

Computer Network Fundamentals



Computer Network Fundamentals (Teacher Pack)

Table of Contents

Table of Contents-----	2
Objective for Course-----	4
Course Type-----	4
Length of Course-----	4
Resources required -----	4
1. Lesson Plan -----	5
Lesson Number: 1 of 2-----	5
Lesson Number: 2 of 2-----	6
2. Topic Introduction -----	7
What is Networking?-----	7
How do Networks help us?-----	8
3. Practical Application of the Technology-----	9
What are the Fundamentals of Networking?-----	9
Network Types - LANs, MANs and WANs...-----	10
LAN Network Topology-----	10
Considerations when choosing a topology...-----	12
Network Design -----	12
Client/Server -----	12
Peer to Peer (P2P) -----	13
So which is more efficient?-----	13
Components of a Computer Network -----	13
Principles of Network security-----	15
Simple ways to protect your Network-----	16
4. Student Engagement with Topic -----	17
Interactive Networking Tutorial – complete a ten-minute course online-----	17
Hang the skeleton – play an interactive game to test your understanding of Networking Fundamentals.-----	17
Multiple Choice Questions – What do you remember?-----	17
5. Industry Exposure-----	19
Prepare for a career in Programming – Things you can do straight away! -----	19
Delve in and see if you like it!-----	20

What do the experts say...?	21
6. Course Conclusion	21
7. Appendix	22

Objective for Course

This course teaches students the building blocks of modern network design including the many different types of networks, networking concepts, network architecture, network communications and network design.

Course Type

Elective

Length of Course

It is envisioned that this course should take two classes to complete.

Resources required

- Internet access is required to run the student presentation. (Produced using Microsoft Sway).
- Projector and screen are required for display.
- Good quality audio/video is required to listen to/watch the embedded YouTube videos.

1. Lesson Plan

Lesson Number: 1 of 2

Lesson Objective: To cover the following:

What is networking?

How networks help us

Fundamentals including network types, topologies and design

Lesson Content: All material provided in 'Taster Course' teacher pack.

Method of Delivery: Sway presentation - <https://sway.com/H1ifD5KUZdLWkhFz>

In-class Activity:

Watch all embedded YouTube videos

Equipment Required: PC or laptop, projector, audio/video display plugins

Projected Duration: One 45-minute class

Learning Outcomes: Overview of Computer Networking and introduction to networking concepts and theory.

Lesson Number: 2 of 2

Lesson Objective: To learn about the following:

Components of a network

Principals of network security

Ways to protect your network

Key concepts – complete an interactive course, play an interactive game and complete a quiz online

Lesson Content: All material provided in 'Taster Course' teacher pack.

Method of Delivery: Sway presentation / online resources including a course, a game and a quiz - <https://sway.com/H1ifD5KUzdLWkhFz>

In-class Activity:

Watch all embedded YouTube videos

Revision– complete an interactive course online

Revision – play an interactive game online

Revision – complete a quiz online

Equipment Required: PC or laptop, projector, audio/video display plugins

Projected Duration: One 45-minute class

Learning Outcomes: Know the components of a network and understand the importance of Network Security. Revise all concepts learned by completing a number of interactive resources online.

