networks, the source host segments long application-layer messages (e.g., an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as message segmentation. Fig. 1 illustrates the end-to-end transport of a message with and without message segmentation respectively. Consider a message that is 12×10^6 bits long is to be sent from the source to the destination in Fig 1. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays.

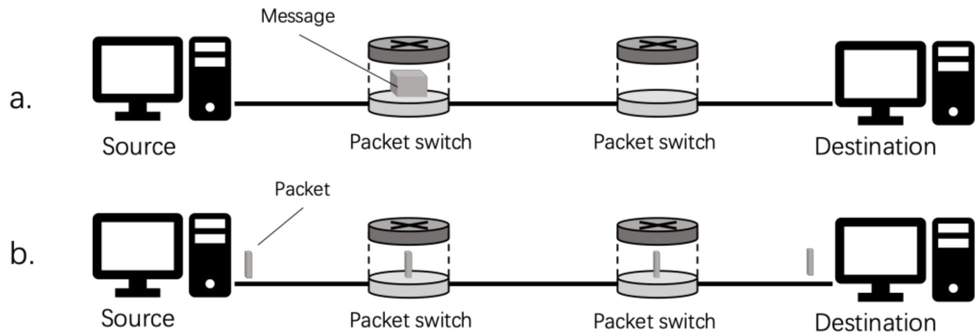

Figure 1. End-to-end message transport: (a) without message segmentation; (b) with message segmentation.

1. Consider sending the message from the source to the destination without message segmentation. How long does it take to move the message from the source to the destination? Keeping in mind that each switch uses store-and-forward packet switching. (3 points) $\frac{12\times10^6}{2\times10^6} \times 3 = 18s$
2. Now suppose that the message is segmented into 1,200 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from the source to the first (left-most) switch? When the first packet is being sent from the first (left-most) switch to the second switch, the second packet is being sent from the source to the first switch. So, assuming the timestamps start from the source sends out the first packet, at what time will the second packet be fully received by

the first switch? (4 points) $\frac{10{,}000}{2\times10^6} = \frac{1}{200} = 0.005\,s$ $0.005\times2 = 0.01\,s$

3. How long does it take to move the file from the source to the destination when message segmentation is used? (3 points) $1200\times0.005 + 0.005\times2 = 6+0.01 = 6.01\,s$
4. In addition to reducing delay, what are the reasons for using message segmentation? (5 points)
5. Discuss the drawbacks of message segmentation. (5 points)

4. Error Control and Retransmission Efficiency. Improved Network Efficiency and Resource sharing.

5. Increased protocol overhead. Reassembly complexity and delay

Question 2 (20 points)

Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters *<cr><lf>* are carriage return and line-feed characters. Answer the following questions, indicating where in the HTTP GET message below you find the answer.

GET /can201/index.html HTTP/1.1*<cr><lf>*Host: sat.xjtlu.edu.cn*<cr><lf>*User-Agent: Mozilla/5.0 (Windows;U; Windows NT 7.1; en-US; rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax) *<cr><lf>*Accept: text/xml, application/xml, application/xhtml+xml, text /html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5 *<cr><lf>*Accept-Language: en-us,en;q=0.5*<cr><lf>*Accept- Encoding: zip,deflate*<cr><lf>*Accept-Charset: ISO -8859-1,utf-8;q=0.7,*;q=0.7*<cr><lf>*Keep-Alive: 300*<cr><lf>*Connection:keep-alive*<cr><lf><cr><lf>*

1. What is the URL of the document requested by the browser? (3 points)
   HTTP://sat.xjtlu.edu.cn/can201/index.html
2. Which version of HTTP is the browser running? (2 points)
   HTTP 1.1
3. Does the browser request a non-persistent or a persistent connection? (3 points)
   persistent
4. What is the IP address of the client host where the browser is running? How does the browser get the web server's IP address? (7 points)
   There is no IP address. Use DNS.
5. What type of browser initiates this message? Why is the browser type needed in an HTTP request message? (5 points) Mozilla/5.0

Content Negotiation / Device Adaptation

Question 3 (20 points)

Complete the following table using Dijkstra's algorithm. Compute the shortest path from node S to all network nodes shown in Fig. 3. Note: Possible ties are broken in favor of the leftmost column.

