Computer Networks – Theory Worksheet

2024 A Leve Paper 1

6 A company has multiple offices and a head office. Alice and Bob work at different offices and can both access the company email system and intranet that are hosted at the company head office. The company has a client-server architecture.

(a) Describe the term client-server architecture. [2]

(b) Describe the term intranet. [2]

(c) The company email server uses the SMTP protocol and its intranet is accessed using the HTTPS protocol.

Explain why networking protocols are required. [2]

(d) Alice is transmitting a document to Bob as an email attachment. Alice has signed the document with a digital signature.

(i) Explain the purpose of a digital signature. [2]

(ii) Explain how a digital signature is generated and sent to the receiver. [3]

(e) Eve has intercepted Alice's transmission and has modified the document.

Explain how Bob will know that Alice's original document has been intercepted and modified. [4]

2023 A Level Paper 1

5 Jeffrey is sending a message to Kim over a network using a network application. A digital signature is sent with the message.

(a) **(i)** Explain how Jeffrey's network application creates a digital signature. [2]

(ii) Explain how the digital signature is authenticated by Kim's network application. [3]

(b) Internet protocol (IP) is used to route packets of data towards their destination. The internet is a packet-switching network.

When a host is connected to the internet it needs an IP address.

(i) State the format of an IPv4 address. [1]

(ii) State **two** ways that a host can be allocated an IP address. [2]

(iii) Explain what is meant by a packet-switching network. [2]

(iv) Describe the role of a router in a packet-switching network. [2]

Jeffrey's message is transmitted using UTF-8 encoding. UTF-8 is a Unicode standard.

(c) The letter M is encoded by the hexadecimal value 4D.

(i) Calculate the denary base-10 value of 4D. [1]

(ii) Give the binary representation of 4D. [1]

(iii) Explain **one** advantage of using UTF-8 encoding rather than using ASCII. [2]

2022 A Level Paper 1

7 **(a)** Data transmitted across the internet is divided into sequentially numbered packets.

(i) Explain why transmitted data is divided into packets. [2]

(ii) Explain why the packets are sequentially numbered. [2]

(iii) State **two** items, other than the packet number, that are stored in the packet header. [2]

(b) Explain why protocols are required to enable reliable communication over the internet. [2]

(c) A router is a device that allows the connection of a LAN to the internet.

Explain how the router directs arriving data packets to the correct device on the LAN. [2]

(d) A firewall is often placed between a LAN and the internet.

Explain how a firewall can provide security to the LAN. [2]

2021 A Level Paper 1 (CLT Question)

3 **(a)** Explain how a denial of service (DOS) attack can compromise an internet server. [2]

A news website posts an article that attracts unusually large worldwide attention. The monitoring software, running on the news website server, warns the system administrator that the site might be the victim of a denial of service attack.

(b) State **two** reasons why the monitoring software generates the warning. [2]

A server connected to the internet provides web hosting, file transfer and email services. Clients send requests to this server using an internet protocol.

(c) Explain how requests arriving at this server are handled. [2]

A firewall is placed between the internet and the server.

(d) Explain how the firewall may manage traffic between the server and the internet. [2]

(e) Describe how a digital signature can be used to give confidence that a received message has not been altered. [6]

(f) State **two** authentication techniques to limit access to a network application. [2]

2020 A Level Paper 1

4 A computer on LAN A wants to send data to a computer on a remote LAN B.

The internet is used to provide a data path between the two LANs.

(a) (i) State **two** ways that a particular device can be identified on a LAN. [2]

(ii) State **two** reasons why LANs need communication protocols. [2]

IP is the protocol used to transfer packets of data between hosts and routers on the internet.

The internet is a packet-switched network.

(b) (i) Explain the term **packet-switching**. [3]

(ii) Describe a disadvantage of packet-switching and how the problem can be handled. [3]

(iii) State how a packet-switched network can cope with a broken cable on part of the network. [2]

When using a web browser, most users do not know the IP address of the server hosting the desired web page. So users enter the domain name instead, which the browser sends to a local domain name server (DNS).

