SY1S51 - CSNC
Network Design and Disk Analysis

University of Glamorgan

Peter Maynard
(88977)

Table of Contents

Part A

Method of Research

The method of research used in this report was mainly the internet, sites such as wikipedia and linuxformat as well as books for verification.

Network Design

The network has to be wireless. It will use the IEEE 802.11g standard. Because it uses the 802.11g it is capable of transmitting at a maximum of 54 Mbit/s. This means that it will be able to send 54 Mega bits of data over the network every second. Although that is the maximum speed, the network will very rarely be able to provide this much bandwidth. The average bandwidth speed will probably be around 19 Mbit/s. Because it is a wireless based network we will have to make sure that it is secure so that the data on the network is safe from unauthorised access. This can be done by enabling Wired Equivalent Privacy (WEP) encryption. This will encrypt all data that is sent over the network.

We will also hide the Service Set Identifier, SSID, of the wireless network so that unauthorised people will not be able to pick up the network by accident, although this will not stop someone from finding out the SSID because each time a node connects or transmits the SSID is sent in plain text. Passive sniffers can easily take advantage of this.

I have chosen “BT Total Broadband: Option 3” this will provide the network with a wireless enabled router, BT Home Hub, as well as an asymmetric broadband connection, this means that the download speeds are faster than the upload speeds. This could cause a problem for a small business that does at a lot of uploading to the internet. But for a simple home network like this the need for fast uploading speeds is low. If the landline's local exchange has been enabled to provide a decent connection then the network will be able to have speeds of 8 Mbit/s. But if the network is situated a great distance from the exchange then it may not be able to get very good speeds, for the best connection speeds you should be in around a five mile radius. I have chosen BT because they are the most reliable in my area.

There are three types of networks. These are Server-based (Client-Server), Peer (Peer-to-Peer) and Hybrid. After looking over the advantages and disadvantages I have decided to use Hybrid. See Appendix A for the advantages and disadvantages of the different types. A hybrid network has all three types of network operating on them. So this means that there is a server which will provide

things like printing and backup and there will be a peer to peer network where all of the nodes share disk space and resources.

