Xi'an Jiaotong-Liverpool University

西交利物浦大學

Paper CODE	EXAMINER	DEPARTMENT	TEL
CAN201		CAN	

1st SEMESTER 2024/25 RESIT EXAMINATION
Undergraduate – Year 3
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. There are 5 questions. Answer all questions.

4. Answer should be written in the answer booklet(s) provided.

5. Only English solutions are accepted.

6. All materials must be returned to the exam supervisor upon completion of the exam. Failure to do so will be deemed academic misconduct and will be dealt with accordingly.

Question 1 (20 points)

Suppose your computer is connected to the Internet through a router with Wi-Fi, and you enter https://www.xjtlu.edu.cn/ in the address bar of your browser to access the homepage of the university, which contains text, images, and videos. Please explain the protocols involved at each layer of the Internet Protocol (IP) stack for this webpage access, considering the connection setup and data transfer processes. (20 points)

① Application Layer : HTTP : request and transfer messages
TLS : encrypt the data.
DNS : resolute the name of web to Ip.
DHCP : request for the local Ip
② Transport layer : TCP : use TCP to connect

③ Network layer : BGP , OSPF : route the paths
IP
④ Link layer : ARP : map the Ip address to mac.

Question 2 (20 points)

The transport layer provides two main protocols for data transmission: TCP (Transmission Control Protocol) and UDP (User Datagram Protocol). Both protocols offer different features and are used in distinct scenarios.

1. Checksum plays a critical role in transport layer protocols, whether UDP or TCP. What is the role of checksum and how does it work? (5 Points)

The error detection. The sender calculate the checksum of UDP every 16 bits. The receiver calculate again to check whether the two checksums are same.

2. Calculate the checksum for the following two 16-bit binary numbers:
1010101010101010
1100110011001100
(7 Points)

1000100010001001

3. Bob is developing a peer-to-peer file sharing service for his project. This service will allow users to upload and download large files like videos and documents. Which transport-layer protocol, TCP or UDP, should Bob use for his file sharing service? Explain and compare the strengths and weaknesses of both protocols for this use case. (8 Points)

TCP.

① TCP make sure the reliable transfer. It uses sequence number. If a packet is lost, it will transfer again. while UDP will not. If the transfer is time out, the TCP will transfer again.

② TCP has flow and congestion control. It will prevent the sender from overwhelming the receiver .

Question 3 (20 points)

Software-Defined Networking (SDN) has emerged as a paradigm that enables the network control to become directly programmable and the underlying infrastructure to be abstracted for applications.

1. In traditional networking, each router is responsible for both routing and forwarding functions. However, in an SDN architecture, these functions are separated. Could you specify which device is responsible for the routing function and which for the forwarding function within an SDN framework? (4 points)

   routing: SDN controller   forwarding: switch

2. Given that a network utilizing SDN architecture has recently been initialized and the switch is configured with a default flow entry, which option below is most likely to represent the default entry? Please provide an explanation for your choice. (8 points)

   a) source=1.2.*.*, destination=3.4.*.*, action=forward

   b) source=*.*.*.*, destination=3.4.*.*, action=drop

   c) source=*.*.*.*, destination=*.*.*.*, action=controller

3. Given a switch with three custom flow entries installed, in addition to the original default flow entry, each associated with a priority number (where a higher number signifies greater priority), please identify which flow entry will match an incoming packet with a source IP of 1.2.1.2 and a destination IP of 3.4.5.6. Provide a rationale for your selection. (8 points)

   a) source =1.2.1.2, destination=3.4.5.6, action=modify, priority=3

   b) source =1.2.*.*, destination =3.4.5.6, action=forward, priority=2

   c) source =1.2.*.*, destination =3.4.*.*, action=controller, priority=1

2. (c).
The default flow entry should be handled no matter where it is from and where it is going to. And it should be handled by the controller to decide which action it should have. So (c) is chosen.

3. (a). The priority of (a) is the highest, and the source and destination of (a) match the incoming packet.

