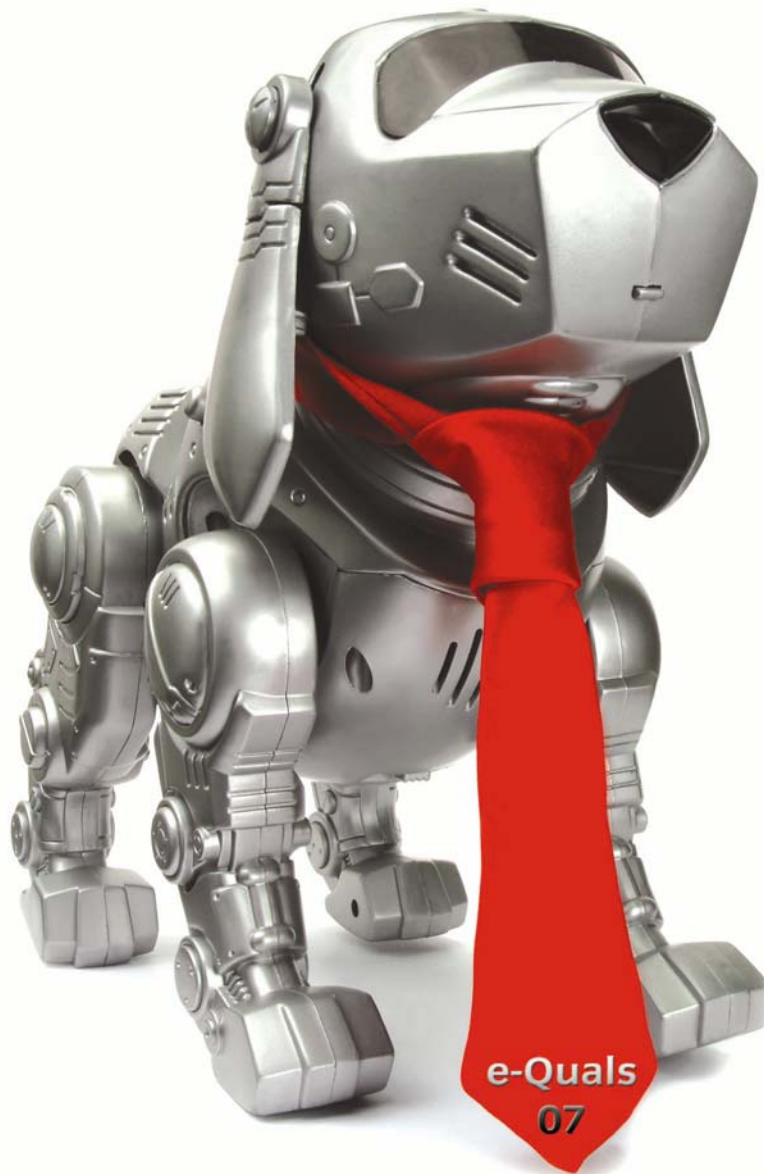


Level 3 Design and maintain ICT Networks software components (7266/7267-522)

e-Quals
Assignment guide for Candidates
Assignment A



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Level 3 Design and maintain ICT Networks software components (7266/7267-522) Assignment A

Introduction – Information for Candidates

About this document

This assignment comprises all of the assessment for Level 3 Design and maintain ICT Networks software components (7266/7267-522).

Health and safety

You are asked to consider the importance of safe working practices at all times.

You are responsible for maintaining the safety of others as well as your own. Anyone behaving in an unsafe fashion will be stopped and a suitable warning given. You will **not** be allowed to continue with an assignment if you compromise any of the Health and Safety requirements. This may seem rather strict but, apart from the potentially unpleasant consequences, you must acquire the habits required for the workplace.

Time allowance

The recommended time allowance for this assignment is **4 hours**.

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Candidate instructions

Candidates are advised to read **all instructions** carefully before starting work and to check with your assessor, if necessary, to ensure that you have fully understood what is required.

Time allowance: 4 hours

Assignment set up: A scenario is provided below for candidates.

This assignment is made up of **four** tasks

- Task A - requires candidates to produce an updated WAN diagram, work with nodes, routing and encryption.
- Task B - requires candidates to explore printer server software components.
- Task C - requires candidates to explore token ring protocols.
- Task D - requires candidates to explore communications using the Xmodem protocol.

Scenario

Tench Associates specialise in networking and data communications software development. They have been hired to provide solutions for a client's communications problems. As an employee of Tench Associates, your team leader has assigned you the task of providing solutions.

