Mark Scheme (Results)

January 2010

GCE

GCE Applied ICT (6959/01)

Communications and Networks

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Unit 9: Communications and Networks

Jan 2010

Activity 1 - Network architecture and topology.

Network topology.

Sensible, titled diagrams showing mesh, Min of 4 nodes, 3 with >2 connections
star, Min of 4 nodes with central connection
hybrid, Must show combination of star and mesh
Only nodes need be shown, hardware should be ignored unless it makes the diagram wrong..
All three diagrams **2 marks**, **OR** any two diagrams **1 mark**

1 mark for each sensible, **pro or con**, note about the three choices that relates to:
a) reliability
b) easy maintenance
c) robustness
d) value.
To a **maximum of 8 marks**. Marks may be given for text descriptions, appropriate diagrams, or a combination.
The ideas given in the table are examples, **not** an exhaustive list. Ideas may be worth more than one mark **IF** they are listed under more than one heading.
N.B. Max of 5 **generic** statements. The other **three** notes must make reference to the scenario.

	mesh	***star***	***hybrid***
Reliable	P. Multiple routes C. Possibility of bottlenecks	P. Switches can be protected in the control centre C. Switches and individual links have no redundancy	P. Cable to outer areas is less prone to interference. Cables have less to go wrong than wifi links. C. More devices to go wrong, switches outside the control centre.
easy to maintain	P. No obvious pros, but allow sensible ideas. C. Difficult to identify faulty links.	P. Switches located in the control centre C. No obvious cons, but allow sensible ideas.	P. No obvious pros, but allow sensible ideas. C. Switches outside the control centre.
robust	P. Multiple routes C. No obvious cons, but allow sensible ideas	P. Switches can be protected in the control centre C. Switches and individual links have no redundancy	P. No obvious pros, but allow sensible ideas. C. More devices to go wrong, switches outside the control centre
value for money	P. Comes from reliability and robustness. C. Equipment costs, Wifi routers rather than simple access points, switches in a cabled version	P. Saving technician time, faulty links / nodes easier to trace, easier set-ups. Cheaper devices. C. No obvious cons, but allow sensible ideas	P. Main (cable) links to outer areas are cheaper than multiple cables **and** wifi links C. Somewhere between star and mesh, allow sensible ideas.

Total for topology 10

Connection technology.

To a maximum of 8 marks.
1 mark for a sensible diagram illustrating how a combined cable plus wifi system might be laid out.

1 mark for each sensible, **pro or con**, note about the three choices that relates:
a) reliability
b) easy maintenance
c) robustness
d) value.
Notes must be in non-technical language.
The ideas given in the table are examples, **not** an exhaustive list. Ideas may be worth more than one mark **IF** they are listed under more than one heading.
N.B. Max of 4 **generic** statements. The other **three** notes must make reference to the scenario.

	cable	***wifi***	***combination***
reliable	P. Not prone to interference. Can reach difficult areas for wifi such as cellars C. No obvious cons, but allow sensible ideas	P. No obvious pros, but allow sensible ideas C. Interference can be a problem. signals to cellars may be difficult.	P. Cable to outlying areas can reduce interference or signal problems. C. Each extra connection is a potential weak point.
easy to maintain	P. Not much to go wrong with a cable C. Possible problems with outdoor areas, buried / elevated cables	P. WiFi links only need maintaining at each end, no physical media to go wrong. C. Wifi devices can be difficult to configure.	P. Cables to outlying areas reduces number of wifi links, less configuration. C. Each extra connection is a potential weak point.
robust	P. Cables can be in armoured ducts. C. No obvious cons, but allow sensible ideas	P. No obvious pros, but allow sensible ideas C. No obvious cons, but allow sensible ideas	P. Cables can be in armoured ducts. Reduces possibility of interference. C. Each extra connection is a potential weak point.
value for money	P. Cable is cheap, should need little maintenance or set-up C. Laying cable may be expensive, e.g. trenches, building alterations.	P. Initial installation could be cheaper than cable. C. Initial investment will probably be higher than cable.	P. Suitable combination can increase reliability, avoid building alterations, reduce configuration problems. C. More complicated may mean more expensive.

Total for technology 8

Network architecture.

1 mark for a sensible, titled diagram of a peer-to-peer arrangement. Only nodes need be shown, hardware should be ignored unless it makes the diagram wrong. Accept a description.

1 mark for a sensible, titled diagram of a server based arrangement. Only nodes need be shown, hardware should be ignored unless it makes the diagram wrong. Accept a description.

