



Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin

Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics & Science

School of Computer Science and Statistics

Integrated Computer Science Programme
Senior Freshman
BA (Mod) Business and Computing
Junior Sophister

Semester 1 Exam

Computer Networks

05 DEC 2024

09.30 – 12.30

Prof. Stefan Weber

Instructions to Candidates:

Answer 2 questions.

Both questions carry equal marks (50 marks).

Answer each question in a **separate** answer book.

If you think details such as values or labels are missing from questions, state this in your answer, make necessary assumptions and explain these assumptions briefly

Materials permitted for this examination:

Calculator (non-programmable)

Question 1)

- a) One of the tasks of the Link layer in the OSI stack is called “flow control”. The High-Level Data Link Control (HDLC) protocol defines a number of types of frames shown in figure 1. Assume that node A, address 10011111, uses HDLC to transmit 4500 bytes in 5 frames to node B, address 11000110. The code in an S-Frame for an acknowledgement is 00 and for a negative acknowledgement is 11. The flag byte consists of the bit-sequence 01111110.
- i) Draw the exchange of the frames **in as much detail as possible** for a Stop-and-Wait approach and for a Selective-Repeat approach. Your diagram should be accompanied by an explanation of the process.
- ii) Discuss the number of bits reserved for the encoding of sequence numbers and the effect of this on the size of sender and receiver windows for Go-Back-N and Selective Repeat.

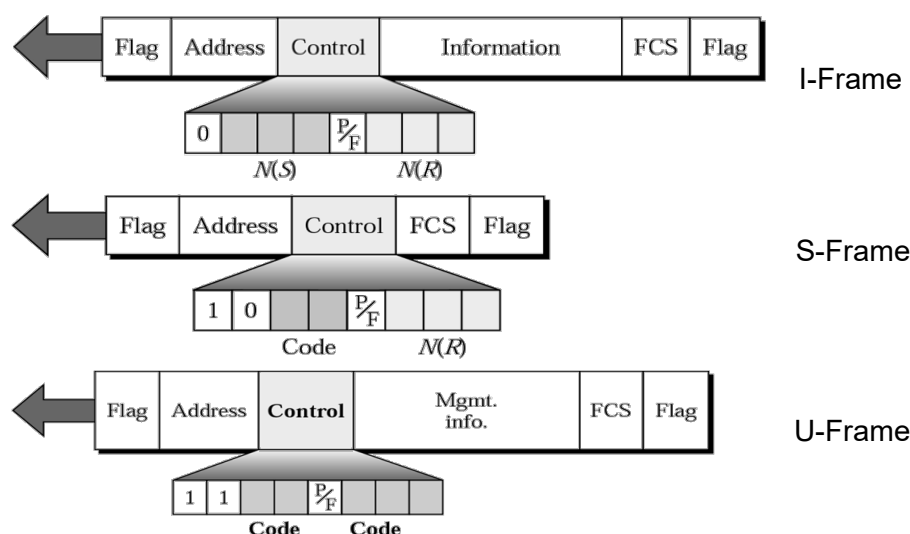


Figure 1: Types of HDLC frames

[25 marks]

- b) The Distributed Coordination Function (DCF) of IEEE 802.11 and Code-Division Multiple Access (CDMA) represent two methods for stations to get access to the medium and transmit data.
- i) Assume that six stations S1 to S6 use 802.11 radios and are within each other coverage area. Station S5 completed communicating with Station S6. Station S2 intends to transmit to station S3 and station S4 intends to transmit to station S1. The stations will use 802.11 DCF to get access to the medium. Use diagrams to visualise the chronological exchange of the frames and the inter-frame spaces that are involved in these exchanges and explain the diagrams.
- ii) Assume that instead of 802.11 DCF, the stations S1 to S4 use Code-Division Multiple Access (CDMA). Station 2 intends to transmit the bit sequence 10 and Station 4 intends to transmit the bit sequence 01; the other stations are silent. A '0' is encoded as -1, a '1' is encoded as +1 and silence is represented by 0. Give the signals that the station S1 and S3 will observe and discuss how the stations will decode these signals. The chip sequences of the stations are as follows:

Station 1: +1 +1 -1 -1

Station 3: +1 -1 -1 +1

Station 2: +1 -1 +1 -1

Station 4: +1 +1 +1 +1

[25 marks]

[Total 50 marks]

Question 2)

- a) Assume that a node A intends to communicate with a node E over a number of intermediate nodes, B to D, as shown in figure 2. The nodes use IEEE 802.3 Ethernet as Link layer protocol for the connections between them and node B acts as a NAT gateway for the local network that includes node A. Define IPv4 addresses, Ethernet addresses and routing information as you see appropriate

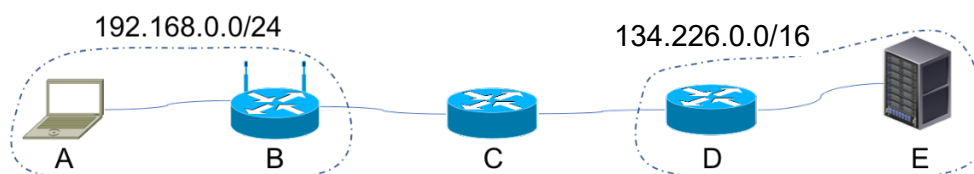


Figure 2: A Topology of two networks connected by a router

- Describe the information that node B will keep in order to act as NAT gateway and how this information is used by B to process incoming and outgoing IPv4 packets.
- Describe the IPv4 packet that A would issue and the routing process of the IPv4 packet from A to E at the intermediate hops.
- Describe the Link layer frames encapsulating the IPv4 packet assuming that all links use Ethernet and the resolution of the IPv4 addresses to Ethernet addresses at every hop.

[25 marks]

- b) Distance Vector Routing and Link State Routing describe two fundamental types of routing protocols.

- Give a short description of both Distance Vector and Link State Routing in your own words and discuss the difference of both approaches to routing.
- Describe the concept of Distance Vector Routing on the example of the computer network in Trinity College. Assume that **12 Schools** of TCD, such as “Computer Science and Statistics (CSS)”, “Electronic Engineering (EE)”, “Genetics (G)”, “Chemistry (C)”, etc., have each an individual router and that these routers are partially connected to one another e.g. the router from CSS may be connected to the router from EE but not to the router from G and so on. The description should include diagrams that visualise the process that the concept follows to establish routing tables at the individual routers.
- Explain the problem of “Count to Infinity” in your own words on the network described in ii)

[25 marks]

[Total 50 marks]

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