

Using Networks

Prerequisite knowledge

Before studying this topic you should be able to:

- Describe the features and functions of the World Wide Web
- Describe the economic factors which have led to the development of networks
- Describe the main legal requirements of network related laws.

Learning Objectives

By the end of this topic you will be able to:

- Describe the functions and use of network hardware including hubs, switches, routers and NICs
- Describe network bandwidth and wireless communications
- Describe developments in hardware and software used in networks
- Describe the misuse and illegal use of networks.

Hub

A hub in an Ethernet network is a multi-port repeater. Hubs are most often used on networks using UTP cabling as the limit for this type of cable is 100 metres.



A hub will also effectively divide the network up into a series of different segments, thus reducing the likelihood that a cable fault will bring the whole network down. Hubs are commonly supplied with 12 or 24 ports, and are suitable for distributing a UTP cable to a room or office full of network stations.

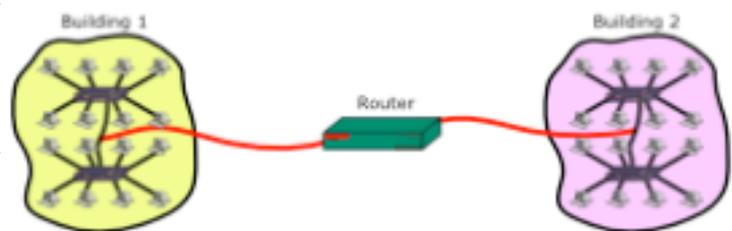
A hub also functions at the lowest level of the OSI networking model, the **Physical Layer**.

Switch

A switch (or switched hub) divides the network up into collision domains. A Collision occurs when a station begins transmission and then receives the beginning of a frame from another station. The station will immediately stop transmission and issue a JAM signal onto the segment. This will indicate to the other transmitting station that a collision has occurred and both stations will back off for a random amount of time and try to re-transmit. The more collisions, the longer the maximum back-off time. This requires that stations be close enough together for each station to see any possible attempted transmission before the first 64 bytes of its frame have been transmitted. (64 bytes - minimum frame size for an Ethernet network.)

Router

A router works much like a bridge, but works on inter-networks - typically a router uses an IP address to determine where data is to be delivered rather than the Ethernet MAC address.



This is why routers are used to link Ethernet networks to the Internet via fibre or ISDN line. Routers can often be programmed to restrict access to certain IP addresses in either direction between the networks it connects. Routers are usually dedicated hardware devices which are programmed remotely over the network, though their functions can also be emulated in software on a normal network station or node fitted with two Network Interface Cards. This arrangement is sometimes called a Gateway.

Network interface card (NIC)

Is a circuit board or card that is installed in a computer so that it can be connected to a network. Personal computers and workstations on a local area network (LAN) will have installed a network interface card specifically designed for that LAN e.g Ethernet.

Network interface cards provide a dedicated, full-time connection to a network.

Processors

The continuing bandwidth explosion has had a dramatic impact on what can be expected of networks. With falling costs more of us are taking advantage of the connectivity networks (Internet) provides.

More available bandwidth has been paralleled with the development of bandwidth-hungry and computationally intensive applications. E.g. streaming audio and video, Peer-to-Peer (P2P) applications, Virtual Private Networks (VPNs) are now demanded.

Features to consider in network processors include:

- Performance - the ability to execute key computational kernels and perform many applications at high speed
- Flexibility - the ability to adapt to changing standards in OS & applications software
- Power - power consumption is an important factor when considering where processors are situated e.g. in energy-sensitive areas and the cost implications of housing and packaging
- Software support - consideration must be given to what compilers, operating systems and libraries are available with, and supported by the processor.

Memory

Factors defining the memory that supports a network processor can be categorised as follows:

- shared, distributed or a combination of memory across the network
- size and type memory used
- caches that are included on or off the chip.

There are also many special features relating to network memory. Including: memory/buffer controllers, packet management units & address generation units etc.

Backing storage

The speed of CPU & memory has increased rapidly recently. Hard disks have been limited by the physical constraints of their moving parts. This has led to paging overheads when considering the performance of stand alone system and more so on networks.

For larger networks, the storage requirements are larger and more complex to implement. Devices can connected directly to the network media. These devices are assigned a network address and can then be accessed by clients via a server that acts as a gateway to the data. In a very large network, such devices, form a storage area network and be accessed via a server.

Browsers

A browser is the application program that enables a computer user, to look at, and interact with World Wide web. It makes requests to web servers throughout the Internet.

Network operating systems

These will usually run on the server or servers installed in a LAN. Common OS are Novell, Windows NT/2000 Server and various flavours of UNIX including the open source OS LINUX. Workstation OS need not be the same as the OS running on the server.