1 mark for each sensible, **pro or con**, note about the two choices that relates to:
a) reliability
b) easy maintenance
c) robustness
d) value.
To a **maximum of 4 marks**. Notes must be in non-technical language.
The ideas given in the table are examples, **not** an exhaustive list. Ideas may be worth more than one mark **IF** they are listed under more than one heading.
N.B. Max of **one generic** statement. The other **three** notes must make reference to the scenario.

	peer-to-peer	***server***
reliable	P. or C. An individual mobile device is more prone to breakdown than a server, but only affects one person. P. or C. A new backpack is needed to get a person back into the adventure.	P. Servers are more reliable than mobile devices and can be run 'mirrored' in the control centre. C. A server / power breakdown could shut the whole system down.
easy to maintain	P. Devices tend to be solid state. Reboot or change memory cards should be all that the technician has to do. C. Anything else will need a return to the supplier.	P. It is a single purpose / specialist server, so most problems should be solvable by reloading a disc image. C. Maintenance will take more technician time.
robust	P. Devices tend to be solid state and will be in a protective backpack. C. No obvious cons, but allow sensible ideas	P. and C. No obvious pros or cons, since the server(s) will be looked after in the control centre, not outdoors. Allow sensible ideas.
value for money	P. or C. Depends on the unit cost and number purchased. The mobile device could include the wifi equipment. A simple server machine will probably still be needed in the control room. Allow plausible arguments.	P. or C. Depends on the unit cost and number purchased of the mobile devices. The adventurers will still need to carry wifi equipment which could have been in the mobile device. Allow plausible arguments.

Total for architecture 6

Maximum 24 marks

Activity 2 - Network connectivity and security.

1 mark per point to a maximum of 10

64 bit Wired Equivalent Privacy (**WEP**)	40 bit / 8 ascii / 10 hex key set by user, 24 bit / 3 ascii / 6 hex Initialization vector set by the system
128 bit Wired Equivalent Privacy (**WEP**)	104 bit / 11 ascii / 26 hex key set by user, 24 bit / 3 ascii / 6 hex Initialization vector set by the system

For either 64 or 128.
The key is used to encrypt the text. Transmitter and receiver need to have the same key.

For either 64 or 128
Client must authenticate by returning an encrypted version of a clear text sent by the server, Match allows (encrypted) communication to continue.

wifi Protected Access (**WPA**)	128 bit / 14 ascii / 32 hex key set by user, 48 bit / 6 ascii / 12 hex Initialization vector set by the system

Can use pre-shared key / passphrase where same key is entered onto each device or use a server system giving different keys to each device.

Uses Temporal Key Integrity Protocol (TKIP) where each successive packet has its initialization vector incremented to form a new key

MAC address filtering	A MAC address is a unique (40 bit) address built into a network card

Receivers have a (white) list of MAC address of all devices that are allowed to connect.
OR. Receivers have a (black) list of MAC address of all devices that are not allowed to connect.

Service Set Identifiers (SSID)	A name / ascii string / identifier for a wifi LAN

SSID is broadcast by all access points so that receivers know which networks are in range.

SSID is not a security feature

Recommendations.
1 mark per point to a maximum of 3

Should use WPA

Should be pre-shared key because it saves having to run a (RADIUS) server / only a few devices
OR. Should be server based because it saves setting up each device with a passphrase
Accept other sensible reasons for choice

Should use MAC filtering

Maximum 13 marks

Activity 3 - Components of a network

a) Table of components.

1 mark for each of the **first 4 components** to a maximum of 4. Giving quantity and reason.

1 mark for any other 2 components to a maximum of 2. Giving quantity and reason.

1 mark for a sensible cost for **each** component. Costs shown are **examples only.** They are taken from commercial web sites in Sept 08 with no effort made to 'shop around' or haggle for discounts.

1 mark for a calculation showing a total cost of <=£2500. **Maximum 8 marks**

Component	Quantity and justification	Reason for component	Cost £
PC (plus screen, keyboard etc)	**1 Given in scenario.**	**For monitoring and control of special effects**	**300**
Cable, Cat 5 / 6	**1 reel / 300m /enough for cabling to the areas given. Min 200m**	**Needed to connect the control centre to each area**	**50**
Wifi access points / routers	**minimum 15. (or as justified if still workable) 1 per tower floor, (NOT 1 per tower) plus wood, stable, staff tower.**	**Needed for the link to adventurer packs**	**1200**
Switch, (8 - 16 port)	**minimum 6, control centre, wood, stable, and 3 towers**	**Needed to supply specified extra network connections, plus multiple WAPs in some locations.**	**500**
Conduit (steel)	about 50 metres	Needed to connect control centre to wood	100
Conduit (plastic)	about 150 metres	Protection for cables to the towers	50
patch cables	1 per wifi point + allow extra for spares / connecting other items	to connect wifi points and computers etc. to switches	3 x number of cables
Protective box	minimum 1, for switch in the wood	Outside switch must be protected from weather . animals	50
Other sensible network related components. e.g. RJ45s, repeaters, network sockets.		With plausible number, reason, and cost	

b) Fault tolerance and reliability.

