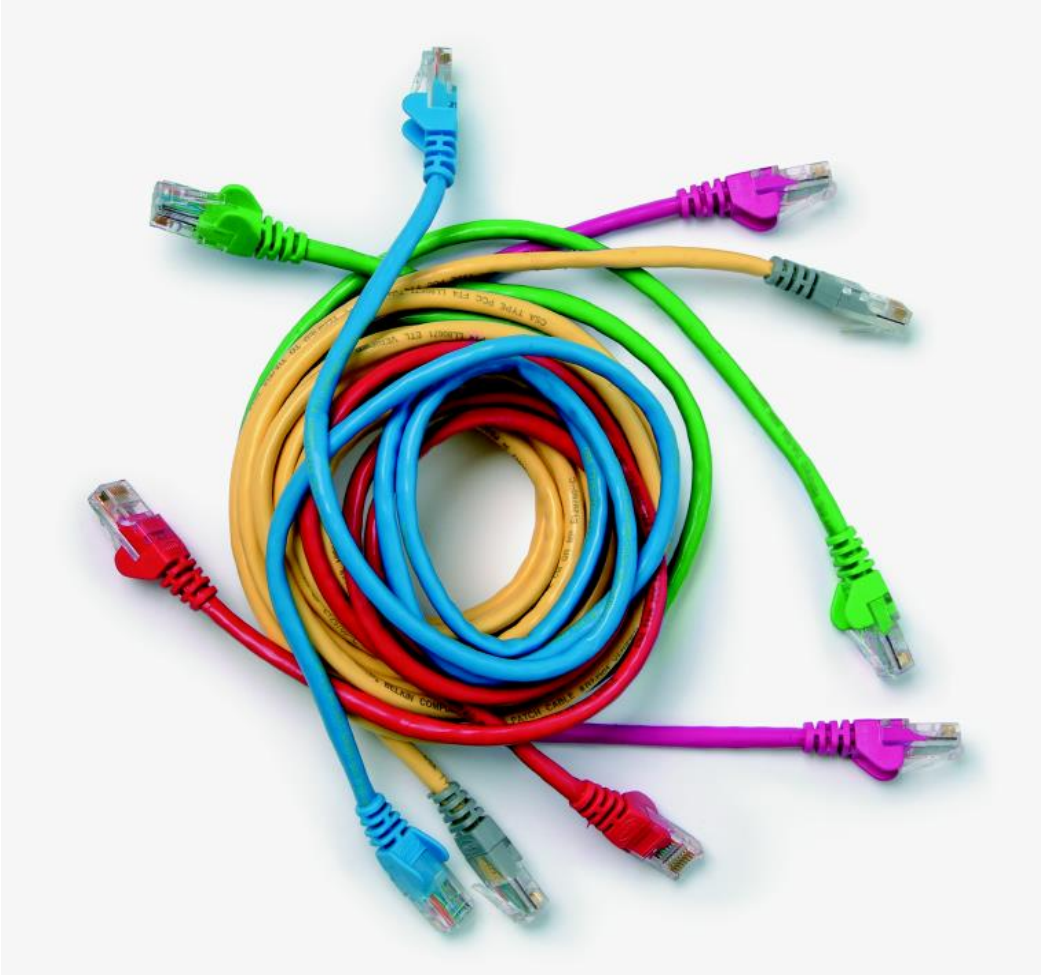
Level 3 Design and maintain ICT network software components (7540-356)

www.cityandguilds.com
September 2017
Version 4.0

Systems and Principles
Assignment guide for Candidates
Assignment A



About City & Guilds

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

City & Guilds Group

The City & Guilds Group includes City & Guilds, ILM (the Institute of Leadership & Management) which provides management qualifications, learning materials and membership services, NPTC which offers land-based qualifications and membership services, and HAB (the Hospitality Awarding Body). City & Guilds also manages the Engineering Council Examinations on behalf of the Engineering Council.

Equal opportunities

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement is available on the City & Guilds website.