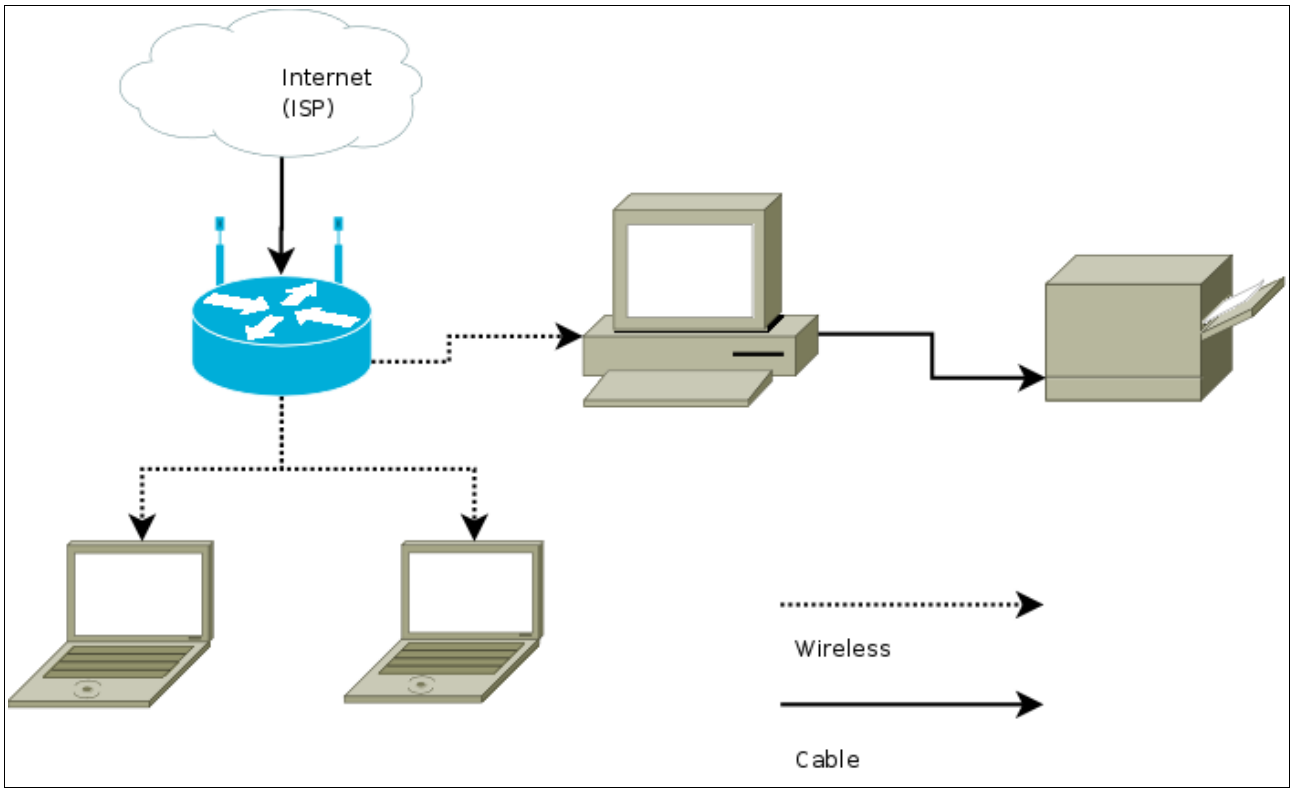

Diagram 1: Basic Network Design

As you can see in diagram 1 the network will be based on a Star topology. This is where all the nodes are connected to one device in the middle of the network. There are five primary topologies which are Bus, Star, Ring, Mesh and Hybrid. See appendix A for more of the advantages and disadvantages of the different types.

The network will use TCP/IP (Transmission Control Protocol / Internet Protocol) to communicate with each node. To enable computers to communicate, they must be able to identify and locate each other. This is done by using IP addresses, e.g 212.219.112.19. A computer can be connected to more than one network, by having more than one address (and network interface card). The IP addressing system is Layer 3 of the OSI model, see Appendix A for more information about the OSI layers.

The way that computers are assigned an address is in two ways:

1. Static – Manually assigned by the system administrator
2. Automatic – Automatically assigned by the Dynamic host configuration protocol (DHCP)

Because this is going to be a non-public network we will be using private IP addresses, and this will

be a relativity small network it will use the Class C (see appendix A for more information about the different classes) internal Address Range which can be from 192.168.0.0 to 192.168.225.225. This means that we will only be able to have 253 nodes connected unless we change to a Class B network.

Each of the computers have to have a Network Interface Card (NIC). This can be a wired Ethernet NIC or a wireless NIC. As you can see from Diagram 1 there will be one desktop connected to a printer. The Network is designed for two laptops but it will be able to support more. All of the computers will be wireless connected. Because it is a star network they are all connected to one point in the middle, the router. A router provides layer 3 (OSI model) network connectivity, meaning that the router will assign an IP address to each node on the network.

The main reason for choosing a router is that it will be able to automatically work out if there is a new computer connected to the network and assign it with an IP address. The router is also an ADSL modem which means that it will be able to provide all the nodes connected to it with a connection to the internet. This has a firewall built into it so that only specific ports will be open to the public, any one that is not inside the network, this will stop a malicious person from attacking the computers inside the network. The router has a wi-fi transmitter and receiver built in which removes the need to use a extra wi-fi transmitter, unless we want to make the range of the wireless network bigger.

The desktop computer will be the main server. It will provide the other nodes with a place to store data, it will also act as a web server, proxy server and application server. It could also be used as a dedicated games server. This requirement to provide many different services means the system will have to have a high specification.

The operating system that will be used on the server will be Ubuntu Linux 7.10 Desktop Edition. Software that will be installed on it will be Apache (Web Server) and Squid (Proxy Server). The other services are already installed on the distribution. These are things like CUPS (Print Server) and samba (file server).

The reasons for the print and file server is to enable other computers, nodes, on the network to print to the printer and to share files in a client server manner with the desktop computer. Apache enable the server to act as a web server, which will serve web pages to nodes that request them from it, this could be used as a local place for users to develop web sites. Squid will enable the system to cache items from other servers to speed up access to web sites, this could be used for authorised users to connect from a public hotspot and securely use the internet.

The other clients that will be on the network will also use Ubuntu 7.10. The main reasons for this is that Linux is much more secure and reliable compared to Microsoft Windows. By using Linux there is no risk of a network virus, or a virus at all. The laptops will have a built in wireless network interface card which they will use to connect to the network. If the user wanted to add a laptop to the network that does not have built in NIC then they would have to buy a Personal Computer Memory Card International Association (PCMCIA) wireless network interface card, see appendix A for more information.

Some of the difficulties that may need to be overcome are the location of the computer or equipment. When you set-up the network you need to make sure that the equipment has enough main power plugs and not to overload your power point. This mainly applies for the desktop as that is the server and will spend more of it's time switched on. Both the computer and the printer will need electricity. Another problem for this network is because it is wireless based you are going to have to make sure that all the computers have a decent signal strength, so this means that you will have to place the access point, the router, in a centred location where the other computers will be. These can be easily over come by making sure that you choose the best place before you set up all the other computers and equipment.

And alternative to this design is a network of peer-to-peer computers in a peer-to-peer topology via ad-hoc mode, this would mean that all computers connected to the network would each share there resources with each other, this is printers and services. Because this is in ad-hoc mode there would be no central server or access point.

Possible Network Use

There are lots of uses for a network of computers. Here are some that are specific to this network.