(c) Describe the actions that would be carried out by the local DNS on receiving this request. [4]

(d) State the security feature that can be used as a precautionary measure when sensitive data is sent across a network in each of the following situations:

(i) No one other than the intended recipient of the message should be able to read it. [1]

(ii) The intended recipient must be confident that the message is from the identified sender. [1]

2013 A-Level – Paper 2 – Question 1

1 A dental practice currently uses a computer system to store details of its patients, staff and appointments in separate files.

The practice manager and the receptionist have their own computers for accessing and updating the files.

The system produces a small number of reports.

An updated system is to be produced by a software company. The updated system will use a database. In the updated system the dentists will be given a hand-held device to use in their rooms for accessing and updating the patient records. The new system will also be capable of producing additional reports.

The software company has software engineers who have expert skills in specific areas of software development. A number of the engineers will be involved in the development of the updated system.

The hand-held devices the dentists use in their practice rooms will be networked. Both client-side scripting and server-side scripting will be used in the new software which is produced. An intranet with a web server will be created. Web browsers will be used on the hand-held devices.

(g) Describe three possible uses of the device. [6]

(h) For each scripting method, client-side scripting and server-side scripting, give an appropriate example. Justify your response. [4]

2013 A-Level – Paper 2 – Question 4

4 A software development company currently hosts its own email server. The company is considering a replacement webmail service, using cloud computing.

(a) State two advantages of this change. [2]

(b) State one disadvantage of this change. [1]

(c) Describe an example of how employees of the company may use the cloud to work collaboratively. [3]

(d) Describe how the cloud can be beneficial to the company when developing new software for a client. [4]

2014 A-Level – Paper 2 – Question 1

1 A supermarket chain wants to encourage customers to return to its store. They operate a scheme of rewards for customers based on how much they spend over a period of time.

Customers are issued with a card that is readable by a Point of Sale (POS) terminal. When a customer provides their card at the checkout, the system identifies them and stores the products they purchased and how much they spent.

Currently the only use of this data is to issue the customer with vouchers every three months. Vouchers have a value based on the total amount the customer has spent during the previous three months. The vouchers can only be used in part payment for goods bought the supermarket.

The supermarket managers want to make more use of the customer purchase data. They hire a software development company to produce software that will implement new uses of data.

Software developers have skills in developing software. The supermarket managers have in depth knowledge of their business. At first, software developers will have little knowledge of the business.

Management staff can already access the company network remotely for other software applications. Management are to be given the facility to access, and interact with, the customer data Via the company LAN. However, a decision is made not to allow access to the customer data remotely for this updated system.

(f) Describe **two** methods which can be used to ensure that there is no remote access to customer data by management staff. [4]

In the new system, customers will have access to information through a web browser. Each customer will be able to see some information about their purchase history.

(g) Explain what software needs to be developed to provide this customer facility. [5]

(h) One of the software developers has the task of ensuring that social issues are considered.

This developer has to document these issues.

Describe **two** issues that might be in the document with regard to customers accessing their data. [4]

2014 A-Level – Paper 2 – Question 4

4 A small local area network (LAN) in a school consists of one switch, one file server and ten computers.

(a) Explain why circuit switching could be used in this LAN. [2]

The network has a connection to the Internet added.

(b) Explain how packet switching is used when a web page is downloaded from the Internet. [3]

A packet from the web server consists of 256 bytes. One of the bytes is the checksum byte.

In each byte one bit is the parity bit.

(c) If the byte 0 0 1 1 0 1 0 1 results in a parity error, state the type of parity being used. [1]

(d) The receiving computer uses the checksum byte to check whether the packet contains an error. Explain how it does this. [4]

2015 A-Level – Paper 2 – Question 1

1 The management of a university is keen to implement changes which will result in higher student attainment. The management believes this is possible if it collects more data about its students which is then analysed.

Possible data that might be collected includes: assignment grades, books taken out of the library, attendance at lectures, attendance at tutorials, meetings with personal tutor, email exchanges with university staff, and participation in sporting and cultural activities.

University staff are classified as either academic or management. All data about students will be available to academic staff for viewing and editing. Summary information, which does not identify any individual student, will be viewable by some management staff. Students have no access to the data.

A project working party is to be set up consisting of representatives from across the university. The working party will define the scope of the project. It will consider what data is to be collected. It will also decide what the data is to be used for and consider any potential further use of the data.

If this project has a successful outcome, the university will market its expertise to other universities.