Question 4 (20 points)

Consider the following Fig. 4-1, where several subnets are interconnected.
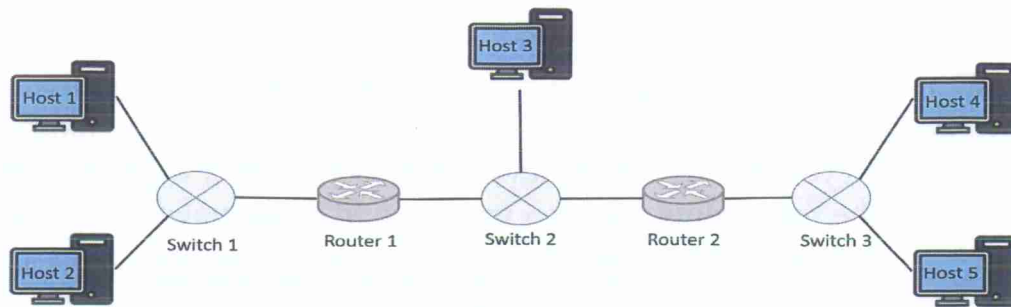

Figure 4-1: Network topology

1. Please list all the subnets in this network. Hint: list them in terms of network interfaces. (9 points)

2. If Router 1 is removed, and Switch 1 and Switch 2 are linked directly, then there are how many subnets left? Explain what they are. (5 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 3. 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. (6 points)

Internal Use Only

Handwritten answers:

1. The left interface of Router1: Host1, Host2, switch1

   The right interface of Router1 and The left interface of Router 2: Switch 2, Host 3

   The right interface of Router2: Host 4, Host 5, switch 3

2. 2.
   The left and right interface of Router 2.

Question 5 (20 points)

Alice and Bob are interested in secure communication, but they face potential threats from Charlie, who may attempt to compromise their communication. Figure 5-1 illustrates Charlie's capability to listen on Alice and Bob's communication channel, enabling him to conduct an eavesdropping attack. Figure 5-2 depicts Charlie executing a spoofing attack by impersonating Alice to send a malicious message to Bob. Regarding the components of the CIA triad, which include **C**onfidentiality, **I**ntegrity, and **A**vailability, given that Alice and Bob opt for **public key encryption** to protect their communication, and assuming the original message is M (which has a very small size), Alice's public key K_A^+ and private key K_A^-, while Bob's public key K_B^+ and private key K_B^-, please answer the following questions.
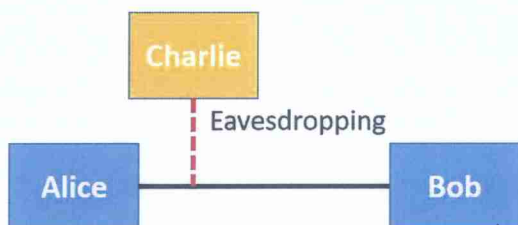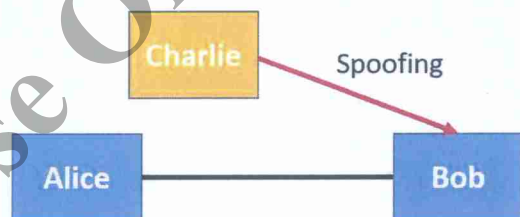

Figure 5-1: Eavesdropping attack　　　　Figure 5-2: Spoofing attack

1. By conducting an eavesdropping attack (see Figure 5-1), which component of the CIA triad is compromised by Charlie? (2 points)

   To protect the communication against eavesdropping, how would Alice and Bob proceed? Describe the actions taken by them respectively. (6 points)

2. By performing a spoofing attack (see Figure 5-2), which component of the CIA triad is compromised by Charlie? (2 points)

   To protect their communication against spoofing, how would Alice and Bob proceed? Describe the actions taken by them respectively. (6 points)

3. Identify the primary challenge for the use of public key encryption. (4 points)

(handwritten annotations)

1. confidentiality.

Alice　　　　　　　Bob

$m \xrightarrow{K_B^+} K_B^+(m) \longrightarrow K_B^+(m) \xrightarrow{K_B^-} m$

2. Integrity. (Authentication)

Alice　　　　　　　　　　　　　　　　　Bob

$m \xrightarrow{K_A^-} K_A^-(m) \xrightarrow{K_B^+} K_B^+(K_A^-(m)) \longrightarrow K_B^+(K_A^-(m))$

$\downarrow K_B^-$

$K_A^-(m)$

$\downarrow K_A^+$

m

(3). Heavy computation.

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