

A2 MODULE 5 (ICT5) 14.4 COMMUNICATION AND INFORMATION SYSTEMS

- Describe the use of networked systems for various applications. (Chapter 58)

local

wide area

public

Describe network topologies:

bus

ring

star

backbone

repeater

bridge

- Describe the network infrastructure required to support the World Wide Web e.g. the role of routers and servers.

Applications of communication and information systems (Chapter 58)

- Select and justify an appropriate networked system for a particular application.

Distributed systems (Chapter 58)

- Understand that distribution can apply to both data and control.
- Describe the uses of distributed databases and understand the advantages and limitations of such distribution.

Client/Server systems

- Describe the concept of a client/server database.
- Recall the relevant advantages of a client/server database over a non-client/server database.

server based

peer to peer.

Centralised Processing Systems

Until the 1970s, organisations used centralised systems where all processing was done by a central mainframe. "Dumb Terminals" (machines with no processor of their own) allowed users access to the mainframe.

Centralised processing still exists e.g. ATMs and airline booking systems, still exist. See the diagram P.314

Dispersed Systems P 314

Because the price of hardware has fallen, it has become more cost-effective to move the processing power to where it is needed, i.e. on desktop machines. Word processing and spreadsheet software has made desktop processing very popular. Standalone machines have now been replaced by networked workstations, to allow data to be shared.

A communication network may be a wide area network (WAN) or a local area network (LAN) or a mixture of both. Some networks are public in which case anyone can use them - usually for a fee or it may be private as would be the case with a company WAN linking branch offices with a central computer.

Thin Client Computing

<http://www.vnunet.com/Analysis/1139792>

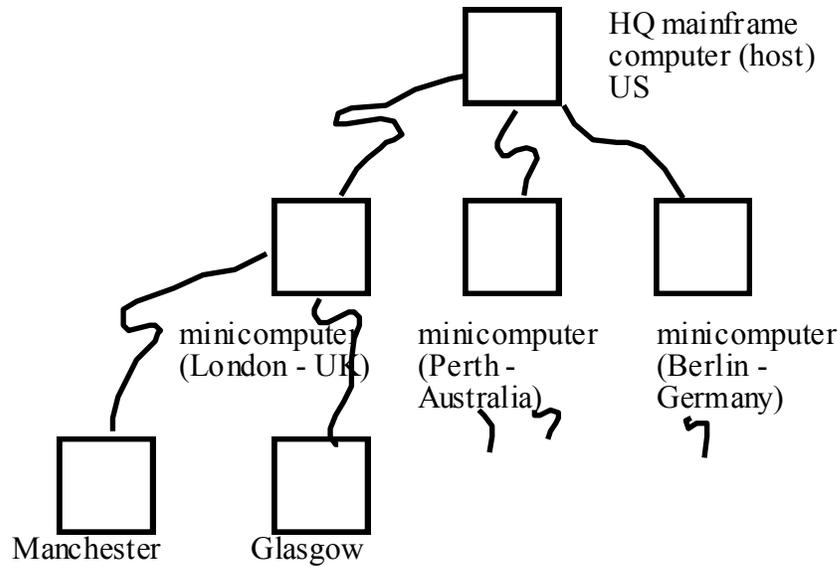
This means having little or no processing power in the client computer. Thin clients are more secure because the user cannot install his own software or introduce viruses. Thin Client networks are easier to administer.

LANs - Local Area Networks (Heathcote p.315)

- A local area network is connected by cable to allow a group of users in a small or limited area, usually within one building or several buildings in close proximity. This is done in order to share data, programs and hardware, users can then buy less hardware and share materials e.g. e-mail, video conferencing, graphics, printers etc.
- The way it is connected is called its **topology**. (Remember bus, ring, star)
- Frequently LANs act as **gateways** hardware and software that gives all network users access to other networks.
- LANs generally have bus or ring topologies and a high bandwidth. (256kps to 100mps).
- Consider Ethernet Cat5, fibre-optics and wireless networks.
- There are LAN versions of many major pieces of software
- A typical LAN Architecture will consist of LAN workstations, network cabling, Servers e.g. File Server, Print Server, Communications Server.
- No telecommunication lines are needed because computers on one site are linked together.
- Files, printers, scanners and disk space can be shared
- Users can communicate using software e.g. Lotus Notes
- Software on the server can be used by anyone
- All users can access the same database
- Backup can be done automatically across the network
- **topology** : The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.
- **protocols** : The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.
- **media** : Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.
- LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distances are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

