BCS THE CHARTERED INSTITUTE FOR IT
BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

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EXAMINERS' REPORT

Computer Networks

General Comments

This session has produced the best performance in the last three years. Reading through the answers, it is clear that a number of students answered sections A and B well. It is also encouraging to note that students did attempt questions seriously, and this has helped them to secure at least average marks in many cases. This is an encouraging sign as the performance indicates that students have prepared well, and it is hoped more will do so in the coming sessions. The purpose of this examiner's report is to help them to prepare well for the examination.

Section A

A1.

Answer Pointers

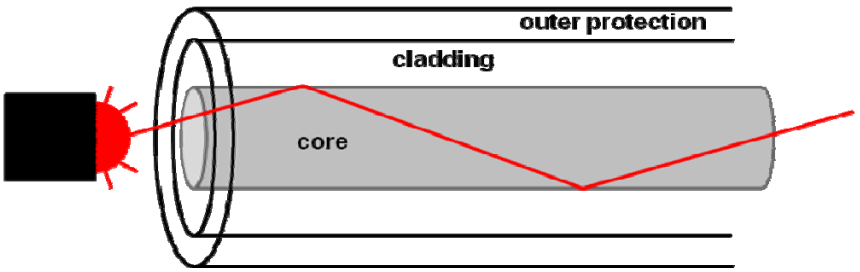
a) Data is transmitted along a fibre optic cable as light using either a laser or LED.

The fibre core is made of a very thin strand of high purity glass.

The fibre core is surrounded by a cladding.

Light entering the core is reflected internally by the cladding and passes along the core with very little loss.

The outer layer simply provides protection for the core and plays no part in the transmission of signals.



Advantages over copper:

The fibre exhibits less loss (attenuation) than copper over the same length.
Fibre has less dispersion (distortion) than copper which allows for higher data rates to be achieved.

Fibre is less prone to external electromagnetic interference than copper and also does not itself generate such interference.

b) Wavelength division multiplexing (WDM) is a technique used in fibre optics in which different wavelengths of light are transmitted along the same fibre. Each wavelength carries its own data stream. In this way multiple data streams are 'multiplexed' over the same fibre at the same time with each stream carrying its own separate data. Therefore the fibre comprises a series of transmission channels. A fibre that uses only one wavelength of light is in effect a single channel and therefore WDM with its multiple channels offers an increase in capacity equal to the number of wavelengths supported.

c) Fibre system uses 16 wavelengths of light. Each wavelength operates at 1Gbps, therefore the total capacity of the fibre is 16Gbps.

16Gbps = 16 x 1024 x 1024 x 1024 (also accept 16 x 1000 x 1000 x 1000)

Telephone call = 64000 bps

Therefore total number of telephone calls = (16 x 1024 x 1024 x 1024) / 64000
= 268,435

(accept 250,000 when 1000 is used instead of 1024)

Examiners' Guidance Notes

This question was attempted by about 70% of the candidates of whom a large proportion (60%) achieved a pass mark. The average mark was only 11 out of 25. The majority of the candidates were familiar with fibre optic transmission systems and managed well in both the theory and practical parts of the question. However, some of the candidates forgot that the each fibre was using 16 wavelengths and failed to adjust their calculations.

A2.

Answer Pointers

a) The Data-Link layer is responsible for:

- Organising the data bits into logical and defined structures known as frames.
- These frames can carry network dependent addressing for point to point communications on a single network, error detection fields for identifying the presence of bit errors, length and control information and data bytes which convey information from the higher layers.
- This layer would also define the access protocols needed to transmit data over the attached media and protocols to achieve the reliable transmission of information between two points.

b) The Network layer is responsible for:

- Providing a global addressing scheme
- Inter-networking which involves the passage of data over multiple networks of differing technologies
- Traffic routing which ensures that data is delivered to a specified destination address
- Error detection and packet fragmentation