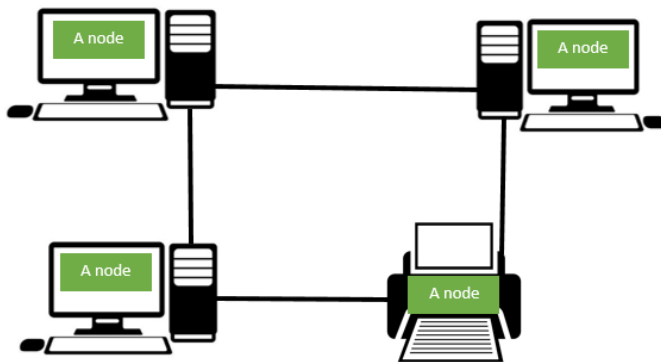
2. Topic Introduction



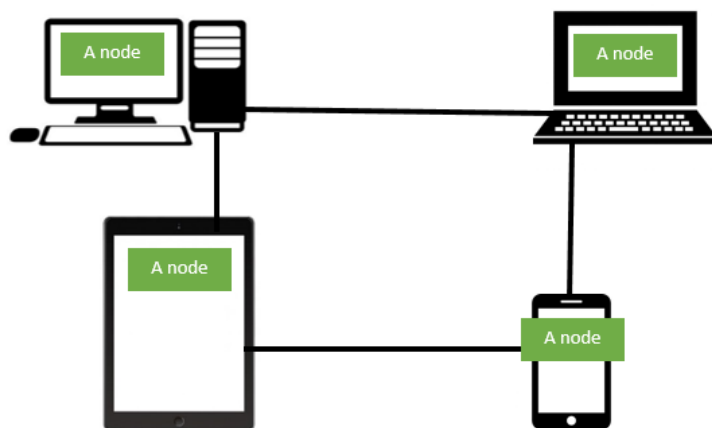
Open the **Computer Network Fundamentals** presentation and display on projector screen: <https://sway.com/H1ifD5KUZdLWkhFz>. Navigate through the SWAY.

What is Networking?

A computer network is a set of two or more computers connected to each other. Once joined together these computers can share files together and also share devices like printers which are on the same network.



The network is connected with wires, either physical wires or wireless links, so the various separate devices (known as nodes) can "talk" to one another and swap data. Nodes refer to desktop computers, laptops, tablets, mobile phones, smart TVs and Gaming Consoles.



Nodes could mean desktop computers, laptops, tablets or mobile phones.

The network is probably one of the best inventions in the history of the computer because you would not be sitting here now using Internet Explorer or Google Chrome (the world wide web – www) to view this tutorial without networking technologies. Yes, the internet is also a large network.



The internet is a large network!

How do Networks help us?



Network

technology helps us every day as we work and play!

Communication

People can communicate with others all over the world at a very low cost using e-mail, chat, telephone, video telephone, video conferencing and SMS (Short Message Service and is also commonly referred to as a "text message") services

Video Conferencing has aided in more efficient and economic global communications.



Sharing Resources

In a network, resources such as printers, scanners, fax machines and modems can be shared among the users.

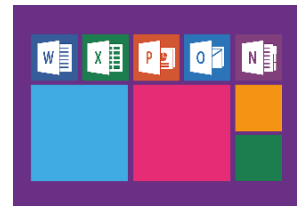
Networking a printer allows everyone in the same classroom or office print to the same machine.



Sharing Software

Application programmes (known as Apps) and software are generally stored on the central computer server and are accessible to any workstation connected to this network.

Programmes such as Microsoft Office can be stored centrally on the server and accessed by all workstations on the network.



Sharing Data

Users on a network can access data stored on other computers and on the internet. Known as Databases, these systems are used in companies to hold information such as customer, product or employee information. Database information can be stored in-house on a computer server or in the Cloud.

Cloud Services allow companies to store their data in large online servers using the internet. This makes this data accessible anywhere once there is an internet connection.