Note

Some tasks require candidates to write algorithms. Where this is the case you should always identify:

- variable names and data types
- argument names and data types
- return values and data types

Task A

Diagram 1 below represents a WAN used by Tench Associates where A, B, C, D, E and F are switching nodes. Computer 1 can communicate with Computer 2 via any available route. Each link between the switching nodes has been given a number.

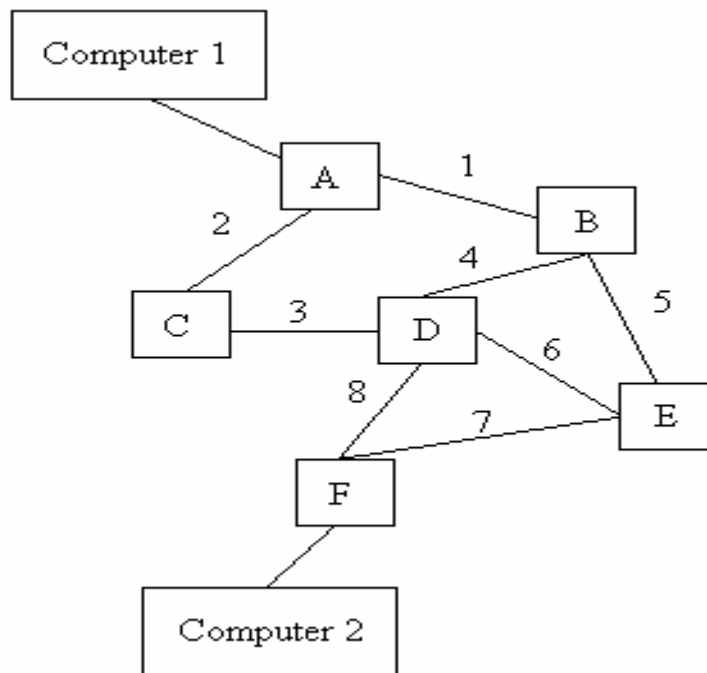


Diagram 1

Table 1 below is a fixed routing table stored on node D. On receipt of a transmitted message, node D will look up the destination node in Table 1 to find which link to use to retransmit the message on. If a 0 entry is found, this indicates that the transmission is intended for itself and is not for retransmission.

| Destination node | Link to transmit on | Alternative 1 | Alternative 2 |
|------------------|---------------------|---------------|---------------|
| A | 3 | 4 | 6 |
| B | 4 | 3 | 6 |
| C | 3 | 8 | 4 |
| D | 0 | 0 | 0 |
| E | 6 | 4 | 8 |
| F | 8 | 4 | 6 |

Table 1

- 1 Add a new node G to the WAN to link directly to nodes C and F. The link between node F and G is to be numbered 9, and the link between nodes C and G is to be numbered 10. Provide an amended diagram to show the WAN with the new node added (*this will be labelled WAN diagram 1*).
- 2 Provide an amended routing table for node D so that node G is included (*this will be labelled Routing Table 1*).

3 Provide a routing table for node B (*this will be labelled Routing Table 2*).

Your team leader has asked you to design a software component that will be stored on a node and will locate the link number for a transmission.

4 Your team leader has asked you to design a software component that will be stored on a node and will locate the link number for a transmission.

a. Provide an algorithm for a function named FindLink which should look up the destination node in the routing table and return the link number that the data is to be transmitted on. If the main link is unavailable, an alternative link number should be returned. FindLink will be passed the following three arguments:

- a character identifying the destination node
- an integer which will contain 0 if all links are available, or the number of the link if a link is unavailable
- a node routing table

b. Check that the algorithm performs correctly by using the following parameters:

- F, 0 and Routing Table 1 for node D
- D, 4 and Routing Table 2 for node B
- B, 0 and Routing Table 2 for node B

Provide the results from checking the algorithm i.e. the link number returned by the algorithm for each of the specified parameter lists

A simple substitution method is to be used to encrypt the character data transmitted across the network. The substitution method used will offset the alphabet by three characters. See *Table 3* below.

| Start character | Encrypted character |
|------------------------|----------------------------|
| A or a | D or d |
| B or b | E or e |
| C or c | F or f |
| D or d | G or g |
| E or e | H or h |
| F or f | I or i |
| <i>and so on</i> | |
| X or x | A or a |
| Y or y | B or b |
| Z or z | C or c |
| Space | Space |

Table 3

Table 4 below shows a partially completed encryption table.

| | | | | | | |
|---|---|---|---|---|---|-----------|
| d | e | f | g | h | i | |
| 1 | 2 | 3 | 4 | 5 | 6 | and so on |

Table 4

- 5 a. Complete the encryption table (*this will be labelled Encryption Table 1*) with 26 entries to hold the characters to be substituted.
- b. Provide an algorithm for a function named Substitute, which is passed one character at a time and returns the substituted character. Note that although Encryption Table 1 holds a character as lowercase, if a character passed to the function is uppercase, the substituted character should be returned as uppercase.
- c. Check the results from your algorithm by encrypting the following message:

Test the encryption is working

Provide the results of the encryption.