- Each node connection to the internet
- Peer-to-Peer data storage
- Client-Server data storage
- Ability to share expensive equipment such as printers, plotters etc
- Web Server
- Application Server
- Proxy Server
- local/Internet Network Games
- Share music

As this is a home network many people in one house may want to use the internet at the same time, this network will provide all computers connected to the network with shared access to the internet. All of the computers connected to the network will have peer-to-peer storage, this is good because as more computers are added to the network then there is an increase of storage and bandwidth. With the use of client and server storage the network will be able to keep important information on the server which will make it more secure than keeping it on a peer computer.

Also the network can share equipment with all the other computers that are connected, this will mean that the users will not have to keep unplugging the equipment when they want to use it on a another computer or to buy new equipment for each of the computers connect to the network. The network will be able to provide users connected to it, or if it has port forwarding and NAT enable it will be able to provide people from out side the network, with access to the services such as being able to host a web site this would be useful for users that may want to develop internet applications that use many different server side technologies, without having to pay for the extras that a web host might provide. It will also be able to provide a central place where all the software would be installed so that all the computers can access and use it.

The network can also be used as a game server, for both the internet and locally, this will mean that clients of the game will be able to connect to the server and play against other players connected to the server. The network will also be able to share music with other computers connected to it, this means that only one computer will have to have all of the music stored on it and all the other computers will be able to play the music that is stored from any where.

Network Configuration

Because the network will be using a class C IP addressing system the IP address for all computers on the network will range from 192.168.1.2 – 192.168.1.253. The IP address 192.168.1.1 will be used for the Router., and will have the name 'main-router'. If the network was to have another router a suggestion for that name could be 'secondary-router' and have an IP address of 192.168.1.254.

Here is a network Diagram showing the naming system.