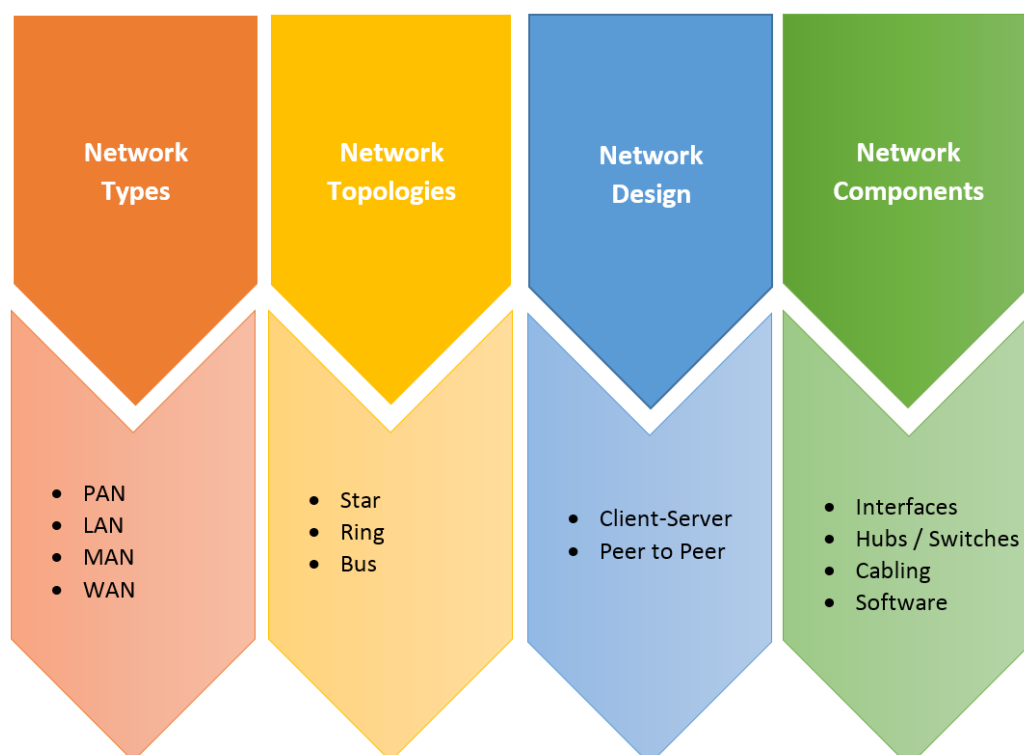


Watch embedded video: [**What is the cloud?**](#) (3:49m)

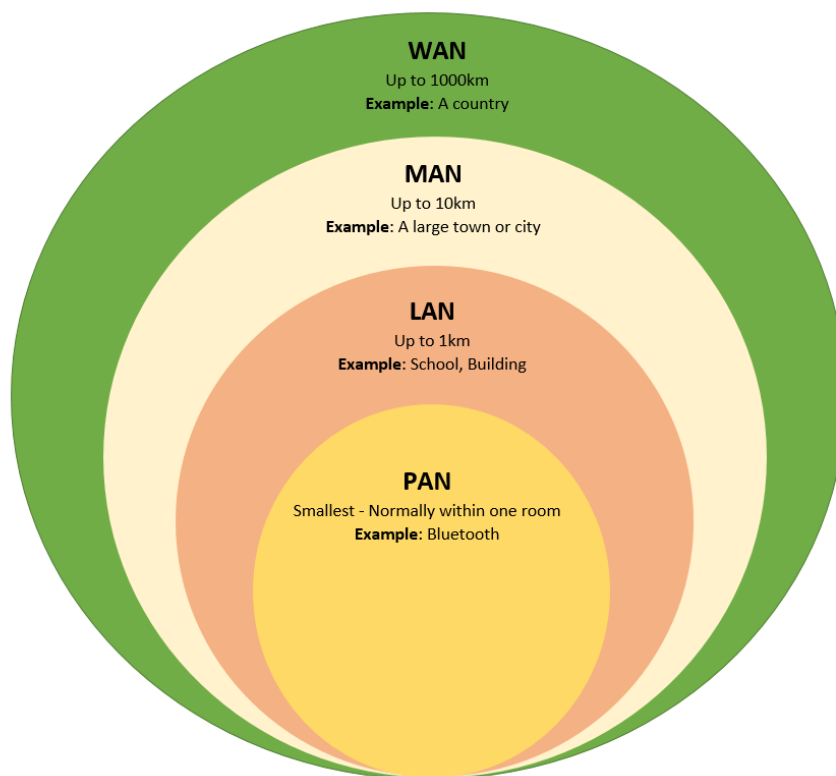
3. Practical Application of the Technology

What are the Fundamentals of Networking?

Networks are divided up into fundamental parts which include types, topologies, designs and components. These parts will all have a bearing on which network type companies will choose as the needs of each business is different.



Network Types - LANs, MANs and WANs...



Not all computer networks are the same - some are small and some are very large!