Task B

The client requires new printer server software. You have been asked to design a component to manage the print queue.

The print queue will be held in an array of MAX size. A new job is added to the end of the queue if the queue is not full. When the printer is ready to print another job, a job is released from the front of the queue, if the queue is not empty. When the queue reaches the end of the array it should wrap around to the front of the array.

- 1 Provide an algorithm for a function named AddJob. This will be passed six parameters:
- a job number
 - the number of jobs currently held in the queue
 - the queue array
 - the position of the front of the queue
 - the position of the rear of the queue
 - MAX

The job number will be added to the rear of the queue. Two values may be returned by the function OK or FULL.

- 2 Provide an algorithm for a function named RemoveJob. This will be passed six parameters:
- the number of jobs currently held in the queue
 - the queue array
 - the position of the front of the queue
 - the position of the rear of the queue
 - a variable to hold the job number removed from the queue

- MAX

The job number will be removed from the front of the queue and placed in the variable to hold the job number removed. Two values may be returned by the function OK or EMPTY.

3 Verify the results from both your algorithms using the following test data with MAX=10:

- i. Add jobs 1,2,3,4,5,6,7,8,9,10.
- ii. Add job 11.
- iii. Remove a job.
- iv. Add job 12.
- v. Remove 10 jobs.
- vi. Remove a job.

- a. What value is returned after ii. 'Add job 11' ?
- b. What value is returned after iii. 'Remove a job'?
- c. What value is returned after iv. 'Add job 12'?
- d. What value is returned after vi. 'Remove a job' ?

Task C

Diagram 2 below shows a token ring set up and built by your team leader to test new software.

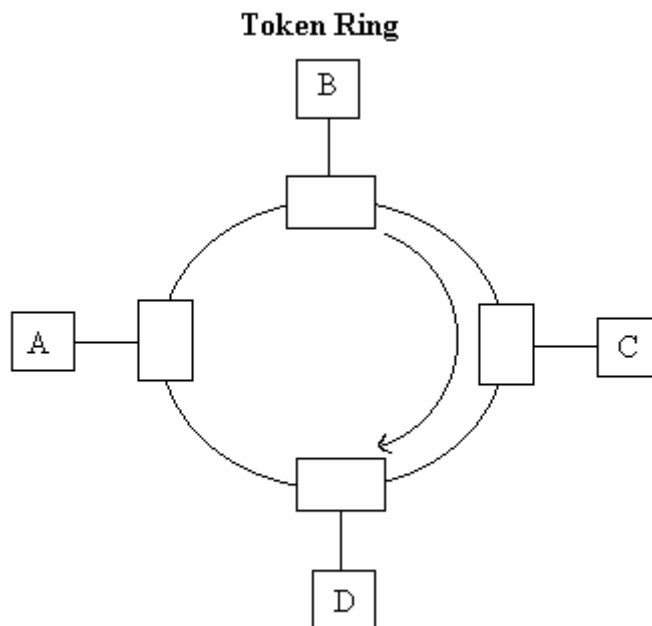


Diagram 2

Your team leader has to manage the production of the software for the token ring. Table 5 shows the message protocol:

| | | | | | | |
|-------|----|----|----|------|----|----|
| Token | DA | SA | CF | Data | EC | RP |
|-------|----|----|----|------|----|----|

Table 5

Each field except the data field is 8 bits. Only one message can be on the token ring at any time.

Table 6 below describes the fields used in the message protocol.

| Field | Contains |
|------------|---|
| Token | 11111111 - to indicate busy 00000000 - to indicate free |
| DA | Destination address |
| SA | Source address |
| CF | Identification number for the message |
| Data field | Data to be transmitted |
| EC | Checksum byte used for error checking |
| RP | LSB is set to 1 by the destination computer if the frame is successfully received |

Table 6

Table 7 below gives the addresses for each of the computers in the token ring.

| Computer | Address |
|----------|-------------------|
| A | 00000011 (03 hex) |
| B | 00000010 (02 hex) |
| C | 00000001 (01 hex) |
| D | 00000100 (04 hex) |

Table 7

You have been asked by your team leader to write a report based on the information contained in Table 6 and Table 7 (this will be called *Token Ring Report 1*) for a message transmission from computer B to computer D.