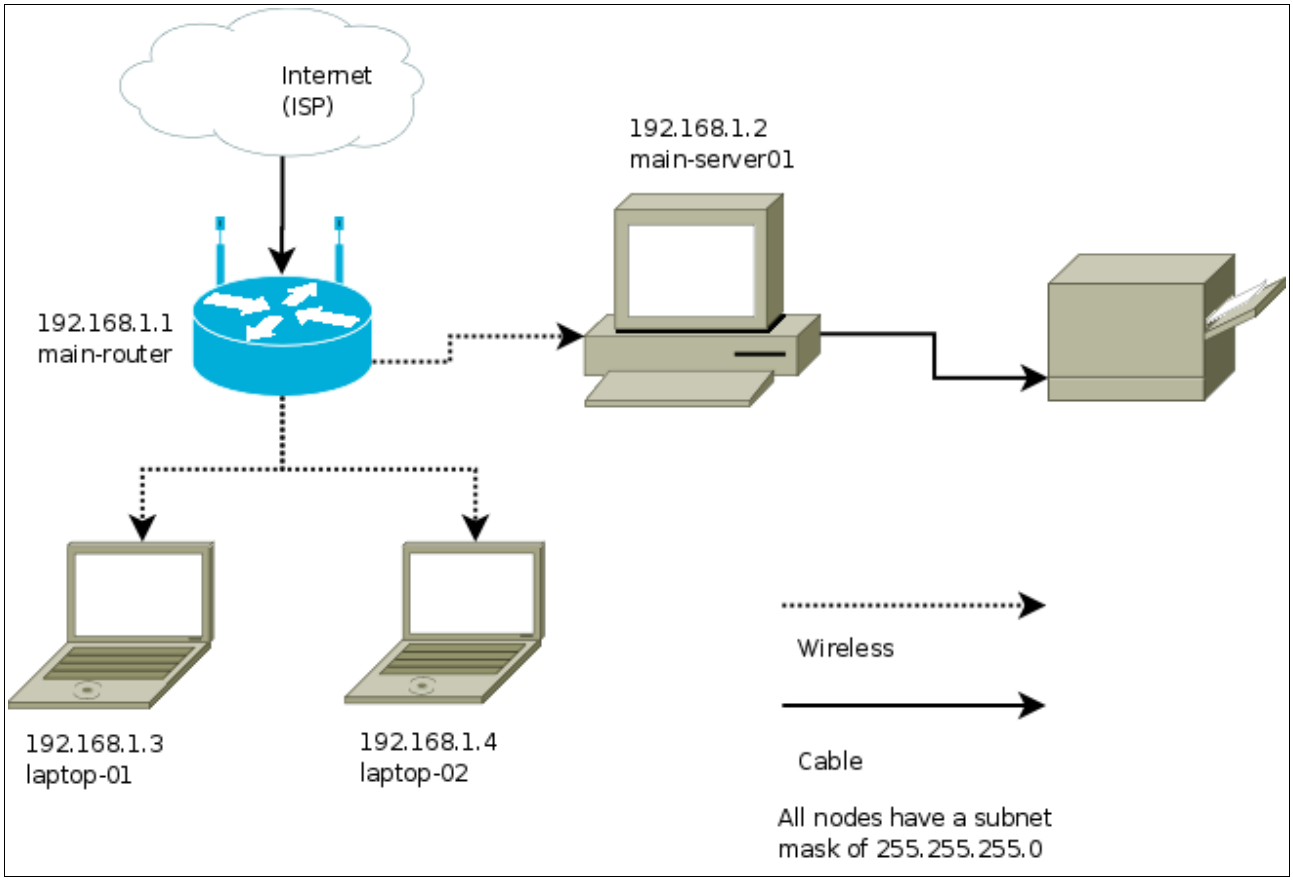

Diagram 2: Network Design showing IP address and naming scheme

The desktop computer will be configured to use a static IP address of 192.168.1.2. The other two laptops will be automatically assigned by the router using DCHP. The naming system will be specific for each computer e.g a laptop will be 'laptop-92'. The number will be the number of the laptop, we have two laptops, they will be called 01 and 02, so there names are laptop-01, laptop-02. The desktop which will provide the network with some services will be called 'main-server01'

The Desktop, Router and Printer could be in the same room. This would mean that if the network

needs some maintenance all the equipment will be in the same room, it would also mean that the server would have a stronger connection to the network, as the further away from the router the weaker the signal becomes.

Conclusion

Below is a table that shows some of the advantages and disadvantages of having a wireless based network compared with a completely cabled network.

Advantages	**Disadvantages**
Easy and quick to set up	Slower bandwidth speeds
Not hard to make fairly secure	Not as secure as wired
Easy to add new nodes	Anyone can connect
Less equipment required so cheaper	Not as reliable as wired
Easy to move computers around	If you have thick walls you might not be able to get a signal

Table 1: Advantages of a wireless network

Because of the way that wireless network in done there is not much way of stopping other people from connecting to your network. It is not possible to stop the wireless signal from going outside of the walls of your house, so unless you have a big garden other people/neighbours may be able to connect to your network and view the data that is being sent over it such as your bank details, where as if you where using a wired network only people with physical access to the network equipment would be able to connect to the network.

Some of the advantages of using a wireless network rather than a wired network is that it is possible for computers to run in ad-hoc mode where they are able to communicate with each other without any extra equipment, apart from a wireless network interface card. By using ad-hoc you are able to create a very cheap and quick network that can support many computers but with out any extra equipment, such as routers and server. Using wireless it is a lot easer to move computers to a different location because there are no network wires, only the power cables. But if you where using a wired network you would have to move all of the cables around, this could be all the cables that are under the carpet or in tidily cabled to the walls, this could be a lot of cable and time.

By using wireless there is less equipment required that a wired network, some equipment that a

wired network may need is a switch, used to connect more computers to the network, repeater, used to boast the signal through the cable so that it can connect a computer that is a long distance away, the distance depends on the media type. Because there is less equipment needed for a wireless network, a access point and a receiver, it is much easer and quicker to add new computers to the network, where as with a wired network you would need to work out how much cable needed, work out the best route making sure not to get the signal disrupted by power lines or getting in the way of doors and health and safety. With a wireless network you would set up the new computer and turn it on check that there is a good enough signal strength and that is it no more equipment or time required.

The BT router that is used in this network can be changed for another with similar specification. The main specifications are that it has to compile with the IEEE 802.11g , or greater, standards see appendix A for an example of an alternative router.

References

http://en.wikipedia.org/wiki/Subnetwork
http://en.wikipedia.org/wiki/WPA2
http://www.linuxformat.co.uk/wiki/index.php/Set_up_your_printer
http://en.wikipedia.org/wiki/Hacker_%28computing%29#Black_Hat_Hacker
http://en.wikipedia.org/wiki/Ad_hoc
http://en.wikipedia.org/wiki/PC_card
http://www.productsandservices.bt.com/consumerProducts/displayTopic.do?topicId=15764
http://www.samknows.com/broadband/

Part B

A good performance disk would have a short seek time, rotational delay and data transfer time. Seek time is the time for the read/write heads to get to the required track and sector. Rotational delay is the time for the required sector to move around and position its self under the read/write head, and the data transfer time is the time that is taken to transfer the data from the disk allocation unit and the system memory. To improve performance we can enable interleaving, this means that the sectors will have logical numbers and will be arranged in non-contiguous way. Although most modern disks do not require interleaving because of the increase in the size of the buffer, which is now large enough to allow all sectors in a block to be read at once with out any delay between sectors.

Directory Encoding

Disk storage can be anything from a CD ROM to a floppy disk or Hard disk. The general term for any physical storage unit is volume. Disks are divided in tracks, these tracks are not a physical division as on a record and their position is fixed by the Read/Write head. The tracks are numbered, then subdivided into sectors. Sectors are normally the same size on each track and throughout the disk, sectors are numbered by inserting the sector number into the sector header. All blank disks need to be formatted this involves writing to each sector some basic housekeeping information, when formatting the number of sectors and tracks are set by the formatting program.