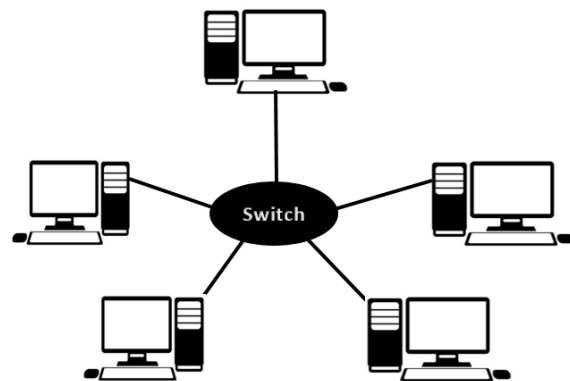
Watch embedded video: [Types of Networks](#) (7:55m)

- The smallest form of network is **PAN (personal area network)**. PAN is used for communication among computer devices, including mobiles phones, laptops and gaming consoles in a limited area - approximately the size of a room! The reach of a PAN is generally only a few meters. This network type is generally wireless. Bluetooth is an example of this type.
- If you are using a computer in a school, you probably use a **LAN (local area network)**. A LAN is chosen as a network solution in a limited geographical area such as home, school, computer laboratory or office building.
- **MANs (metropolitan area networks)** cover a larger area than the LAN. As the name suggests, MANs covers whole cities or large towns. Even some of the bigger universities opt for this solution.
- **WANs (wide area networks)** consists of several LANs connected together over the internet. WANs covers the largest geographical area of all networks. The internet is an example of a WAN that covers the entire world. (Woodford, 2016)

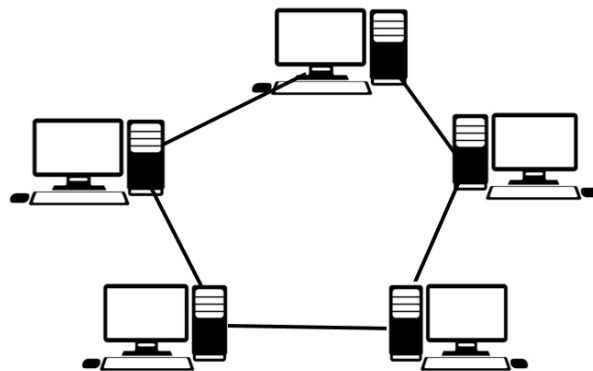
LAN Network Topology

For LAN networks to perform without experiencing problems, they must be organised into strict patterns which has become known as "Network Topology". You can connect nodes, cables and peripherals in:

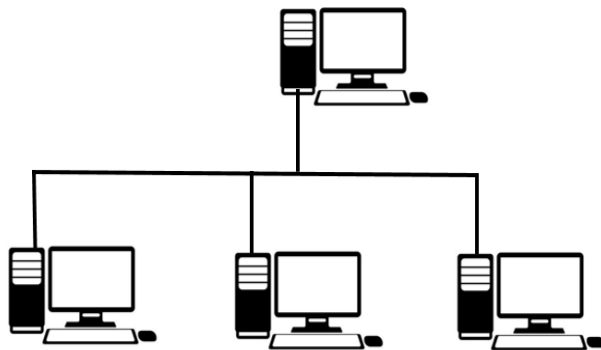
Star Patterns - Each node has a dedicated set of wires connecting it to a central network hub. Since all traffic passes through the switch (formally known as a hub), the switch becomes a central point for isolating network problems and gathering network statistics. Many home and office networks use the star topology. A failure in any star patterned LAN will only take down one computer's network access and not the entire LAN. (If the hub fails, however, the entire network also fails.)



Ring Patterns - All messages/data packets travel through a ring in the same direction (either "clockwise" or "counter clockwise") from one network device to the next and features a closed loop. A failure in any cable or device breaks the loop and can take down the entire network. Ring patterns can be found in some office or on school networks.

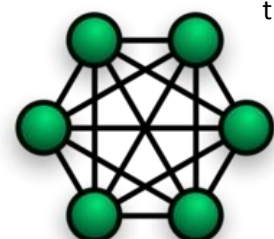


Bus Patterns - Each node attaches directly to a common single cable. The backbone functions as a shared communication medium that devices attach or tap into with an interface connector. A device wanting to communicate with another device on the network sends a broadcast message onto the wire that all other devices see, but only the intended recipient actually accepts and processes the message. Bus patterns work best with a limited number of nodes. If more than a few dozen computers are added to a network bus, performance problems may result. In addition, if the backbone cable fails, the entire network effectively goes down.