Copyright

The content of this document is, unless otherwise indicated, © City & Guilds Limited and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and learners studying for City & Guilds qualifications may photocopy this document free of charge and/or include a locked PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching learners working towards a City & Guilds qualification, or for internal administration purposes
- learners may copy the material only for their own use when working towards a City & Guilds qualification

The *Standard Copying Conditions* on the City & Guilds website also apply.

Please note: National Occupational Standards are not © City & Guilds Limited. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Publications

City & Guilds publications are available on the City & Guilds website or from our Publications Sales department at the address below or by telephoning +44 (0)20 7294 2850 or faxing +44 (0)20 7294 3387.

Every effort has been made to ensure that the information contained in this publication is true and correct at time of publication. However, City & Guilds products and services are subject to continuous development and improvement, and the right is reserved to change products and services from time to time. City & Guilds cannot accept responsibility for any loss or damage arising from the use of information in this publication.

City & Guilds
1 Giltspur Street
London EC1A 9DD
T +44 (0)844 543 0000 (Centres)
T +44 (0)844 543 0033 (Learners)
F +44 (0)20 7294 2413

www.cityandguilds.com
learnersupport@cityandguilds.com

Contents

Level 3 Design and maintain ICT network software components (7540-356)

Assignment A

Introduction – Information for Candidates	2
Candidate Instructions	3

Level 3 Design and maintain ICT network software components (7540-356) Assignment A

Introduction – Information for Candidates

About this document

This assignment comprises all of the assessment for Level 3 Design and maintain ICT network software components (7540-356).

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**.

Level 3 Design and maintain ICT network software components (7540-356)

Candidate Instructions

Time allowance: 4 hours

Assignment set up:

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

- Task A – Produce an updated WAN diagram, work with nodes, routing and encryption
- Task B – Design a software component to manage a print queue
- Task C – Produce a report on message transmission on a Token Ring
- Task D – Design a software component linking two computers via a serial link

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 the following should always be identified:

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

Task A – Produce an updated WAN diagram, work with nodes, routing and encryption

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

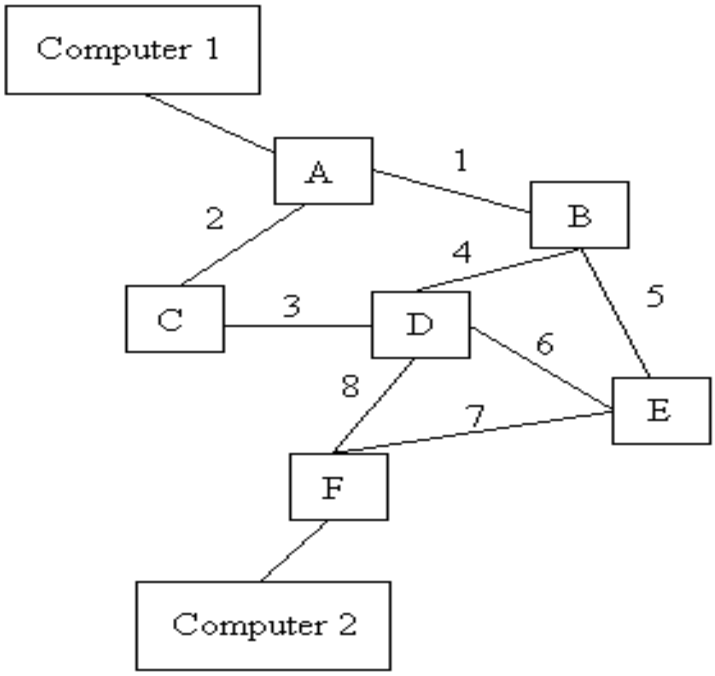


Diagram 1

Table 1 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. 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**).

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 ie the link number actually 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.

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
and so on	
X or x	A or a
Y or y	B or b
Z or z	C or c
Space	Space

Table 3

Table 4 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) The space character should be returned unencrypted.

d) Check the results from your algorithm by encrypting the following message:

Test the encryption is working

Provide the results of the encryption.