Data stored on disks as files is a collection of binary data that may be a program, database, ASCII text or word processing file if we assume that they are all stored in the same way then we can say that a file is a logical unit of storage and its logical organisation is determined by the program or users that created the file. The logical file structure is independent of the physical file structure. When we save a file to a disk we need to be able to access it as and when required, a typical file would spread out more than one allocation unit. In general a new file starts a new allocation unit and any space that is left is filled with null data. Most file store systems have a reserved area where we can not write data to, and then data block areas which we write to.

We will concentrate on using a standard file allocation table such as FAT12, but not every format works in the same way there are others such as extent, GFS2 and ext4. The root directory has a fixed size and contains all the root directory entries for the disk under examination, each entry in the directory is of a fixed size and contains the following information for each entry, there are 8 parts of a directory entry these are:

Offset	Description	Size (Bytes)	Format
00H	Filename	8	ASCII
08H	Filename extension	3	ASCII
0BH	Attribute	1	Bit coded
0CH	Reserved	10	Unused
16H	Time	2	Word, Coded
18H	Date	2	Word, Coded
1AH	Starting cluster number	2	Word
1CH	File size	4	Integer

Table 2: Eight Parts of a directory entry

The data file area is the major area of the disk and all of the files and subdirectory entries are stored in it, the system should attempt to write the clusters in a contiguous manner if possible.

Now that we know how the data is written to the disk and how the file system works, we will talk about how to convert what is written to the disk to useful information such a file name and size. This is normally done by the operating system. We will use example file that was provided with the assignment. See appendix B.

Look at Table 1, that will provide us with the information that we will be able to use to convert the file into readable information. The filename is stored in ASCII, which means that all we have to do is look up the value in the file and compare it with the value in the ASCII table, see appendix B. The filename is 8 bytes in size and starts at 00H, so this means it the first 8 sets of numbers in the file.

Filename

```
14FD:2600  45 58 50 41 4E 53 59 53 58 54 20 00 6E AA 44
```

Because the filename is in ASCII we can look it up in the ASCII table like this, remember that it is stored in hex:

ASCII Value	Char
45	E
58	X
50	P
41	A
4E	N
53	S
59	Y
53	S

Table 3: Filename Conversation

So the file name is “EXPANSYS”. The next value in the file is the filename extension, again the extension is stored in ASCII, so we just have to compare the values with the ASCII table. The extension is 3 bytes in size and starts at 08H, so this is the next three sets of numbers starting from the end of the file name.

Filename extension

```
14FD:2600  45 58 50 41 4E 53 59 53-54 58 5420 00 6E AA 44
```

ASCII	Char
54	T
58	X
54	T

Table 4: Filename Extension

So the filename extension is ”TXT”. The next value in the file is the attribute, this can tell us if the file in question is hidden, read-only or an archive. Because it is bit coded we will have to convert it from Hex to binary, this also means that we have to swap the two sets of numbers around. Once we have don that we can work out what that attribute is. It is only 1 byte in length and starts at 0BH, this is the next two sets of numbers from the file extension.

Attribute

```
14FD:2600  45 58 50 41 4E 53 59 53-54 58 54 20 00 6E AA 44
```

So to work out what the attribute is we take the two sets of numbers that represent it and swap them around and convert them to binary.

Binary	**Swapped Hex**
0010 0000	00 20

Table 5: Binary Attribute

Now that it is in binary we compare it with the attribute bits table to find out it's value.

7	6	5	4	3	2	1	0	Meaning
-	-	-	-	-	-	-	1	Read-only
-	-	-	-	-	-	1	-	Hidden
-	-	-	-	-	1	-	-	System
-	-	-	-	1	-	-	-	Volume Label
-	-	-	1	-	-	-	-	Subdirectory
-	-	1	-	-	-	-	-	Archive
-	1	-	-	-	-	-	-	Unused
1	-	-	-	-	-	-	-	Unused

Table 6: Attributes Table

Because the 1 is in the fifth position, starting at zero, the attribute of this file is an archive. The next part of the entry is the reserved, this is 10 bytes and starts at the end of the attributes section which is 0CH and then continues until 16H, which is the 22 set of numbers in, that is all of the reserved.

Reserved

```
14FD:2600  45 58 50 41 4E 53 59 53-54 58 54 20 00 6E AA 44
14FD:2610  49 34 49 34 00 00 DB 4C-84 2D 02 00 91 06 00 00
```

After that its the time information which is 2 bytes long. The time is word coded so we will have to swap the set of numbers around, and then we can work out what it is, he time is the time that the file was created.

Time

```
14FD:2610  49 34 49 34 00 00 DB 4C-84 2D 02 00 91 06 00 00
```

After we switch the two sets of number around we convert it into binary.