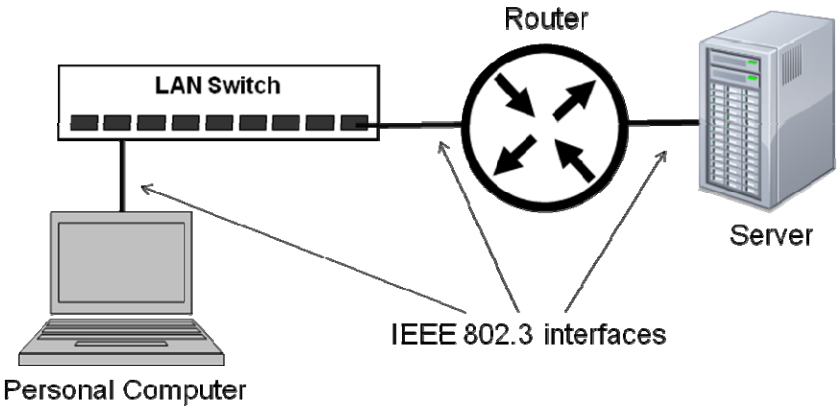
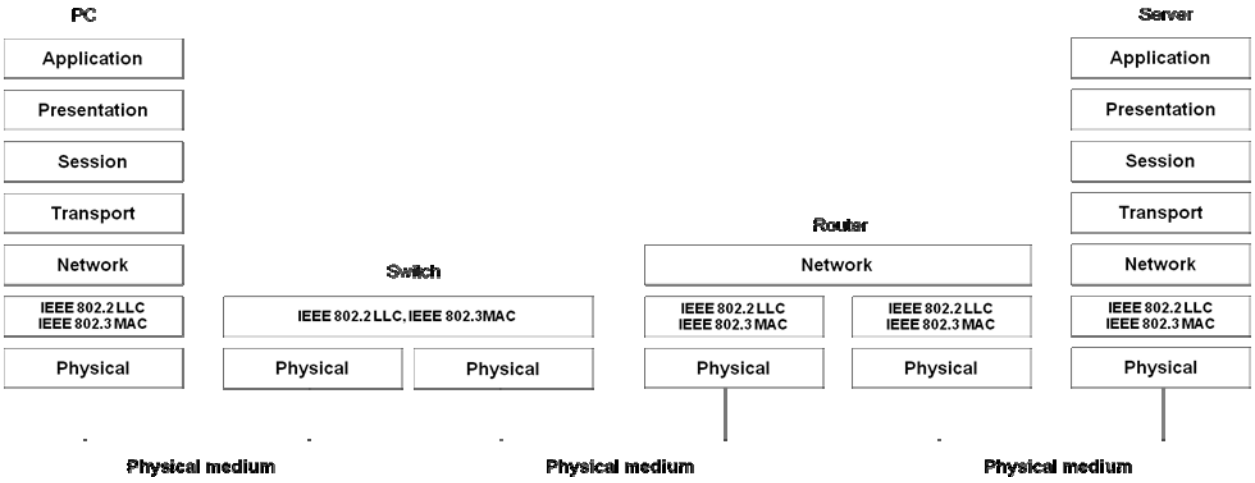


Figure x

Protocol layer diagram:



Examiners' Guidance Notes

This question was attempted by the largest proportion of candidates (88%) that attempted Section A. Two thirds of the candidates (67%) achieved a pass mark and about 25% of them achieved a high grade. The candidates were well prepared on the OSI reference model and answered correctly part a. However, responses to part b varied as candidates in some centres did not know the difference between a switch and a router and how they operate within the OSI reference model.

A3.

Answer Pointers

a) TCP
TCP operates above IP and provides a connection orientated service in which end to end data transfer is guaranteed with flow control and congestion avoidance capabilities. It is a reliable service.

UDP
UDP operates above IP and provides a connectionless, unacknowledged service to the upper layers. There is no error detection or recovery and no flow control provided by UDP. It is a best effort service.

b) i) This should be TCP
The reason is that you want a file to be transmitted in its entirety without any errors, therefore the error detection and correction properties of TCP are needed.

ii) This should be UDP.
The reason is that when watching a movie, delay is critical and therefore there simply isn't any time to seek the retransmission of any errors. The simplicity of UDP is therefore required.

iii) This should be TCP
The reason is that web pages need to be delivered without error so that all content is properly formatted and presented. Therefore the error detection and correction properties of TCP are needed.

iv) This should be UDP.
The reason is that a telephone conversation has strict timing requirements for the transfer of data and seeking the retransmission of any errors would introduce too much delay. Therefore the simplicity of UDP is needed.

c) Both TCP and UDP provide services to higher layer protocols however multiple higher layer protocols can be multiplexed onto a single UDP or TCP layer. Each of these higher layer protocols are then differentiated by means of UDP/TCP port numbers. Port numbers are 16 bits in length. Therefore the port number identifies the particular higher layer protocol to which a given data stream is destined.