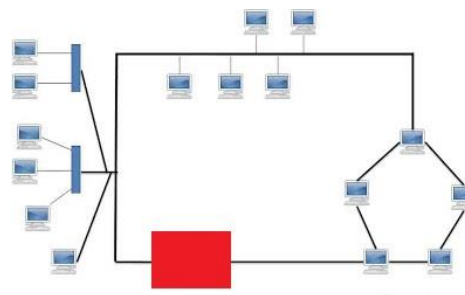
Watch embedded video: [Network Topology](#) (10:35m)

Mesh is where all the network nodes are individually connected to most of other nodes. There is not a concept of a central switch, hub or computer which acts as a central point of communication to pass on the messages. Installation and configuration can be difficult and expensive in this pattern however it is robust and provides security and privacy.



the

Hybrid refers to integrating two or more different topologies. This combination of topologies is done according to the requirements of the company. For example, if there exists a ring topology in one office department while a bus topology in another department, connecting these two will result in Hybrid topology. Star-Ring and Star-Bus networks are most common examples of hybrid network. While this topology has positives such as reliability and effectiveness, it is costly and complex in design and infrastructure. (Network Topologies, 2016)



Considerations when choosing a topology...

1. **Cost:** A linear bus network is the cheapest option to install.
2. **Cable type:** The most common cable in schools is unshielded twisted pair, which is most often used with star topologies.
3. **Length of cable needed:** The linear bus network uses shorter lengths of cable.
4. **Future growth:** With a star topology, expanding a network is easily done by adding another switch.

Network Design

Sometimes called “Network Architecture”, Network Design focuses on the configuration and functionality of the network. There are two main designs:

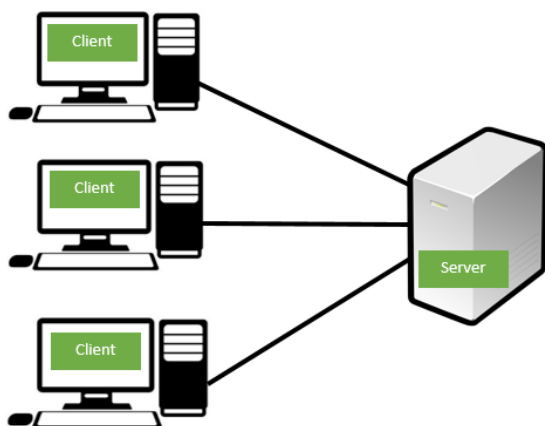
- Client/Server
- Peer to Peer (P2P)



Watch embedded video: [Client Server and Peer-to-Peer Networking](#) (2:46m)

Client/Server

In a **Client/Server Design**, one computer or dedicated storage device acts as a central storage unit for the network.

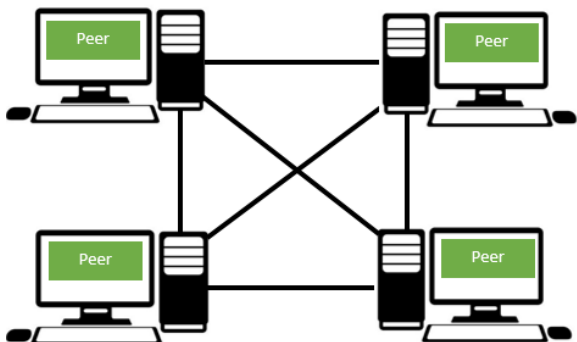


A **server** is a computer (node) that is a central storage unit for the network. This can be a computer or a dedicated server like the one in our image. Example are for files, emails, print and web servers.

A **client** is a node that requests some service from a central server

In this Network Design, one node acts as a server that provides the services, and the other nodes (clients) request services from the server. Generally, a server is a powerful device with good processing power and storage capacity.