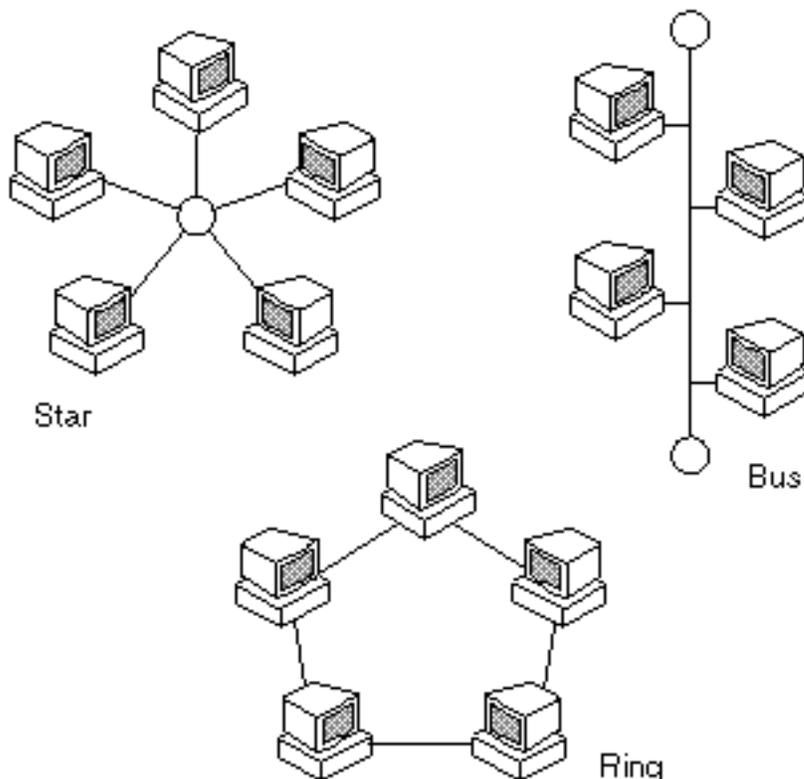
WAN - Wide Area Network (Heathcote p.316)

- A type of private network that uses a series of technologies including phone lines, modems, microwave relaying stations, satellites to connect computers over a wide geographical area
- Digital communication systems will greatly enhance the use of WANs.
- WANs support **distributed processing** where computers are located throughout an organisation to satisfy processing needs. e.g.



Network Topology

Network Topology means the layout or shape of the network. The most common types of network are Ring, Bus and Star.



- The network cable links **nodes**. A node is any element connected to the network that plays some part in making the system work. A file server, a printer server, the interface on a user PC are all network nodes.

- **Bus topology:** All devices are connected to a central cable, called the bus or backbone. Bus networks are relatively inexpensive and easy to install for small networks. Ethernet systems use a bus topology. Advantages are that less cable is needed than token ring, network can be easily extended and that if one section of cable is faulty the network can be shortened and the remaining section used while the fault is repaired. Disadvantage is that behaviour of network under heavy traffic is unpredictable and long delays may occur. A frame will consist of identification of source and destination, data length (variable) and data plus error detection data.
- **Ring topology:** All devices are connected to one another in the shape of a closed loop, so that each device is connected directly to two other devices, one on either side of it. Ring topologies are relatively expensive and difficult to install, but they offer high bandwidth and can span large distances. The most important ring network implementation is the IBM token ring. A token is passed from node to node. A station wanting to transmit data to another station must wait until its interface node receives the token. The data is attached to the token together with the destination and transmitting stations addresses. The token is then passed onto the next node.
- **Star topology:** All devices are connected to a central *hub*. Star networks are relatively easy to install and manage, but bottlenecks can occur because all data must pass through the hub. This was once a common configurations when a central computer was used to link dumb or semi-dumb terminals. It is not often used now but could be used for LAN or WAN networks. It has the advantage that if one cable or node (other than the central node) is faulty then the rest of the network can continue to function.
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Questions

1. What is a node?
2. What is a host computer?
3. Why are star networks very popular in WAN's?
4. What are the main advantages and disadvantages of star networks?
5. Why is a ring network not appropriate for a WAN?
6. What are the main advantages and disadvantages ring networks?
7. What are the main advantages and disadvantages of bus networks?

