University of KwaZulu-Natal
Electrical, Electronics and Computer Engineering,
Final Examination: October 2025
Subject, Course code: Internet Engineering: ENEL4IE

Examiners: Prof. T Quazi (Internal Examiner)

Dr. C Chabalala (External Examiner)

Duration: Two Hours Total Marks: 80

Instructions to candidates:

1) Attempt all questions. Questions carry equal marks.
2) Scientific Calculators may be used.
3) Show your computations step-by-step; otherwise, you will receive no credit.
4) **NO NOTES/reference sheets of any form** are allowed in this examination.

Question 1 **[20]**

a. List and explain the differences in the parameters that lead to 802.11n achieving bitrates of up to 300 Mbps as compared to 802.11b, which only achieves up to 11 Mbps. [8]

b. Derive the formula for the efficiency of CSMA/CD knowing that the maximum number of attempts made in the contention period before the 1st successful transmission is the exponential constant e ($e = 2.7183$). Clearly show your formulation, define your variables and show each step of the derivation. Clearly define your variables and show each step of the derivation. [7]

c. Assume M terminals are attached by a dedicated pair of lines to a hub in a star topology. The distance from each terminal to the hub is 1500 meters, the speed of the transmission lines is 11 Mbps, all frames are of length 12500 bytes, and the signal propagates on the line at a speed of 2.5 x10^8 meters/second. Calculate the maximum network throughput achievable when the hub is implementing CSMA/CD. [5]

Question 2 **[20]**

a. Show the (classless) routing table for the local ISP 2 shown in Figure 1. You can use your own interface labelling scheme. [7]

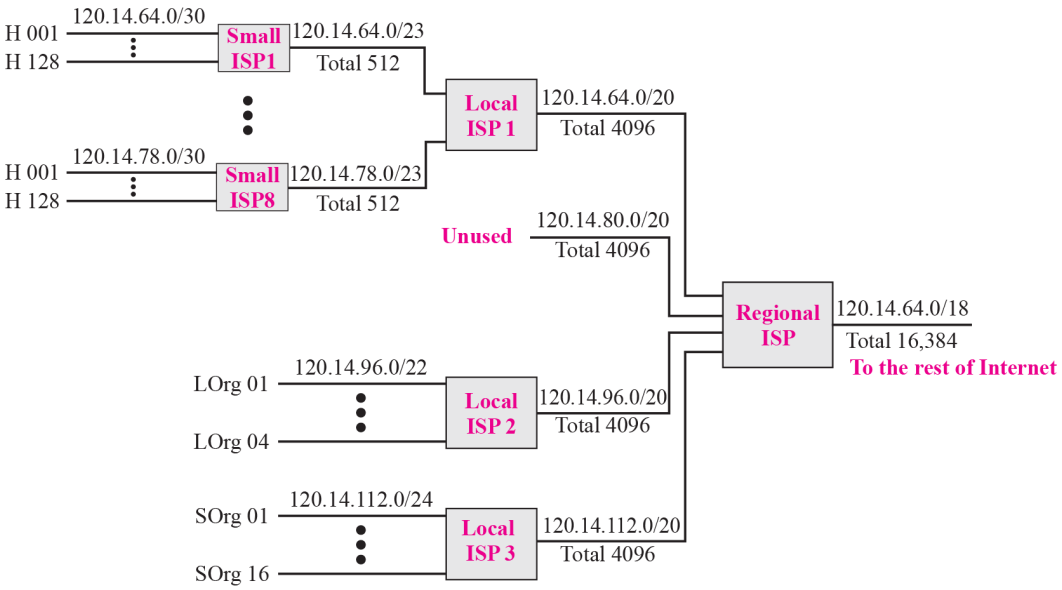


Figure 1: Network Allocation

b. Consider the routing table for a router shown in Table 1.

i. Draw the network diagram according to the data in the table. [10]

ii. If the router, which is given a /16 subnet mask, receives a packet with a destination address 146.230.19.20, show by means of a calculation whether the delivery is direct or indirect. [3]

Table 1: Classful Routing Table

Class A

Network address	Next-hop address	Interface
111.0.0.0	----------	m0

Class B

Network address	Next-hop address	Interface
145.80.0.0	----------	m1
170.14.0.0	----------	m2