Technical factors affecting communications

- *Advances in cabling technology* for local area networks has resulted in the equipment becoming easier to install, cheaper to purchase and has provided ever increasing **bandwidth**.
- *Amount of Bandwidth* available to users of networks. (the rate at which data can be transmitted over a network) The demand for bandwidth, (WANs especially) has always outstripped the ability of networks to provide it. Many service providers charge their users by the amount of data they receive rather than by the time they are connected.
- *Data Compression* - if data is compressed before it is transmitted then it requires less bandwidth. There are a variety of methods for compressing data - most rely on removing redundant information by detecting repeating patterns in the data transmitted and then they only need to transmit the pattern once together with details of how often it is repeated.
- *Caching* - if data can be stored locally, then the data need only be re-transmitted over a short distance when users request it. This system is used by your browser to reduce download speeds by storing files from Internet pages you have viewed on your hard disk.
- *Broadcasting* - if data such as video or audio is transmitted live, then the user only has one chance of viewing it, the bandwidth requirements will be a lot less than if users are continually downloading their own copy of the data.
- *Increasing the available capacity* - Faster modems and services like ISDN and ADSL have made data transmission much faster so that it has become feasible to receive multimedia services like graphics, sound and video over an Internet link.
- *Wireless* - networking in LANs is still slower than conventional cabling, but the advantages of being able to move around a building and still be connected to the network often makes wireless networking worthwhile. (e.g. Bluetooth or WiFi)
- *Mobile communications technology* is likely to be very important in the development of the Internet in the next few years. Mobile phones can access the Internet via a software standard called Wireless Application Protocol (WAP). (e.g. PDA's or MDA's)

Misuse of networks

Social issues

Personal privacy

Monitoring of individuals' Internet & email use. Many governments would like to have access to this sort of information. (Many individuals would not like this kind of access) With modern communications networks it is theoretically possible to trace the movements of any individual around the world - they use cash machines, pay with credit cards, use the Internet, use mobile phones, appear on surveillance cameras, and may use electronic road tolling systems.

Encryption

Encrypting data is a method of coding it, in order to make it difficult/impossible for someone to read it unless they have authorisation from you. Some governments make encrypting data illegal, others regard it as an individual right. There is a trade-off between security and convenience. The more secure a communication system, the more inconvenient it is to use.

Disconnection

People in western countries are described as "Information rich" whereas most people in the Third World are "Information poor", since connecting to the Internet requires expensive equipment and access to a networking infrastructure which does not exist in many poor countries.

Social isolation

There is a fear that the increased use of electronic communication will mean that many people will become physically more isolated from each other.

Ethical issues

Netiquette

Simple rules such as not sending "spam" (unsolicited commercial email), not shouting (writing in capital letters) and respecting people's privacy may seem obvious, but it is easy to make mistakes without realising it.

Misrepresentation

The ability to post messages on newsgroups or discussion lists anonymously means that offensive statements can be made without the person making them being held to account.

Surveillance and monitoring

The email you send and receive, the pages you view and the files you download via the Internet can all be logged by a number of organisations. These organisations may not always have your best interests at heart.

Hacking

Controlling access to the network :-

The network operating system is responsible for security on the network. The most obvious example of this is when a user logs on. The user must supply an identity and a password. If the identity and password do match, then the resources which the user has access to will depend on the level of access that user has been given by the network manager. The access a user has to resources depends on that user's level of permissions.



Viruses

A virus is a piece of programming code that causes some unexpected and usually undesirable event in a computer system. They are often designed so that they automatically spread to other computer users on a network. Viruses can be transmitted as attachments to an e-mail, as a download, or be present on a disk being used for something else. Some viruses take effect as soon as their code takes residence in a system whilst others lie dormant until something triggers their code to be executed by the computer. Viruses can be extremely harmful and may erase data or require the reformatting of a hard disk once they have been removed.

Copyright

The Internet has made the distribution of software cheap and easy, but this also means that the distribution of illegal copies of software is just as easy. Software piracy is a major problem in many parts of the world. Many people argue that software piracy increases the cost of software because software distributors need to charge more to recover the cost of research and development if only a percentage of those using the software are actually paying for it.

Computer Misuse Act

In the UK, the Computer Misuse Act (1990) covers using computers to damage or steal data. The Computer Misuse Act covers crimes such as breaking into computer systems or networks to destroy or steal data and propagating viruses which destroy or damage information or computer systems.

Data Protection Act

In the UK, the Data Protection Act (1998) describes the duties and responsibilities of those holding data on individuals. It also describes the right of these individuals. In general, it is the duty of those holding data on individuals to register with the Data Protection Registrar, to keep the information secure, make sure it is accurate, and to divulge it only to those persons who are authorised to view it. It is the right of an individual who has data stored concerning them to view that information and to have it changed if it is inaccurate. There are a number of organisations which may be given exemption from this act - namely the Police, Customs, National Security and Health Authorities.

Copyright Designs and Patents Act

Copyright is the ownership of intellectual property outlined by a particular nation's or international law. In the UK, the Designs and Patents Act of 1988, and legislation in other countries who signed the Berne Convention, provide protection.