Network Architecture

To have a client-server network, you need to know about: -

The hardware and software components with name and function including File Server(s).
The ways nodes are connected and communicate with each other e.g. Network Adapter - each workstation needs a network card
Cabling - to physically connect the computers
Network Operating System
Network Accounts - each user has a user ID and password to access their space on the network.
Communications hardware - such as modems and routers, which are responsible for supporting the data transmission

On a single site there may be several LANs in different areas of the building that can be connected using **repeaters**, **backbones** and **bridges**.

The standard cabling used in a bus network is **Ethernet**

10BaseT Standard Ethernet is the same as most telephone cabling and has a transmission rate of 10Mbps.

Using fibre optics cabling, transmission rates of 1.24Gbps can be achieved

Groups of networks can be connected via **repeaters to bridges**, which in turn connect to fibre optic cable, which acts as a **backbone** to the main network controller.

Baseband transmission allows for very fast data transmission but it has one major disadvantage. Electrical pulses flatten out when they travel through a long wire. This, together with other electrical and factors impose a maximum length restriction on LAN's. The maximum length will depend on the type of cable used but it is typically around 1 to 2 km and may be as low as several hundred metres.

Two strategies are used to overcome this length restriction. **Repeaters** can be installed to clean up and boost the signal at various points. This allows a single network to be extended beyond its normal maximum.

An alternative is to install several smaller networks and link them together using a device called a **bridge**. A bridge links two similar networks - usually LAN's so that data can flow between the two. Note that unlike a gateway that provides a link between a LAN and a WAN, a bridge will not need to handle different protocols on either side.

Applications of networks

VAN (value added networks)

Added value includes videotext, e-mail, fax, bulletin boards, specialist databases as well as audio.

Public networks

An open communications method, the network is open for use by anyone.

Public switched telephone network (PSTN)

Short for *Public Switched Telephone Network*, which refers to the international telephone system based on copper wires carrying analog voice data. This is in contrast to newer telephone networks based on digital technologies, such as ISDN and FDDI.

Public switched data network (PSDN) -

- Short for *packet-switched data network*, a data communications network that is based on the principles of packet switching, as opposed to circuit switching that is used in public telephone networks. Packet-switched networks do not establish physical communication channels between communicating devices like circuit-switched networks do. Instead, signals are formed into fixed-length packets that are affixed with a source and destination address and packet ordering details. The packets then rely on network routers to read the address data and route the packets through the network to their destinations. When the packets arrive at the receiving device, the packet ordering data is used to reassemble the original signal. One advantage of packet-switched networks is that packets from different sources going to different destinations can share common data pathways.
- Modems are not required. I.e. A digital network
- Conforms to CCITT protocol known as x25.
- Can be used for international connections

Television and radio broadcasting

Cellular telephone system

EDI (electronic data interchange)

http://www.theedizone.com/edi_resources/edi_qa.html

- Electronic Data Interchange is using networks to transfer forms such as invoices, purchase orders, shipping notices and even payments (Mondex) between computers)
- Consider B2B (Business to Business applications) p.318 example on publisher.

Intranets http://www.painsley.org.uk/webweavinginsc/intranets_toc.htm

- A network based on TCP/IP protocols (an internet) belonging to an organization, usually a corporation, accessible only by the organization's members, employees, or others with authorization. An intranet's Web sites look and act just like any other Web sites, but the *firewall* surrounding an intranet fends off unauthorized access.
- Like the Internet itself, intranets are used to share information. Secure intranets are now the fastest-growing segment of the Internet because they are much less expensive to build and manage than private networks based on proprietary protocols.
- Particularly companies and governments

Gateways <http://shopping.guardian.co.uk/computers/story/0,1587,907985,00.html>

- Software and/or hardware that allows equipment designed for connection to one type of network to work in another. Entire networks are often connected to dissimilar networks using gateways.
- A node on a network that serves as an entrance to another network. In enterprises, the gateway is the computer that routes the traffic from a workstation to the outside network that is serving the Web pages. In homes, the gateway is the ISP that connects the user to the internet.
- In enterprises, the gateway node often acts as a proxy server and a firewall. The gateway is also associated with both a router, which use headers and forwarding tables to determine where packets are sent, and a switch, which provides the actual path for the packet in and out of the gateway.

Interactive Services e.g.