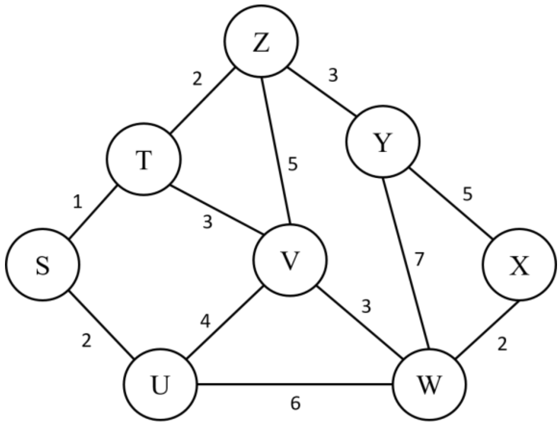

Figure 3. A network topology for performing Dijkstra's algorithm.

Step	*N'*	*D(T), p(T)*	*D(U), p(U)*	*D(Z), p(Z)*	*D(V), p(V)*	*D(Y), p(Y)*	*D(W), p(W)*	*D(X), p(X)*
0	S	1, S	2, S	∞	∞	∞	∞	∞
1	ST	Done	2, S	3, T	4, T	∞	∞	∞
2	STU		Done	3, T	4, T	∞	8, U	∞
3								
4								
5								
6								
7								

Question 4 (20 points)

Consider the following Fig.4, where several subnets are interconnected.

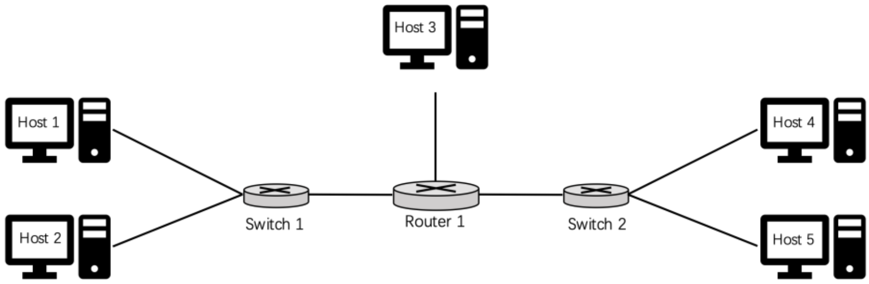

Figure 4. One computer network example consists of router, switches and hosts.

1. How many subnets in this network? List them in terms of network interfaces. (8 points)
2. If the interface of Router 1 linked with Host 3 has an IP address 10.0.2.1/25, which would be the largest IP address that can be assigned to the interface of Host 3 and the corresponding network mask? (4 points)
3. Assuming the interface of Host 1 has an IP address 10.0.1.2, and the adapter for that interface has a MAC address aa-aa-aa-aa-aa-aa; the interface of Router 1 lined with Switch 1 has an IP address 10.0.1.1, and the adapter for that interface has a MAC address 11-11-11-11-11-11. Now, consider sending an IP datagram from Host 1 to Host 5. Suppose Host 1 has an empty ARP table, while Router 1 has the up-to-date ARP table and routing table respectively. Describe all the steps to succeed in sending the IP datagram. (8 points)

1. 3.

Subnet1: the left side of Router 1

Subnet2: the right side of Router 1

Subnet3: the upside of Router 1.

2. 10.0.2.126

255.255.255.128

Xi'an Jiaotong-Liverpool University 西交利物浦大学

Question 5 (20 points)

Alice wants to communicate with Bob using symmetric-key cryptography (e.g., DES) with a session-key K_S. We learned how public-key cryptography (e.g., RSA) can be used to distribute a session key K_S between Alice and Bob. Suppose the private keys of Alice and Bob are k_A^- and k_B^-, while the public keys are K_A^+ and K_B^+. Also, we assume that Alice and Bob have got each other's public key through a certificate authority (CA).

1. Describe the main problem for using symmetric-key cryptography. (4 points)
2. Describe the main disadvantage of using public-key cryptography instead of symmetric-key cryptography for the whole communication. (4 points)
3. Draw a diagram to show how Alice would use the public-key cryptography to distribute the symmetric session-key K_S to Bob. (6 points)
4. Describe the problem when there is no CA distributing the public keys. (6 points)

4. Man in the middle attack.

1. key distribution

2. computational efficency

3. Alice Bob

$$k_s \xrightarrow{k_B^+} k_B^+(k_s) \longrightarrow k_B^+(k_s) \xrightarrow{k_B^-} k_s$$

-------------------------*END OF EXAM*-------------------------