Examiners' Guidance Notes

This question was attempted by about 77% of the candidates of whom less than half (48%) achieved a pass mark. The average mark was 9 out of 25, while many candidates received less than a mark of 4. Candidates made an attempt to correctly answer part a to distinguish the QoS differences between TCP and UDP. However, responses to part b were mostly guessing attempts. Part c was poorly answered, indicating that the candidates did not have a clear understanding of the purpose of ports.

Section B

B4.

Answer Pointers

a). The term “best effort network” means a network that makes reasonable efforts to deliver traffic but promises no guarantees (2). Standard internet links and routers have limited resources, not infinitive and make no attempt to prioritize traffic (2). The nature of the Internet is that traffic may be delivered in the wrong order (2). Thus all traffic is treated equally and if resources become consumed e.g. buffers become full or traffic volumes exceed raw capacity then information has to be discarded (2). Other issues could be raised and will be rewarded if appropriate. The total mark for this part of the question will be capped at 8.

b). The QoS needs are summarized by the following issues. Traffic for IP Video conferencing needs to be delivered in order (2) with relatively low delay (2) and the delay variation (jitter) needs to be low (2). Videoconferencing will generate medium to high levels of traffic, 64kbps -> 2mbps, and so routers and links need to be able this level of traffic(2). Other issues could be raised and will be rewarded if appropriate. The total mark for this part of the question will be capped at 8.

c). There are many issues that could be raised, students are not expected to identify them all. The key issue is that routers need to have multiple traffic queues (2) and ways to decide which queue traffic should enter each queue (2) and the order in which traffic is taken out of the various queues and sent out of interfaces (2). Traffic needs to be marked in some manner to indicate which queue should be used (2). The total traffic levels for each queue needs to be policed to make sure it remains with acceptable levels (2) and discarded (2) or remarked (2) if it exceeds planned levels. Other issues could be raised and will be rewarded if appropriate. The total mark for this part of the question will be capped at 9.

Examiners' Guidance Notes

This question was attempted by about 50% of the candidates of whom 33% achieved a pass mark. The marks gained covered a wide range.

Some answers were unclear in the choice of words. For example, some candidates said that various QoS parameters were important (e.g. jitter) but they did not make it clear whether jitter needed to be a low value or a high value (it should be low of course). Many candidates were not really aware of the needs of services such as videoconferencing or perhaps made extreme remarks about appropriate QoS parameters. For part c, the key issue is that the router must have multiple queues so as to enable some traffic to be held in lower priority queues while more important traffic is placed in higher priority queues.

B5.

Answer Pointers

a). An infrastructure Wireless LAN is a WLAN that has an Access Point (or several) as the central piece of equipment (1). The data between all other stations in the network has to pass via the access point (1). The access point also implements the central component of any network security (1). The Access Point is of course also involved in the various media access control procedures (1).

In contrast, an Ad-Hoc wireless network is one formed without the use of access points (1) and is a connection directly formed between two wireless stations (1). It thus provides direct connectivity between only two systems (1). The presence or absence of security depends on settings of the end stations alone (1).

b). There are many relevant points a candidate might raise in this answer; students are only expected to identify ten issues to gain full marks for this section. This issue, also called the “hidden station problem” is caused when some stations are not heard by all the others (1). The physical spread of the nodes around the access point may be such that while they are all in signal reach of the access point (1) they are a relatively long way away from it. This can mean that stations may not be in direct range of other stations at the far side of the access point (1). This leads to a variety of problems but in essence, stations transmit over the signals of other stations (1) causing signal and thus data corruption (1). The normal approach to solving this problem is that when a station with traffic to transmit first senses the media, and if it appears free (1) it transmits a very short request-to-send (RTS) frame (1). This will get received by an intended intermediate destination (typically the access point) (1). In response a clear-to-send frame is sent (1) and because this has come from the access point, it will be received by all stations (1). They will then note that they cannot use the airwaves for the time noted in the CTS (1) and they will thus not transmit over another station's data traffic even if they can’t hear it (1). Any other relevant remarks will be rewarded with the overall mark capped at 10.

c). The frequencies used are those normally referred to as “microwave” (1). Almost all current usage is around 2.4Ghz (1) or 5.8 GHz (1) although the standard does also include infrared (1). A lot of other types of equipment use these frequency bands including microwave ovens (1), cordless phones (1) and radars (1). In many countries, some of the frequencies also specified for unlicensed ISM (industrial, scientific and medical) equipment (1). Any other relevant remarks will be rewarded with the overall mark capped at 7.