Fault tolerance. Look for the following ideas. **See also** answers under reliability heading

Use of WiFi routers rather than WAPs so that signals can be passed without cable

Siting of WiFi so that coverage overlaps to next point plus one

Siting of WiFi to minimize obstacles to the signal, e.g. place just inside tower windows rather than next to thick walls

Extra WiFi in more exposed / vunerable areas such as the wood

WiFi raised on e.g. wall, tower roof, to cover movement between areas.

WiFi with better signal strength / range, e.g. 11N rather than 11G

Duplicate cables

Any other sensible and workable suggestion

1 mark per workable solution to a maximum of 3 marks

Plan specifically addresses cable failure **and** wifi point failure. 1 mark

Total 4 marks

Contingency plan for improving reliability. Look for the following ideas.

Using WiFi with greater range / signal strength

    to improve overlap in open areas (not in the towers)

Duplication of main area cables

    as hot swap ready **or** as built in fault tolerance

Running cables to each wifi point / network outlet

    reducing number of switches as possible failure points

Duplication of wifi points

    as hot swap ready **or** as built in fault tolerance

Duplication of switches / extra ports

    as hot swap ready **or** as built in fault tolerance

Fitting UPSs / battery back up to each area / standby generator

    to allow for possible (local) power failures **or** as built in fault tolerance

Use good quality **identified** device

    will have longer life / less likely to be damaged **or** as built in fault tolerance

Spare adventurer hardware, gloves, goggles, headsets, linking cables, etc. ready for fast swap.

    minimises loss of player time if spares in game locations / carried by staff, etc.

1 mark for each workable idea, to a maximum of 2

1 mark for each point explaining an idea, to a maximum of 2

1 mark for consideration of cost, showing it is within the £500 limit.

Total 5 marks

N.B. some reliability answers are also allowable as fault tolerance. They may only be credited for one **or** the other.

Activity 3 - total 17 marks

Activity 4 - Network design

A design for the entire LARP system

A network layout diagram in an appropriate format showing the logical layout of the network. The diagram should be comprehensive, showing how each building and area is connected and a minimum of how each room or set of devices is connected. The diagram should show how PCs, switches/hubs, routers, WAPs, and different cable types are used together to create the network. There are many possible configurations for the network and thus any sensible layout is acceptable. The diagram should show all of the areas and separate rooms, but showing a single adventure tower with an indication that it is repeated three times is acceptable..

a) Cabling to wood, stable, 4 towers (understandable, even if otherwise incorrect) 1
b) cable type(s) identified 1
c) switch / hub in each of wood, stable, 3 adventure towers 1
d) cable to 4 rooms in all 3 adventure towers 1
e) wifi in each of wood, stable, staff tower 1
f) wifi in each room of adventure towers 1
g) server (cluster) in control centre 1
h) special effects PC in control centre 1
i) cable from control centre to Dornton Castle LAN 1
j) switch / hub in control centre 1
k) connection to special effects equipment in any area 1
l) connection to transponder (RFID) equipment in any area 1
m) adventurer pack / equipment in any area 1

See illustrative network diagram on the next page.

Notes justifying each major decision made about the network design.

1 mark for each sensible explanation which does not simply describe what is on the diagram.

To a maximum of 6 marks

e.g. Use wifi router = 0
Use WiFi router instead of WAP to give fault tolerance = 1

Put WAP in each room of tower = 0
Put WAP in each room of tower because construction would stop signals travelling very far = 1