Output from the system is made available to permitted staff via the university intranet. However, the university intranet can be accessed by all students and staff, both locally and remotely, via the Internet. The system needs security measures to prevent all types of unauthorised access.

(g) Describe **two** suitable physical security measures that could be adopted. [4]

(h) Describe **two** suitable software security measures that could be adopted. [4]

Following the success of the project, management decides that the software system will be marketed to other universities.

(i) Explain how the university's investment in the software can be legally protected. [2]

2016 A-Level – Paper 2 – Question 1

1 Many elderly people spend later life in a nursing home. The Ministry of Health (MOH) requires each nursing home to keep detailed care records for each resident. Care staff make daily entries in the care records about all aspects of resident care. These care records are currently paper-based documents. There is no common format for the documents that different nursing homes use.

Care staff do not have computer access to medical records that each resident's doctor holds. Nurses at a nursing home need to keep their own medical records and to consult with residents' doctors.

The MOH is planning an initiative to computerise all care records and would like all nursing homes to use a common design for care records.

The MOH will send a project proposal which is to be circulated to all nursing homes. This is to find out which homes would consider taking part in a pilot project. The MOH's aim is to introduce a pilot system into a single nursing home.

The MOH needs to find a software house to design and implement the computerised care record system. It will send the project proposal to software houses.

At a later date, all nursing homes will use the new computer system.

(f) When the analysis stage was completed, the following decisions were taken:

- Each nursing home will store and manage its own care records data.
- Each nursing home will be provided with a local area network (LAN).
- The care record system on each LAN will use a client-server model with a web interface for client computers.

(i) Explain the meaning of the term client-server model. [3]

(ii) State the **two** items of software that the LAN will use to implement this client-server design. [2]

During the presentation event to doctors (part of activity D), the doctors gave feedback. They said that they would like to have access to the new computerised care records from their own offices.

(g) A second phase of the project is to allow each nursing home access to the medical data stored by doctors. This will involve connecting the LAN for each nursing home to a number of doctors' surgery LANs.

(i) State **two** methods for ensuring the security of access to the care record network application. [2]

(ii) Give **two** methods for protecting the security of the LAN. [2]

2017 A-Level – Paper 2 – Question 2

2 A multinational company has many local branches in various parts of the country that are linked using a wide area network (WAN).

(a) The company's network transfers data using asynchronous data transmission.

(i) State which of the following diagrams represents asynchronous data transmission. Explain your answer. [2]

Diagram A

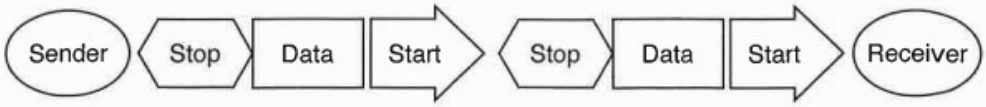
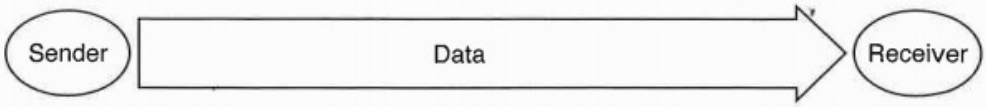
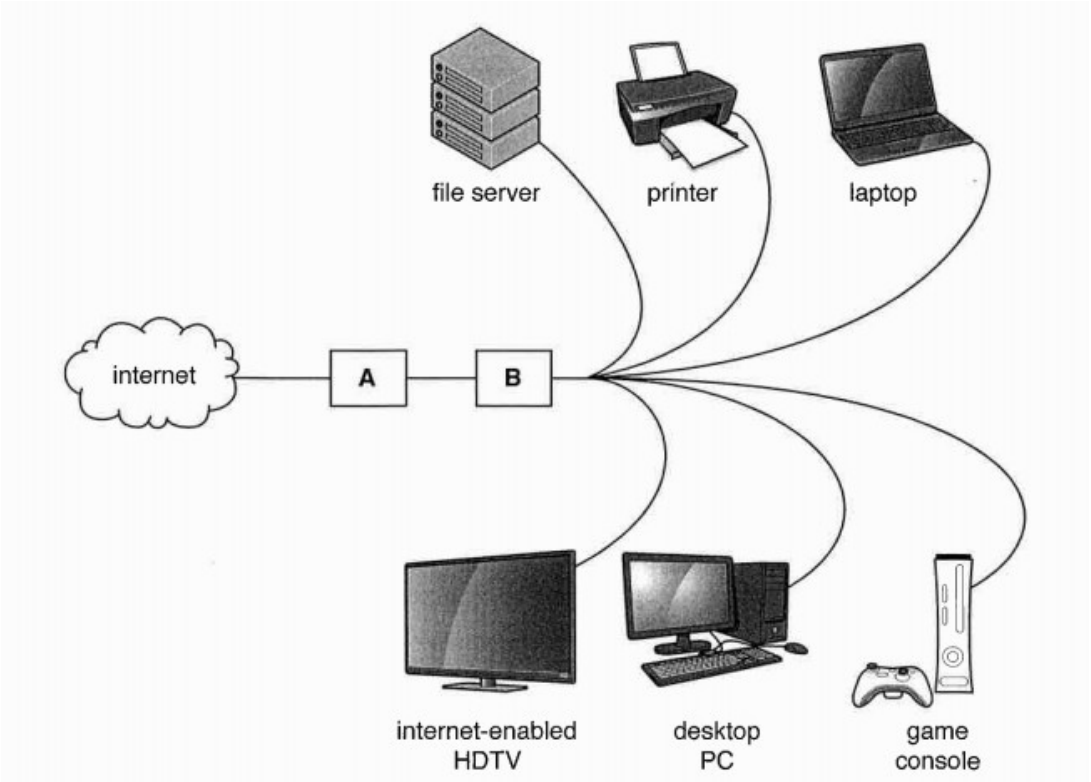