Examiners' Guidance Notes

This question was attempted by only about 32% of the candidates of whom 28% achieved a pass mark. While a small numbers of very good quality answers, some gaining nearly full marks were submitted, many answers were fairly weak.

Some candidates exhibited a poor understanding of the difference between ad-hoc and infrastructure modes of operation. Some answers showed a good understanding of the issues in part b), but many missed the point and talked about nodes trying to spy on traffic; an important issue but not the one relevant to part b. Those that attempted part c) generally gave a reasonable answer.

B6.

Answer Pointers

a). Many things could be raised here; candidates only need locate five main issues to gain full marks for this section. One key aspect of the building A is the presence of the main computer room which contains a variety of servers (1). The server computers are clearly fixed in location so a cabled network is appropriate (1). Being high performance servers, a 1gbps (or perhaps even 10gbps) network would be appropriate (1). We are are also told that external access is required to the web servers, but this issue will be covered in the answer to part d). We are also told that the building contains the offices of the development staff and that they have high performance computers exchanging large amounts of data with the servers – they should have 1gbps connections too (1). We are not given numbers of servers or development workers but network switches should be purchased with sufficient capacity to connect all existing computer and with a reasonable allowance for future changes (2). Other relevant remarks rewarded with the total mark capped to 5.

b). The key issue here is the fixed location, low performance desktop computers (1). Clearly a cabled network should be deployed (1) and this could be 100mbps or a 1gbs network (1). Considering the size of the building, a single Ethernet switch could be installed near the centre (1) and all computers cabled back to that (1). Other relevant remarks rewarded with the total mark capped to 5.

c). The nature of the space in building C will lead to most computing usage being laptop, tablet or other mobile devices (1). Clearly a wireless network should be deployed (1). Given that there are multiple rooms and other spaces it would seem that multiple WLAN access points will be needed (1). Some sort of cabled connection will be needed to interlink the Access Points (1). We are asked to consider how access can be provided to visitors without compromising security. This will best be achieved by using Virtual LANs (VLANs) (1). The access points would be provided with multiple SSIDs (1), which would have different passwords (1). Visitors would only be allowed to connect to the visitor SSID VLANs which would then be carried back using VLANS over cabled connections to the company's Internet router (1). Other relevant remarks rewarded with the total mark capped to 8.

d). Various issues here and several options are possible; candidates should identify 7 relevant issues to gain full marks for this section. The buildings are all on a new industrial estate and within 40 meters of each other. The use of copper technologies to interlink the buildings is not really recommended (1) but might be possible as we know the estate has ducting installed (1). The use of fibre optic cabling is the recommended guided media (1). Such fibre is now NOT expensive (1) and fibre interfaces to network switches are not expensive (1). The closenest of the buildings does also mean that Wireless technology could be used (1), perhaps WLAN equipment with directional antennas (1). Clearly, the connectivity should eventually be back to the central computer room (1). The scenario talks about the public having access to the web servers and so a router (1) and a high performance Internet connection (1) will be required. Visitors using the Visitor VLAN also need access out via the Internet router (1). Firewalls could be discussed too (1). Candidates should NOT be nominating ADSL connections for the main internet link as their asymmetric nature makes them inappropriate. Other relevant remarks rewarded with the total mark capped to 7.

Examiners' Guidance Notes

This is currently old comments. This question was attempted by about 82% of the candidates of which a very pleasing 75% achieved a pass mark.

A large number of good quality answers were submitted, and only a small number of poor answers.

There were a few common problems. Candidates should NOT believe that all wireless access point are always routers as well, this is simply not true. A small number of candidates proposed a WLAN as being the correct solution for part a) but that is not really appropriate. There seemed to be a large confusion in terminology/abbreviations in many answers. WLAN is normally used for Wireless Local Area Network and WAN for Wide Area Network. A significant number of answers may have confused WLAN and WAN. Some candidates proposed copper co-axial cabling which is really not used at all in modern deployments. It is important to know how a co-axial cable Ethernet functions to answer theoretical questions that we might set, but it is unlikely to be the correct answer for a modern deployment. Many candidates confused megabit and megabyte in answers. Some candidates also misread the scenario which clearly says that "underground cable ducts" exist, it did *not* say that cables were already installed in those ducts.