Binary	**Swapped Hex**
01001 100110 11011	4C DB

Table 7: Binary time

The first 5 numbers of the binary are the seconds. So to work out the seconds we would work out what 110011 is in decimal and times it by two., which will give us 54
Seconds: 11011 = 27 *2 = 54
The next 6 number of the binary give us the minutes. So to work out the minutes we would work out what 100110 is in decimal, this is 38. The last number of the binary are the hours, we do the same as the minutes and work it out in decimal, this is 9. So the time that this file was created was 9:38:54.

The next set of data that we can work out from the table is the date, the date starts from 18H and is 2 bytes in size. Again this is a word and is coded so we will have to swap the set of numbers around and convert then to binary.

Date

```
14FD:2610  49 34 49 34 00 00 DB 4C-84 2D 02 00 91 06 00 00
```

Binary	**Swapped Hex**
0010110 1100 00100	2D 84

Table 8: Binary date

Now that they are in binary we have to work out the date that the file was created, the first five bits are the day, the next four bits are the month and the last seven bits are the year. So converted into decimal they look like this, year 22, month 12, day 4. The number for the year must be added with 1980 to get the correct year that the file was created, which was 2002. So the complete date is 4th December 2002. So the complete information about this file is:

Description	**Information**
Filename	EXPANSYS
Extension	TXT
Attribute	Archive
Time created	9:38:54
Date Created	4th December 2002

Table 9: Complete File Information

```
14FD:2600  45 58 50 41 4E 53 59 53-54 58 54 20 00 6E AA 44   EXPANSYSTXT .n.D
14FD:2610  49 34 49 34 00 00 DB 4C-84 2D 02 00 91 06 00 00   I4I4...L.-......
```

Here is an example of the decoding again, but using different data, below is the data that will be used.

```
14FD:2660  54 52 41 43 45 20 20 20-54 58 54 02 18 3D F7 53   TRACE   TXT .=.S
14FD:2670  53 30 53 30 00 00 9D 5B-36 2F 02 00 28 06 00 00   S0S0...[6/..(...
```

Filename

14FD:2660 **54 52 41 43 45 20 20 20**-54 58 54 02 18 3D F7 53

The filename is “TRACE”

ASCII Value	Char
54	T
52	R
41	A
43	C
45	E
20	Space
20	Space
20	Space

Table 10: Filename

File extension

```
14FD:2660  54 52 41 43 45 20 20 20-54 58 5402 18 3D F7 53
```

The file extension is “TXT”

ASCII	Char
54	T
58	X
54	T

Table 11: file extension

Attribute

```
14FD:2660  54 52 41 43 45 20 20 20-54 58 54 02 18 3D F7 53
```

The files attributes are Hidden, Volume Label, Subdirectory

Binary	Swapped Hex
01101 1010	18 02

Table 12: Attribute

Time

```
14FD:2660  54 52 41 43 45 20 20 20-54 58 54 02 18 3D F7 53
14FD:2670  53 30 53 30 00 00 9D 5B-36 2F 02 00 28 06 00 00
```

The time that the file was created was on 11:28:58

Binary	**Swapped Hex**
01011 011100 11101	5B 9D

Table 13: Binary Time

Date

```
14FD:2670  53 30 53 30 00 00 9D 5B-36 2F 02 00 28 06 00 00
```

The date that the file was create was on the 22nd January 2003

Binary	**Swapped Hex**
0010111 0001 10110	2E 36

Table 14: Binary Date

Here is the complete information about the file:

Description	**Information**
Filename	TRACE
Extension	TXT
Attribute	Hidden, Volume Label, Subdirectory
Time created	11:28:58
Date Created	22nd January 2003

Table 15: Complete information about the second file

```
14FD:2660  54 52 41 43 45 20 20 20-54 58 54 02 18 3D F7 53   TRACE   TXT .=.S
14FD:2670  53 30 53 30 00 00 9D 5B-36 2F 02 00 28 06 00 00   S0S0...[6/..(...
```

Cluster access

The most logical way to store a file would be to store it contiguously, this is means that we store each file in consecutive allocation units on the disk. This will allow the system to easily read the whole file. This is fine until the file needs to be extended because by the time you have written another file to the disk there will be no free space after the original file. This way of storing data files is the best way in terms of speed of accessing the data file. The system decides where to save the data file by one of these three ways:

1. Best Fit - Find the area with the closest amount of free space required
2. First Fit – use the first available area on the disk where the file will fit
3. Worst Fit – Put the file into the biggest available space on the disk

Another way to store data is non-contiguous which allows files to be spread out over the disk rather than stored contiguously, this means that the system will be able to use allocation units on the disk in any order or location. One way of doing this is to sort it using an indexed method, because the system can use any order and location to store the data it needs a way to find the next sector this is done by recording in an index a list of the allocation units that each file has been given, this allows the file to be accessed reasonably efficiently.