- Electronic bulletin boards
- EFT and Consumer Services
- Information Utilities
- Automatic Tellers (ATM's)
- Computerised Booking

On-line databases

(Remote databases) from modems e.g. Case studies will be provided but you should also collect your own readings on: -

- Financial databases e.g. Stock Exchange
- General Business and Research
- Special Purpose - weather, agriculture etc.
- News Services - Guardian, Times, Reuters (Bibliographic Databases)
- Data trawling
- Yellow Pages (P.318)

Telex, electronic mail, voice mail and fax

EFTPOS and EFT

Teletext and viewdata

Teleconferencing and videoconferencing

General questions

1. What is the difference between interactive and on-line?
2. The psdn is the X25 network. A popular standard for packet-switching networks. The X.25 standard was approved by the CCITT (now the ITU) in 1976. It defines layers 1, 2, and 3 in the OSI Reference Model..

The network infrastructure required to support the World Wide Web p.320

The Internet started life as the ARPANET in 1969 and it consisted of four computers. It now consists of several million computers linked together by cables, wires and satellites. Data travelling from one computer to another is transmitted from one link in the network to another using the best possible route it can find. If some links are out of service, the data will be routed through different links. The major communication links that for the Internet are called the "backbone". A handful of network service providers (NSPs) e.g. BT, maintain a series of nationwide links. More links are being added as Internet use increases.

Unlike online services, which are centrally controlled, the Internet is decentralized by design. Each Internet computer, called a *host*, is independent. Its operators can choose which Internet services to use and which local services to make available to the global Internet community. Remarkably, this anarchy by design works exceedingly well.

The Internet is **not** synonymous with *World Wide Web*.

www.webopedia.com/DidYouKnow/Internet/2002/Web_vs_Internet.asp

There are a variety of ways to access the Internet. Most online services, such as America Online, offer access to some Internet services. It is also possible to gain access through a commercial Internet Service Provider (ISP).

Internet Service Provider, a company that provides access to the Internet. For a monthly fee, the service provider gives you a software package, username, password and access phone number. Equipped with a modem, you can then log on to the Internet and browse the World Wide Web and USENET, and send and receive e-mail.

A home computer user connects to the Internet through an ISP, which is connected to an NSP.

The World Wide Web

A system of Internet servers that support specially formatted documents. The documents are formatted in a script called HTML (*HyperText Markup Language*) that supports links to other documents, as well as graphics, audio, and video files. This means you can jump from one document to another simply by clicking on hot spots. Not all Internet servers are part of the World Wide Web.

Internet Backbone

the main network connections composing the Internet.

Network Service Provider

A company that provides Internet access to ISPs. Sometimes called *backbone providers*, NSPs offer direct access to the Internet backbone and the Network Access Points (NAPs). What does a browser do?

Web Browser

A software application used to locate and display Web pages. The two most popular browsers are Netscape Navigator and Microsoft Internet Explorer. Both of these are *graphical browsers*, which means that they can display graphics as well as text. In addition, most modern browsers can present multimedia information, including sound and video, though they require plug-ins for some formats.

Java

Java is a general purpose programming language with a number of features that make the language well suited for use on the World Wide Web. Small Java applications are called Java applets and can be downloaded from a Web server and run on your computer by a Java-compatible Web browser, such as Netscape Navigator or Microsoft Internet Explorer.

Who are the major service providers in the UK?

Compare the speed of current communication links.

A global network connecting millions of computers. More than 100 countries are linked into exchanges of data, news and opinions.

Distributed Databases (p.316-318) www.computing.surrey.ac.uk/personal/st/D.Barton/CS363/2-DistribDB-4up.pdf (Pdf file)

- Distributed systems may contain a number of separate but connected processors, although some centralised processing is possible. Read Heathcote and be able to explain the difference between centralised and distributed computing.
- Files and programs need not be held centrally in a distributed system - functions can be passed onto regional centres e.g. Police
- Be aware of examples where data is distributed
- Be aware of examples where control within the database (different functions) are distributed
- Initially distributed systems still maintained a single central database. However the use of distributed data soon developed since otherwise a large amount of data needed to be moved through the network and a mainframe or telecommunications failure isolated the local processor from the data that it needed.
- A distributed database is a database that consists of two or more data files located at different sites on the network. Because the database is distributed, different users can access it without interfering with one another. However, the scattered data must be periodically synchronised to ensure data consistency.