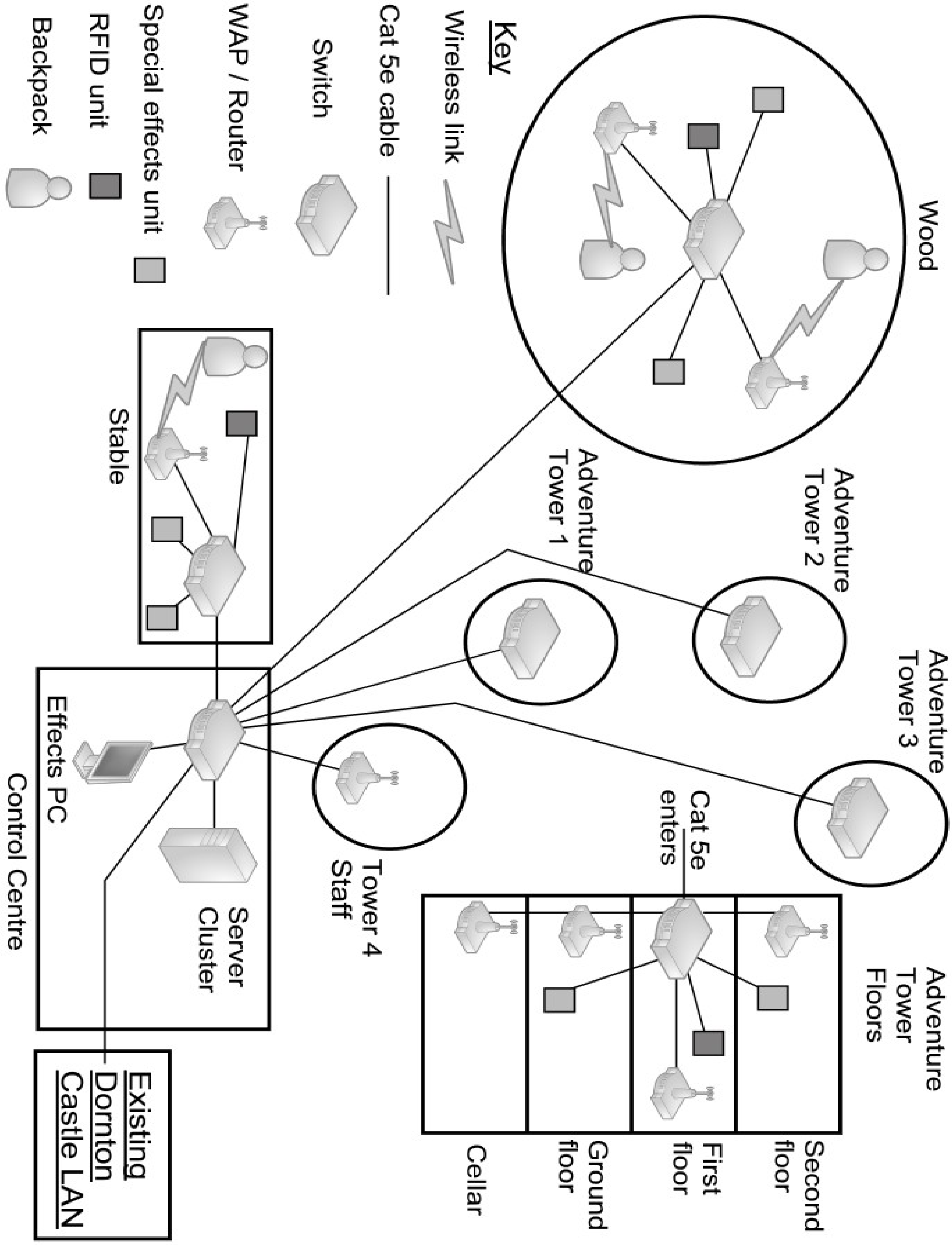
Use 16 port switch in each tower = 0
Use 16 port switch in each tower because each tower needs 8 connections in the room where the cable comes in and an 8 port switch would not leave room for expansion = 1

Put a WiFi point on top of the wall = 0
Put a WiFi point on top of the wall to give coverage between the locations = 1

Total 18 marks

Network Diagram. NOTE. This diagram:

- is **not** the only answer
- is probably not the best answer
- is drawn to illustrate all of the marking points



Activity 5 - Network management

An A4 poster, a flowchart that shows the actions that a staff member should take in the event of a fault.
Examples of flowcharts.

Single item (goggles / glove / headset) fails
Maximum of 10 for single item failing
Identify faulty component
check cable connection at item
fixed? Yes = end
no, check cable connection at backpack
fixed? Yes = end
no, switch pack off and on again
fixed? Yes = end
no, swap item with spare.
fixed? Yes = report damaged item
no, report unsolved problem.

Allow other sensible and relevant actions

All items fail
Maximum of 10 for all items failing
switch pack off and on again
check connections to backpack
fixed? Yes = end
no, check battery connection
fixed? Yes = end
try a different WiFi point
fixed? Yes = report WiFi point problem
no, try a fresh battery
fixed? Yes = put battery on charge / end
no, report unsolved problem.

Allow other sensible and relevant actions

1 mark per item to a maximum of 16

Standard ways of working.

All printouts must have a header and a footer. The header must contain the activity number. The footer must contain your name, candidate number and centre number.

Minimum font size of 10 should be used for all word processed documents.

Total 2 marks

Total for paper 90 marks.

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