

Dept. of Computer Science and Engineering, National Sun Yat-sen Univ.
Fall 2024 PhD Qualifying Exam

Subject: Computer Networks

Each question 5 pts. Exam max 75 pts.

1. What is Frequency Division Multiplexing (FDM)? What is Time Division Multiplexing (TDM)? What is packet switching? What is circuit switching?
2. Draw pictures to explain what are TDMA, FDMA, and slotted ALOHA.
3. For Internet Protocol (IP) Stack, how many layers are there? For the Open Systems Interconnection (OSI) model, how many layers are there? Please draw the IP stack and explain the function of each layer, respectively. Also, indicate which layer(s) of the OSI model correspond to the IP stack.
4. Encapsulation is a method adopted repeatedly in computer networking. What are the advantages of encapsulation? Please draw pictures to explain the operations of encapsulation. Please describe four examples in which encapsulation is used.
5. Please draw a graph to show the operations of Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). The slow start phase, congestion avoidance phase, and experiencing a time out or three repeated ACKs must be included in your picture and explanations. How can we achieve a reliable data transfer under unreliable channel conditions? What is the role of a window? Can we mimic TCP behavior with UDP?
6. What is a Domain Name System (DNS)? There are four types of Resource Records (RRs). Please explain each type in detail.
7. There are four main causes of a packet delay. Please draw a picture to explain them in order. Please also explicitly demonstrate the differences between the transmission delay and the propagation delay. When the traffic load is larger than a threshold (0.9 as an example), the queuing delay increases exponentially. Why?
8. Please write TCP socket programming pseudo-code for simple client-server interactions. Please also comment your code for easier reading.
9. What is demultiplexing in TCP and UDP, respectively? Please draw pictures to show the differences in demultiplexing in TCP and UDP.
10. Please write the pseudo-code for Dijkstra's algorithm and provide some remarks about your code, i.e. provide useful comments.
11. What is Carrier Sense Multiple Access with Collision Detection (CSMA/CD) and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)? Why is CSMA/CD used in IEEE 802.3 wired Ethernet? Why is CSMA/CA used in 802.11 wireless networks? How do they work?
12. What is Multi-Protocol Label Switching (MPLS)? What is Software-Defined Networking (SDN)? Please explain them in your words.
13. Please draw pictures to explain weighted fair queueing (WFQ), FIFO scheduling, round-robin scheduling, and priority scheduling, respectively.
14. What is Address Resolution Protocol (ARP)? Please describe the ARP protocol by giving an example. Please draw signals between a client and a DHCP server to explain how and what an arriving client obtains via the DHCP protocol.
15. If a host A receives two SYN packets from the same port of remote host B, the second may be either a retransmission of the original or, if B has crashed and rebooted, an entirely new connection request. (a) Describe the difference as seen by host A between both cases. (b) Give an algorithmic description of what the TCP layer needs to do upon receiving a SYN packet. Consider the duplicate/new packet cases above, and the possibility that nothing is listening to the destination port.