Local systems often store local databases but will still have access to a central online database. This central database can be accessed remotely or it can be held on local machines. A system is needed, therefore, to ensure that data integrity is maintained by ensuring the database is updated. This means that computers have their own processing capabilities rather than all computers using a mainframe.

See case study p. 316-317

A distributed database is one that is held in several locations. There are three methods of achieving this:

1. Each remote processor has data on its own customers, stock, etc. The database is uploaded each night and changes made.
2. The entire database is duplicated at the remote site. The database is uploaded each night and changes made.
3. The central database contains only an index of entries. The actual records are held at the remote site. A query to the central database will locate where the record is held. This system is used by very large databases.

Distributed processing is growing rapidly because speed of processing at local sites is increased. The drawbacks are security concerns and the need to maintain data integrity.

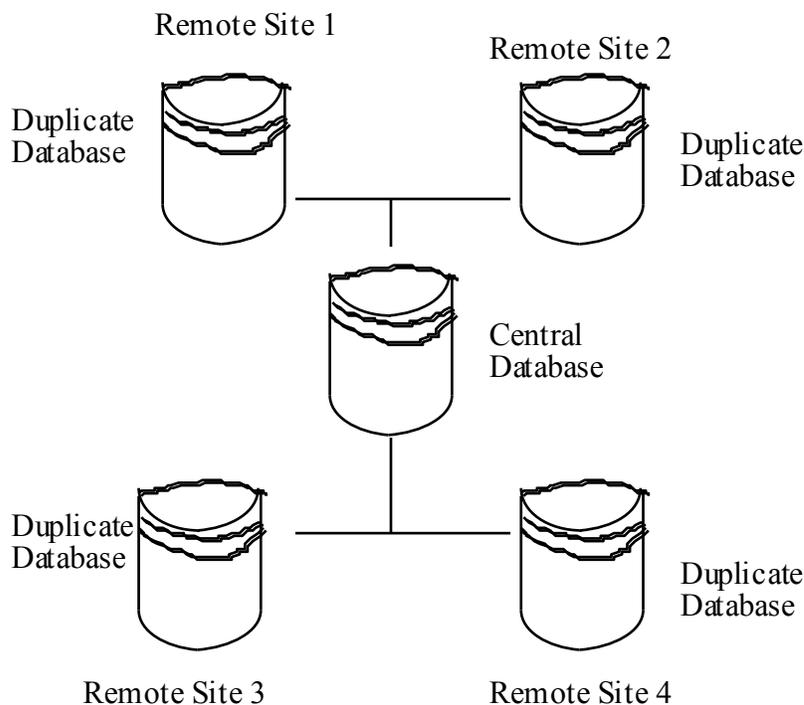
Advantages of distributed databases (p.318)

1. Provide faster response times and service at each location.
2. Reduce the vulnerability of putting all essential data at one site
3. Faster response to local queries
4. Reduction in amount of network traffic
5. Effect of breakdowns is minimised
6. Better local control over the system
7. Less powerful cheaper processors needed

Limitations of distributed databases

1. Security - dependence on telecommunications links and widened access to sensitive data.
2. Increase data redundancy especially if a replicated database is chosen. Inconsistencies can easily arise between central and local systems, especially if changes to the data not immediately updated by the other.
3. Increased tendency to data redundancy and data inconsistency.
4. System is dependent on high quality telecommunication lines, which may be vulnerable.
5. Need to maintain and enforce consistent standards and data definitions over a wide area.
6. Increased security problems - need to enforce security procedures over wider area plus increased problems over data transmission.