Task B – Design a software component to manage a print queue

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 – Produce a report on message transmission on a Token Ring

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

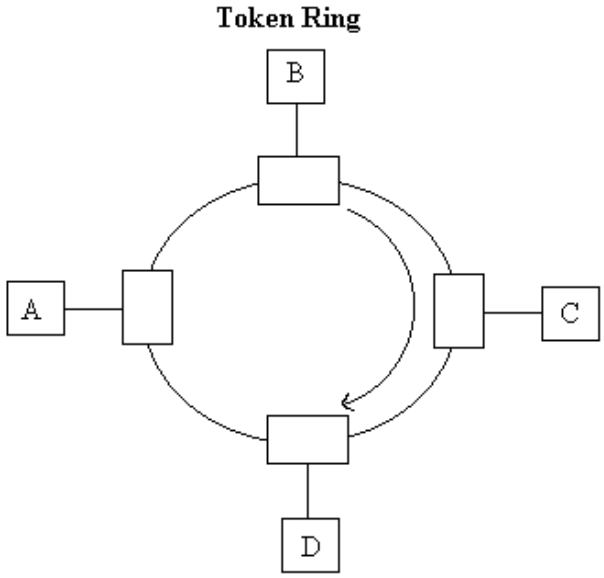


Diagram 2

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 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 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 for a message transmission from computer B to computer D. The report will be called **Token Ring Report 1**.

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 – Design a software component linking two computers via a serial link

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 is the State Transition Diagram for the receiver software.

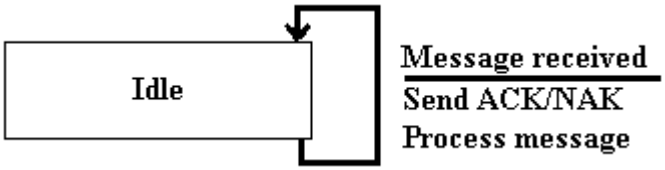


Diagram 3

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

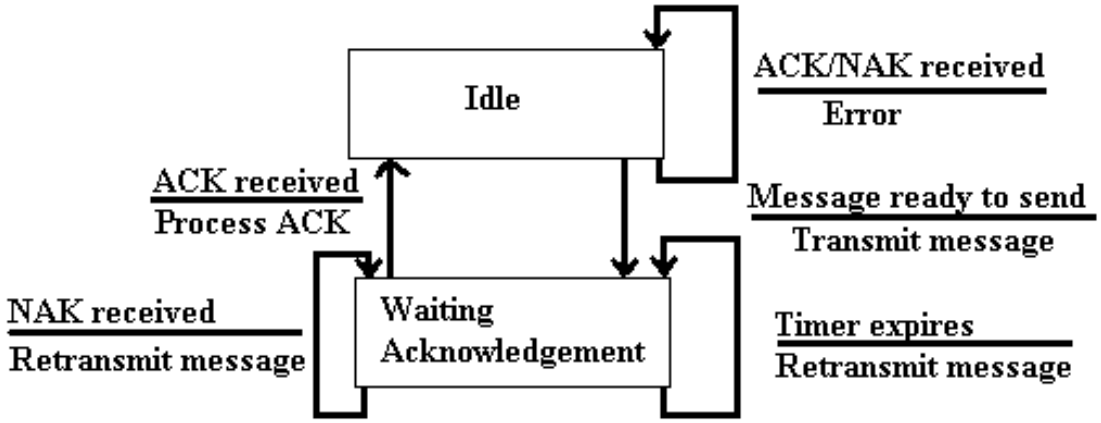


Diagram 4

Table 8 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 labelled **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 labelled **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).

When you have finished working:

- Sign each document above your name and label all removable storage media with your name.
- Hand all paperwork and removable storage media to your assessor.

If the assignment is taken over more than one period, all paperwork and removable media must be returned to the test supervisor at the end of each sitting.

End of assignment

Published by City & Guilds
1 Giltspur Street
London
EC1A 9DD
T +44 (0)844 543 0000 (Centres)
T +44 (0)844 543 0033 (Learners)
F +44 (0)20 7294 2413
www.cityandguilds.com

City & Guilds is a company registered in England and Wales (company number 16513878)