We can see by looking at the first few entries of a FAT12 table how the file is stored on the disk. We will use the following table entry as an example.

Reserved 0 and 1	Clusters 2 and 3	Clusters 4 and 5	Clusters 6 and 7	Clusters 8 and 9
F0 FF FF	03 40 00	05 60 00	07 80 00	FF 3F 12

A cluster is a set of hexadecimal numbers inside the FAT table, each cluster has three digits, which hold information about the file stored on the volume. To work out what the data is in the cluster we take the last digit and put it in front of the next cluster and then take the original first digit of the next cluster and put it at the start of the current cluster. e.g

Take clusters 2 and 3.

Cluster number	Cluster data
2	03 4
3	0 00

Table 16: Step One

We take the last value of cluster 2, which is 4, then place it in front of cluster 3. We then take the first original value of cluster 3, which is 0, then place it at the end of cluster 2.

Cluster number	Cluster data
2	003
3	004

Table 17: Step Two

We then look up the FAT value to find out what it means, using the following table.

FAT Value	Meaning
0	Unused cluster
FF0-FF6	Reserved cluster
FF7	Bad cluster
FF8-FFF	Last cluster in a file
other values e.g 005 or 008	Next cluster in a file

Table 18: FAT value meaning

If the value of the cluster is number that shows where the rest of the data is stored for that file. if we take cluster 0 which is FF0 means that cluster 0 is unused. If we do this for all the values in the entry we will get this:

Reserved 0 and 1	Clusters 2 and 3	Clusters 4 and 5	Clusters 6 and 7	Clusters 8 and 9
FF0 FFF	003 004	005 006	007 008	FFF 123

This shows a contiguous file, which means that the file is stored in order.

Here is an example of two non-contiguous, fragmented, files one of which takes up four sector and the other takes three.

Cluster Number	**FAT Entry**
000	-
001	-
002	*FFF*
003	006
004	002
005	008
006	004
007	*FFF*
008	007

Table 19: non-contiguous files

File one starts a cluster 003 and ends at cluster 002 and is 4 sectors long. File two starts at 005 and ends at 007, it is 3 sectors long.

Appendix A

Network Types

Here are the advantages and disadvantages of the three different network types:

A peer network has no servers and uses the network to share resources among independent peers.

Advantages	**Disadvantages**
No extra investment in server hardware or software required	Additional load on computers because of resource sharing
Easy to set-up	Lack of central organization
Little network administration	Weak and intrusive security

Table 20: Advantages and disadvantages of a Peer-To-Peer network

A client server network contains clients and the servers the support them.

Advantages	**Disadvantages**
Strong central security	Expensive dedicated hardware
Central file storage, which allows all users to work from the same set of data	A dedicated network administrator (usually required)
Easy manageability of a large number of users	

Table 21: Advantages and disadvantages of a Client Server network

A hybrid network is a client server network that also has peers sharing resources. Most networks are normally this type.

Advantages	**Disadvantages**
The advantages of server based networking	Hybrid network shares the same disadvantages of the server-based network
Many of the advantages of peer-to-peer networking	
Ability of users and network administrators to control security based on the importance of the shared resource	

Table 22: Advantages and disadvantages of a Hybrid network

Topologies

Five primary topologies advantages and disadvantages

Advantages	Disadvantages
Easy to connect a computer or peripheral to a linear bus.	Entire network shuts down if there is a break in the main cable
Requires less cable length than a star topology.	Terminators are required at both ends of the backbone cable.
	Difficult to identify the problem if the entire network shuts down.
	Not meant to be used as a stand-alone solution in a large building.

Table 23: Advantages and disadvantages of a Bus topology

Advantages	Disadvantages
Easy to install and wire.	Requires more cable length than a linear topology.
No disruptions to the network then connecting or removing devices.	If the hub or concentrator fails, nodes attached are disabled.
Easy to detect faults and to remove parts.	More expensive than linear bus topologies because of the cost of the concentrators.

Table 24: Advantages and disadvantages of a star topology

Advantages	Disadvantages
Very orderly network where every device has access to the token and the opportunity to transmit	One malfunctioning workstation or bad port in the MAU can create problems for the entire network
Performs better than a star topology under heavy network load	Moves, adds and changes of devices can affect the network
Can create much larger network using Token Ring	Network adapter cards and MAU's are much more expensive than Ethernet cards and hubs

Table 25: Advantages and disadvantages of a ring topology

Advantages	Disadvantages
Offers superior redundancy and reliability	Expensive because it uses a lot of cables
Provides redundant paths throughout the network so that if one cable fails, another will take over the traffic	Hard to move a computer around
Easy to troubleshoot	

Table 26: Advantages and disadvantages of a mesh topology

IP Classes

There are three main IP classes, these are A,B.C. Class A is normally used for a big organisation like the army, which will have 100,000+ computers connected to a network. Class B would be used for a university or school with a few thousand computers, class C is normally used for small office or home networks with only 100 computers connected

Class A 10.0.0.0 10.255.255.255
Class B 172.16.0.0 172.31.255.255
Class C 192.168.0.0 192.168.255.255

PCMCIA

a PCMCIA WiFI adapter is a card that can be plugged into a laptop, sometimes desktop, and allow the computer to communicate wirelessly over the network. Below is a basic specification of a PCMCIA wifi card.