TAKE NOTE OF THE FOLLOWING TWO MODELS

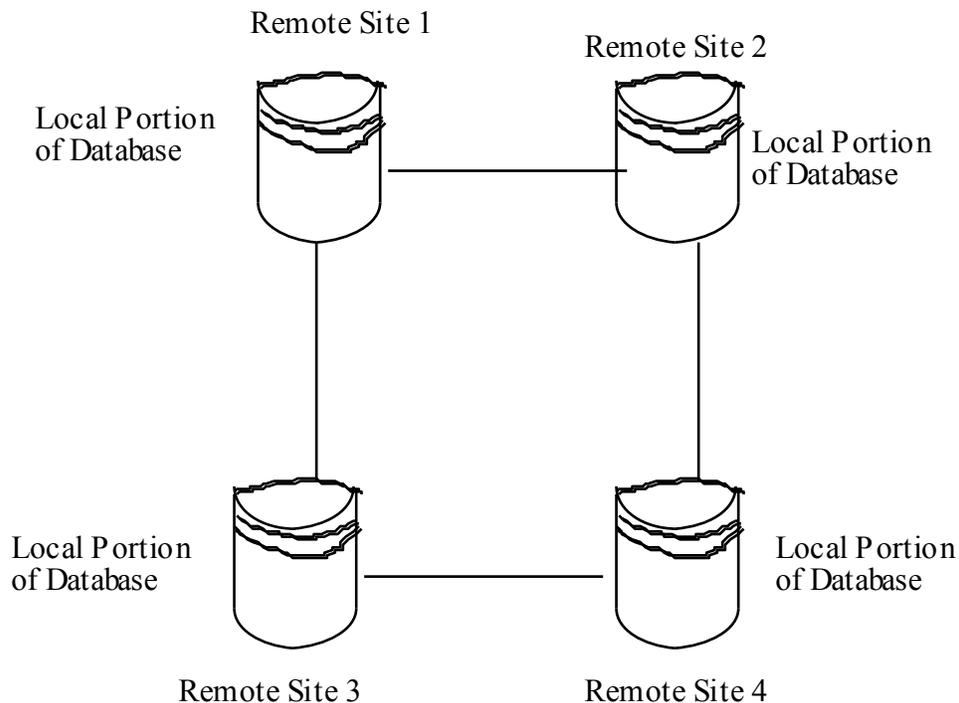


REPLICATED DATABASE

With a **replicated database** a central database is duplicated at all other locations. This is the most appropriate for problems in which every location needs to access the same data. Another approach is to hold only one working copy of the data at the local node with each node storing the

data that is most closely associated with it. The database is in fact distributed throughout the network. If a node needs access to records that are not held locally then this is obtained through the network - possibly by initially accessing a central index to find the location of the data. Software handles access to the database so that the fact that it is spread over a number of sites is not apparent to the user.

This approach requires more constant and heavier use of the network but it eliminates the problems of data redundancy and it removes the need for overnight reconciliation.



PARTITIONED DATABASE

A **partitioned database** is subdivided so that each location has only the portion that serves its local needs. Partition. The database is partitioned with each node on the network containing that section of the database that relates to it. For example the section of the database that relates to customers served at that node. Other data is held centrally and any changes to central data can be dealt with overnight by a batch update.

An extreme case of this approach is when the entire database is replicated to local processors. Here again the central copy will be updated by batch processing, probably overnight.

Both of these approaches lead to data inconsistency and will therefore be unsuitable for applications such as holiday bookings where data changes at one node need to be available to other nodes. They will however work well in situations where local data processing is compartmentalised and has no immediate effect on other nodes. An example of this is supermarket stock control.

Using Telecommunications for Competitive Advantage (P.318-320)

The use of telecommunications has reshaped the way organisations work. They can increase efficiency and speed of operations, they can help make management more efficient and they can improve customer service.

Look at the examples on pages 318-319

See UPS (United Parcel Service) case study on pages 319-320

Client-Server networks p315

Networks with powerful servers - in which different pieces of hardware work on the same processing problem. The network tries to use the full processing power of each computer in the network, including the **file-server** and the user workstations or **clients**.

Servers are required to: -

Manage the activities of the network
Can store application programs and data files
Can distribute programs or data files to other computers on the network as they request them.

A client-server solution has enabled companies to downsize from the sole use of mainframes.

Advantages include:-

It is less expensive and more flexible than mainframe.
Power of client and servers are used jointly (p.163)
Administration e.g. backup and file-sharing can be dealt with by server
Printing can be queued

A Client-Server network requires:-

- A file-server
- Network cards which provides a physical interface
- A networking OS such as **Windows NT**

Specialist servers might be used such as a

- File server
- Print server
- Communications server.
- Database servers for example provide access to central database files for all workstations or “clients” on the network.