- 1 Explain how the contents of the checksum will be calculated for the EC field.
- 2 Provide a diagram (*Protocol bytes diagram 1*) that shows the contents of the protocol bytes: Token, DA, SA, CF, and RP for the transmission of the message. The message identification number is 00000100 (04 hex).
- 3 Explain why handshaking is not required.
- 4 Explain how flow control is achieved.
- 5 State how computer B identifies that the ring is free so that it can transmit a message.
- 6 Explain the action taken by computer C on receipt of the message.
- 7 Explain the action taken and the content of the protocol of any message transmitted by computer D on receipt of the message under the following conditions:

- a. Calculation of the checksum indicates an error.
 - b. Calculation of the checksum indicates the message is OK and accepted.
- 8 Explain the action taken and the content of the protocol of any message transmitted by computer B when the response from computer D indicates:
- a. An error occurred during transmission between computer B and computer D.
 - b. The message was accepted by computer D.

Task D

Your team leader has asked you to design a software component, which will link two computers via a serial link using the Xmodem protocol. Diagram 3 below is the State Transition Diagram for the receiver software.

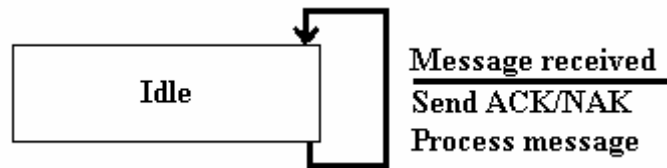


Diagram 3

Diagram 4 below is the State Transition Diagram for the transmitter software.

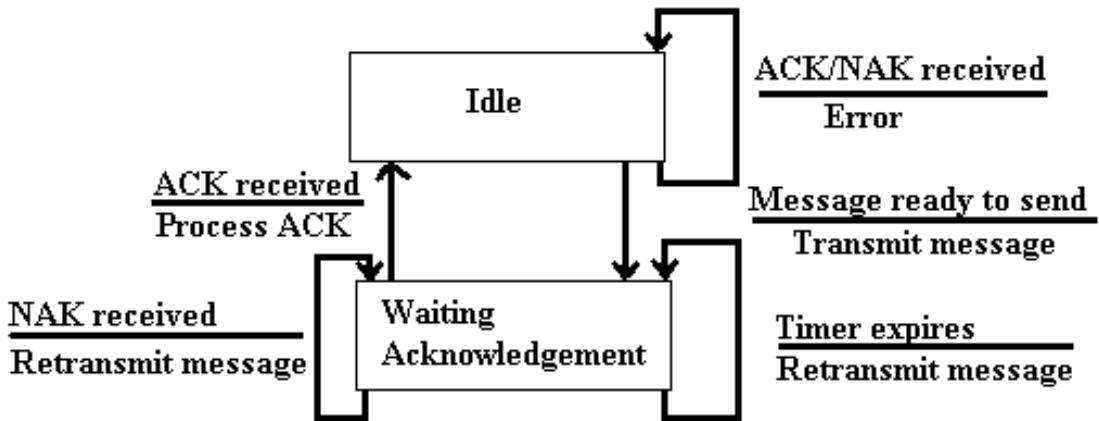


Diagram 4

Table 8 below is the Event-state table for the transmitter, which has been partially completed.

| Event Present State | Timer Expires | Message ready to send | ACK received | NAK received | |
|-------------------------------|---------------|-----------------------|--------------|--------------|-----------|
| Idle (0) | NA | Tx | | | Action |
| | 0 | 1 | | | New State |
| Waiting Acknowledgment (1) | | Delay | | | Action |
| | | 1 | | | New State |

Table 8

Tx: Transmit message
 NA: No action
 Delay: Wait for a defined time (eg 10 seconds)

- 1 Provide the completed Event-state table (*this will be called Event-state Table 1*) for the transmitter using the information provided in the STD (*Diagram 4*).
- 2 Provide the Event-state table (*this will be called Event-state Table 2*) for the receiver using the information provided in the STD (*Diagram 3*).
- 3 Provide an algorithm for the receiver software component using the information in Event-state Table 2. An incoming message will contain an id-number. The data received is to be written to disk in a sequential file. The algorithm must check for duplicate messages and errors in transmission (*ie checksum*).
- 4 Provide an algorithm for the transmitter software component using the information in Event-state Table 1. An outgoing message should contain an id-number, which is incremented for each message sent. An ErrorLog is to be created to hold a count of the number of errors that have occurred. The data to be transmitted will be provided by another software component in a sequential file.

Note

- At the conclusion of this assignment, hand all paperwork and removable media to the test supervisor.
- Ensure that your name is on the removable media and all documentation.
- If the assignment is taken over more than one period, all removable media and paperwork must be returned to the test supervisor.

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