Product Description	Belkin Wireless Pre-N Network Notebook Card network adapter
Device Type	Network adapter
Form Factor	Plug-in module
Interface (Bus) Type	CardBus
Data Link Protocol	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n (draft)

Data Transfer Rate	108 Mbps
Network / Transport Protocol	TCP/IP, IPX/SPX, AppleTalk, UDP/IP, NetBEUI/NetBIOS
Frequency Band	2.4 GHz
Compliant Standards	IEEE 802.11b, IEEE 802.11g

Alternative router

Alternative router to the BT Hub

Plexus Wireless 54 Mbps Access Point

“This access point is fully compliant with IEEE802.11g/b standards. It can help you extend from the wired network to the wireless network, free from the cabling troubles. It is the best choice for SOHO and small enterprise users. It provides five work modes: AP, WDS P2P Bridge, WDS P2MP Bridge, WDS AP Bridge and Client. It also supports 64/128-bit WEP, WPA, TKIP, AES, WPA2, WPA&WPA2 encryption and security mechanism. The MAC address filter can protect your network against any malicious intrusion. Moreover, the Web management utility can benefit you to manage the device easily. “ - Overview of router.

- Supports IEEE 802.11g, IEEE 802.11b and IEEE 802.11i standards
- Supports five connection modes: AP, WDS P2P Bridge, WDS P2MP Bridge, WDS AP Bridge and Client
- Provides up to 54M transmission rate and 54/48/36/24/18/12/9/6M or 11/5.5/2/1M Auto-Negotiation rate
- Supports one 10/100M Auto-Negotiation Ethernet port
- Supports 150 meters indoors and 400 meters outdoors (depends on the environments around)
- Supports Web management utility and Setup Wizard
- Supports 64/128-bit WEP data encryption
- Supports WPA, TKIP, AES, WPA2, WPA&WPA2 encryption and security mechanism
- Supports IEEE802.11b/IEEE802.11g Auto-negotiation and manual configuration modes
- Supports Auto MDI/MDIX
- Supports Firefox1.0， IE5.5 or above
- Supports authorization access over 32 MAC addresses
- Supports auto wireless channel selection

Appendix B

Example File:

```
-l 0 0 0 33

-d0
1428:0000  EB 34 90 49 42 4D 20 20-33 2E 33 00 02 01 01 00   .4.IBM  3.3.....
1428:0010  02 E0 00 40 0B F0 09 00-12 00 02 00 00 00 00 00   ...@............
1428:0020  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 12   ................
1428:0030  00 00 00 00 01 00 FA 33-C0 8E D0 BC 00 7C 16 07   .......3.....|..
1428:0040  BB 78 00 36 C5 37 1E 56-16 53 BF 2B 7C B9 0B 00   .x.6.7.V.S.+|...
1428:0050  FC AC 26 80 3D 00 74 03-26 8A 05 AA 8A C4 E2 F1   ..&.=.t.&.......
1428:0060  06 1F 89 47 02 C7 07 2B-7C FB CD 13 72 67 A0 10   ...G...+|...rg..
1428:0070  7C 98 F7 26 16 7C 03 06-1C 7C 03 06 0E 7C A3 3F   |..&.|...|...|.?

-d 2600

14FD:2600  45 58 50 41 4E 53 59 53-54 58 54 20 00 6E AA 44   EXPANSYSTXT .n.D
14FD:2610  49 34 49 34 00 00 DB 4C-84 2D 02 00 91 06 00 00   I4I4...L.-......
14FD:2620  52 45 41 44 4D 45 20 20-42 47 20 20 00 BB 10 45   README  BG  ...E
14FD:2630  49 34 49 34 00 00 75 6E-C1 26 06 00 4F 07 00 00   I4I4..un.&..O...
14FD:2640  4E 45 54 52 49 50 20 20-44 4F 43 23 18 1B CD 76   NETRIP  DOC ...v
14FD:2650  7D 2A AA 2A 00 00 A1 7A-AA 2A 02 00 00 FE 01 00   }*.*...z.*......
14FD:2660  54 52 41 43 45 20 20 20-54 58 54 02 18 3D F7 53   TRACE   TXT .=.S
14FD:2670  53 30 53 30 00 00 9D 5B-36 2F 02 00 28 06 00 00   S0S0...[6/..(...
```

http://www.osdev.org/osfaq2/index.php/FAT12%20document
http://en.wikipedia.org/wiki/Interleaving