Peer-to-Peer networks

A peer is an **equal** i.e. each node in such a network is equal to any other node. If the node is a computer it can also act as a stand-alone device, and is also able to share data back and forth with other nodes at any time. If the node is a fax, printer, modem, tape-backup drive etc. it can be used and shared by any other node. It is therefore not necessary to have file server since all workstations contribute to control of the network. Performance is slowed down and file management is complicated. Windows for Workgroups (up to 10, LANtastic 6.0)

QUESTIONS

1. What does a network card do?
2. What is the difference between a client and a dumb terminal?

3. What does login do? What part of the system controls it?
4. Why is a peer-to-peer configuration not suitable for a large organisation?
5. What is a gateway?
6. What is X25? Why is it required?
7. What hardware and software is required to be able to share resources over the network? Give names of the major networking software.
8. Can you give several contexts in which networking is particularly important?
9. Why is security a particular concern? From whom or what?
10. How do networks save storing applications and software packages?
11. Why not give every user the latest storage device?
12. Why not buy lots of expensive printers/scanners/plotters?
13. How does a network reduce data duplication in a RDBMS?
14. Why are LAN's needed if a WAN can cover the whole organisation?
15. What is disk mirroring?
16. How and when should you backup?
17. What results might the monitoring of activity levels demonstrate? What can/should be done?
18. What might a systems report indicate?
19. What is a systems purge? Why is it required?
20. Ditto for archiving.
21. What is a systems configuration?

User interface on a network

When connecting to a network

- The workstation makes a self-test
- The local OS is booted up
- Network connection software is loaded
- Users must then log in to the network
- Network applications are then presented through either a menu system or a GUI.
- Users can then execute applications
- Managers can control access rights.

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EXAM QUESTIONS

1996.6 (4 marks)

Describe TWO differences between a Local Area Network (LAN) and other networks such as a Wide Area Network (WAN)

LAN	
<i>normally within same building</i>	<i>maximum cable length 2km</i>
<i>connection is by local physical cable</i>	
WAN	
<i>network is distributed nationally or internationally</i>	<i>transmission uses telecommunications network or even satellite links</i>

1996 & 1994 (20 marks)

“The development of communication systems has enabled individuals, organisations and society to operate on a global basis.”

Discuss this statement. Include in your discussion: -

- specific examples of facilities and/or tasks that make use of communication systems
- specific examples of applications that make use of these facilities and/or tasks,
- the communication technology and/or techniques that have enabled this development

5 marks for each of 3 sections + 5 marks for presentation and coherence of argument
Facilities and/or tasks that make use of communication systems - any 5 from the following list with examples/understanding

<i>e-mail</i>	<i>EDI e.g. distribution of utilities, documentation, exam entries</i>
<i>viewdata Prestel or Ceefax</i>	<i>closed user groups</i>
<i>commercial use: distributed databases, on-line software support, technical support lines</i>	<i>research use: on-line databases, bibliographies</i>
<i>electronic diaries</i>	<i>telecommuting (see later)</i>
<i>conferencing</i>	<i>bulletin boards</i>
<i>chatlines</i>	

Applications that make use of these facilities and/or tasks- any 5 from the following list with examples/understanding

<i>Finance: ATMs, EFT, Electronic clearinghouses, on-line enquiry systems</i>
<i>Sales: POS, telemarketing, airline/hotel reservations, on-line order processing, credit card payment/authorisation</i>
<i>Manufacturing: process control, CIM (computer integrated manufacturing)</i>
<i>Human resource management: personnel enquiry, application tracking, tele-conferencing</i>
<i>plus all specific comms applications e.g. internal e-mail systems etc.</i>

Communication technology and/or techniques- any 5 from the following list with examples/understanding

<i>OSI</i>	<i>LANs linking to WANs via gateways</i>
<i>Satellite links</i>	<i>fibre-optic cable</i>
<i>protocols</i>	<i>microwave systems</i>

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<i>PABXs</i>	<i>faxs</i>
<i>telephone</i>	<i>superdata highways</i>
<i>modem</i>	<i>private lines if qualified</i>

(Possible problems in the technology... give marks if used as a counter argument)

<i>lack of standards</i>	<i>incompatible architecture</i>
<i>small scale planning of LANs</i>	<i>local need v organisation need</i>
<i>security, hacking, viruses</i>	

2000. 9 (20 marks)

A car-hire company has different offices across Europe. Customers can hire a vehicle from one office and return it to any other office. All the offices **have** network access to the company's **internal** distributed information system. The network also gives staff access to public local and wide-area information systems.

Discuss this **system**. Particular attention should be given to:

- The nature and significance of a distributed information system,
- The types of information systems that you would expect to be available on such a network,
- The data that should be distributed **on** this system,
- The advantages and disadvantages of distributing the data across the network.