Diagram B



(ii) Explain why asynchronous data transmission affects network performance. [2]

An employee works from home on her wireless laptop. The following diagram shows the configuration of the employee's home network.



(b) This network uses both a switch and a router to transfer data. State which of the pieces of equipment labelled **A** and **B** is the switch. Explain your answer. [2]

(c) Describe **two** features of a router. [2]

(d) Describe **one** advantage and **one** disadvantage, for the employee, of working from home. [2]

2017 A-Level – Paper 2 – Question 4

4 **(a)** A local area network (LAN) can be set up as either client-server or peer-to-peer.

(i) State where data are stored on a client-server network. [1]

(ii) State where data are stored on a peer-to-peer network. [1]

(iii) Describe **one** benefit of a client-server network over a peer-to-peer network. [2]

(iv) Describe **one** drawback of a client-server network compared to a peer-to-peer network. [2]

(b) A college has five IT rooms. Each room has 20 computers which can only print to a single printer in the room. At busy times in the year, there can be up to 100 students printing their coursework at the same time.

Explain how all these print jobs are controlled and sent to the printer. [2]

(c) A 30 megabyte file is transferred over a network to a printer in 5 seconds.

Calculate the transfer rate, in megabits per second, used to transfer this file. Show all of your working. [2]

2018 A-Level Paper 2

4 A university allows students to access the university network from home.

(a) The university server has a firewall.

Describe **two** ways that a firewall can be used to block unauthorised access to the network. [2]

(b) The university wishes to restrict access to inappropriate websites from within its network.

Describe **two** methods that could be used to restrict access to inappropriate websites. [4]

(c) The university is concerned about the possible loss of data from their local servers.

Describe a strategy that could be used to prevent data loss. [2]

(d) The university has its own intranet.

Describe **two** benefits that the intranet might provide for students. [2]

2019 A-Level paper 2

6 Data communication networks can use circuit switching or packet switching.

(a) (i) Give **two** advantages of packet switching over circuit switching. [2]

(ii) Give **one** advantage of circuit switching over packet switching. [1]

(b) (i) State **one** reason for using either a parity check or a checksum. [1]

(ii) Give **one** example of an error that a parity check cannot detect. [1]

(c) Switches and routers are common devices used in networking.

Explain the most significant differences between a switch and a router. [2]

(d) Explain the purpose of a bridge in a network. [1]

(e) A local area network (LAN) can be set up as either client-server or peer-to-peer.

Give **two** advantages in storing shared data on a client-server network rather than on a peer-to-peer network. [2]