Class C

Network address	Next-hop address	Interface
192.16.7.0	111.15.17.32	m0

Default: 111.30.31.18, m0

Question 3 **[20]**

a. A router with IP address 125.45.23.12 and Ethernet physical address 23:45:AB:4F:67:CD has received a packet for a destination with IP address 125.11.78.10 and Ethernet address AA:BB:A2:4F:67:CD. Show the address entries (following the Preamble field) of the encapsulated data link layer frames for both the ARP request and response packets. [5]

b. Give pseudocode for the ***update(T,R)*** function of the Distance Vector Algorithm where ***T*** is the table of routing entries at a node and ***R*** is the record received from a neighbour. [10]

c. A computer sends an ICMP timestamp request to another computer. It receives the corresponding timestamp reply at 4:56:08AM (Universal Time). The values of the original timestamp, receive timestamp, and transmit timestamp are 17 560 000, 17 562 000, and 17 764 300, respectively. What is the sending trip time? What is the receiving trip time? What is the round-trip time. [5]

Question 4 **[20]**

a. Assume that a sender at the transport layer is trying to get 10 packets through to a receiver, and every 5th packet is lost. How many transmissions would be required if the [6]
   i) Stop and Wait
   ii) GBN, N=3
   iii) SR
   algorithms are being used. Clearly show how the final number is derived.

b. If the TFTP protocol is being used to download a file that is 1 421 803bytes,
   i. how many packets are needed for the download? [3]
   ii. what is the size of the last packet? [2]

c. Show a detailed TCP congestion control graph using the following scenario. The graph should show the value of the cwnd till the 16th RTT. Clearly show and label the different phases of the congestion control operation. Assume that the initial threshold value is 32. [9]
   - A time-out occurs after the 8th RTT
   - 3 duplicate ACKs are received after the 14th RTT

USEFUL INFORMATION

Efficiency of CSMA/CD = $\frac{1}{1+6.44a}$

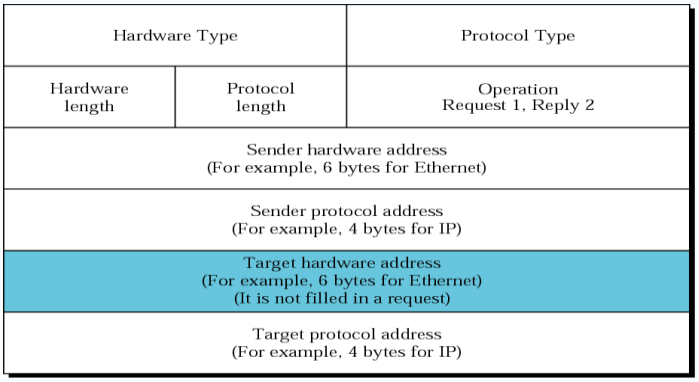


Figure A: ARP Packet Format

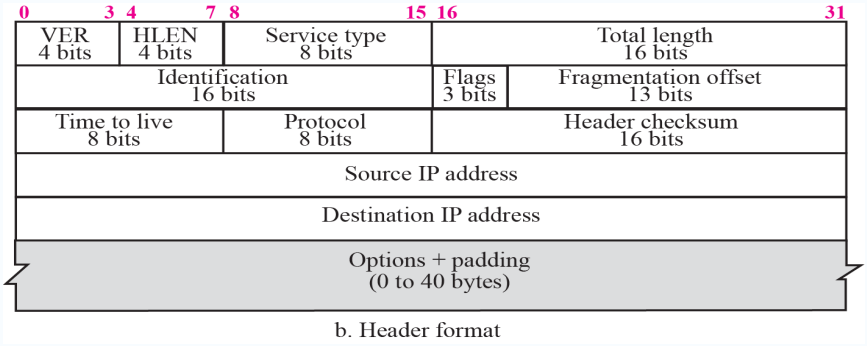


Figure B: IP Header Format

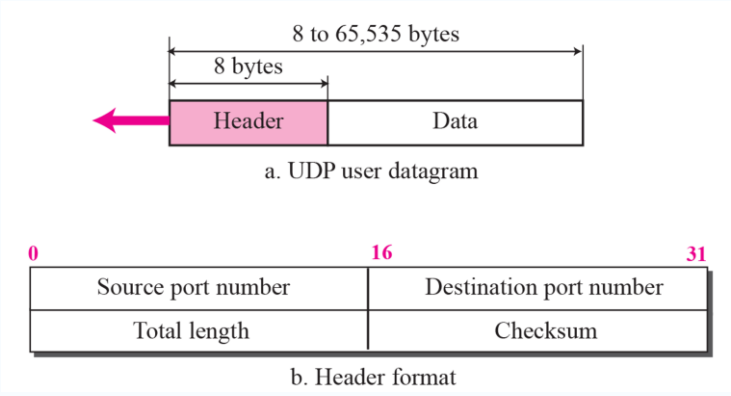


Figure C: UDP Packet Format