Describe the nature and significance of a distributed information system Max 6

- *Wide-area/long haul network rather than LAN (2, 1,0)*
- *Likely to include special microwave links, satellite, land-based links (2, 1,0)*
- *Communications protocols exist to determine how information is transferred (2, 1,0)*
- *Distributed control as well as distributed data (2,1,0) i.e. control lies with computers at each node or location (2,1,0)*
- *Need For High Bandwidth or High Volume of Data Transfer (2, 1,0)*

The fact that distribution of control and data is transparent to the user; (2, 1,0)

Describe, with examples, the types of information systems that you would expect to be available on such a network. Max 6

- *Company Internet e.g. access to company wide code of conductor work procedures; (2,1,0)*
- *Internet access e.g. Company profile, details of key contacts, hire-charges, etc. (2, 1,0)*
- *Public networks E.g. 'Electronic Yellow Pages' for supplier contacts. (2,1,0)*
- *Closed user groups by subscription only: E.g. Motor insurance or accident repair rates available to company employees only; (2,1,0)*
- *Company wide applications such as invoicing, purchasing, payroll, personnel, etc (2,1,0)*
- *Company wide e-mail to improve communications. (2, 1,0)*

Explain what data you would expect to be distributed in this type of system Max 6

- *Customer records, vehicle records, loan records. (3,2,1,0)*
- *Advantages/disadvantages: Faster data processing data is stored on the node where it is needed less delays communicating with a central server. (2, 1,0)*
- *More robust system; No reliance on a single server (2, 1,0);*
- *Disadvantages: More complex system - increased management overheads (2,1,0)*
- *Difficult to back up entire system (2, 1,0)*
- *Increased security risks- more points of access (2, 1,0)*

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- *Risk of viruses* \checkmark *all offices need up to date anti-virus software*

Maximum mark for content 16/20.

Up to 4 marks are available for the quality and coherence of the candidate's argument

Spring 2003.9

Internet technologies allow large companies to deliver training and assessment across their entire organisation. This can be of benefit to the companies and to their employees.

- a. Describe three possible benefits to a company. (6 marks)
- b. Describe three possible benefits to an employee. (6 marks)
- c. The interaction of an employee with an online training system needs careful planning. List four factors that should be considered. (4 marks)

a.

- *Training is consistent across the company (1) irrespective of physical location (1)*
- *Able to move staff around (1) without need for retraining/ they can continue current training (1)*
- *Able to change content at one time (1) so that latest training is available to employees (1)*
- *Quality Assurance (1) easy to track online assessment and see if there are areas to work on (1)*
- *Cost benefit (1) e.g. no need to employ an instructor to deliver the courses/ no need to send staff on courses (1)*
- *Time factor (1) employees can train during quiet periods for the company (1)*
- *3 x (2,1,0) marks*

b.

- *Access to curriculum all the time (1) so missed sessions can be caught up with (1)*
- *Instant feedback on assessment (1) so that weak areas can be addressed immediately (1)*
- *Ability to work at own pace (1) so misunderstood parts can be repeated over and over until they are understood (1)*
- *Stimulating learning environment (1) some people do not learn well in a classroom situation/ very hands on approach (1)*
- *Ability to work for different sites (1) so training can be carried out when convenient to the student not the trainer (1)*
- *3 x (2,1,0) marks*

c.

- *User friendliness*
- *ICT literacy of the student*
- *Use of shortcuts*
- *Familiar/ meaningful icons*
- *Consistent layout*
- *Informative response from system/ error messages*
- *Forgiveness (system has to cope with 'odd' responses)*
- *Feeling of control - employee controls system not the other way around*

1995 (12 Marks)

- (a) Describe or draw bus and ring network topologies (4)

A2 MODULE 5 (ICT5) 14.4 COMMUNICATION AND INFORMATION SYSTEMS

A large supermarket chain is about to introduce a website so that customers can purchase their shopping on-line.

- (a) During testing, it is discovered that the site cannot be viewed correctly using certain browser software.

Describe why this may be a problem for the supermarket. *(2 marks)*

- (b) This system will involve extensive financial transactions. The retailer is aware that security is an issue.

Describe **two** measures that can be taken to ensure that this facility is secure. *(4 marks)*

- (c) In addition to a computer fitted with a modem, and a knowledge of the site address, give **two** items that are necessary for the customer to be able to connect to the retailer's website.

(2 marks)

- (d) Explain how protocols and addressing mechanisms are used to support the World Wide Web.

(3 marks)