Peer to Peer (P2P)



In a **Peer to Peer Design**, all nodes (peers) have equal capabilities to use the resources available on the network. There is no central server. This network is a good choice for needs of small businesses where the users are situated in the same area and the business does not think it will grow.

So which is more efficient?

Review the advantages and disadvantages of both: (Understanding the differences between client/server and peer-to-peer networks, 2016)

Client/Server Design	Peer to Peer Design (P2P)
Advantages	
<ul style="list-style-type: none"> • Hard to set up, specialist knowledge required. • All files are stored in a central location. • Peripherals such as printers are controlled centrally. • Data can be backed up and security can be controlled centrally. • All clients can access data which is centrally controlled. 	<ul style="list-style-type: none"> • Easy to install. • All the resources and contents are shared. • Reliable as there is no dependency on a central server. If one peer fails, there is no impact on other peers. • No need for System Administrator, users can administer. • Cost to build and maintain is low.
Disadvantages	
<ul style="list-style-type: none"> • Specialist staff is required i.e. Network Manager • A dedicated server can be expensive to purchase. • If any part of the network fails, a lot of disruptions can occur. 	<ul style="list-style-type: none"> • Difficult to administer as no centralised system in place. • Difficult to add security as no centralised system in place. • Data recovery or backup is very difficult. Each computer would have its own back-up system.

Components of a Computer Network

Interfaces



Every device on the network has network interface of some kind. Referred to as a **NIC (network interface card)**, it is generally integrated into a computer's motherboard. It can also come as a separate card. This component takes data packets/ information from the computer and sends it out onto the network cable, or into the air in the case of a wireless network.

Hubs / Switches

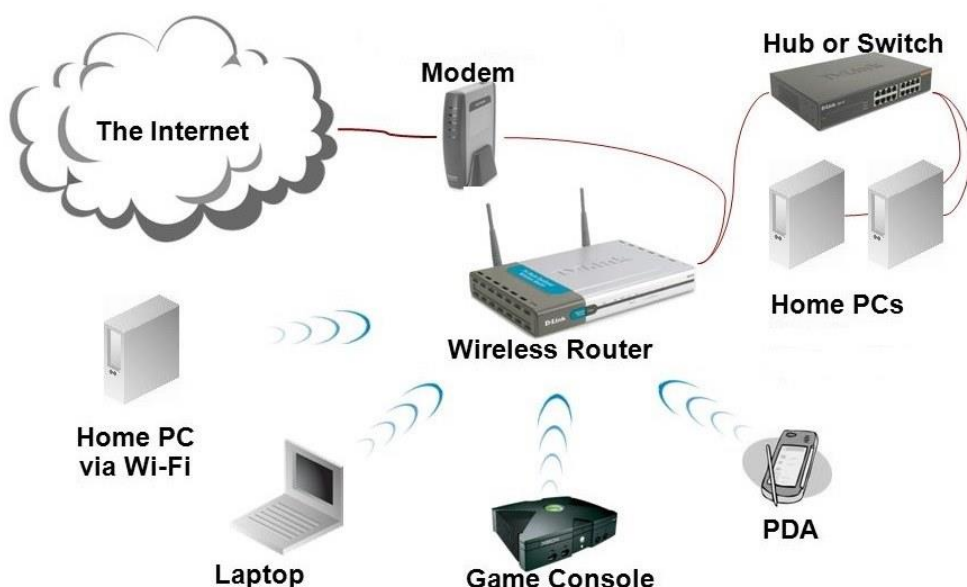


When you connect multiple workstations on a network, they plug into a central device known as a "**Hub**". The hub has the job of moving the network signal from one cable to another. Lately, "**Switches**" have replaced the hubs because they are able to keep up with which computer is on which switch port (connection). A switch does not transmit all information to all other computers on the switch, just to the destination computer. Switching technology helps to reduce congestion on a network and should be used for networks of 10 or more computers.

Routers

In addition to using switches, network technicians use "**routers**" to connect one local area network (LAN) to another, many times across and across long geographic areas using commercial data carriers.

A **router** has a lot more capabilities than hubs/ switches, as they can analyse the data being sent over a network and send it to another network or over a different network. In home networks, routers are commonly used to share an Internet connection between multiple computers.

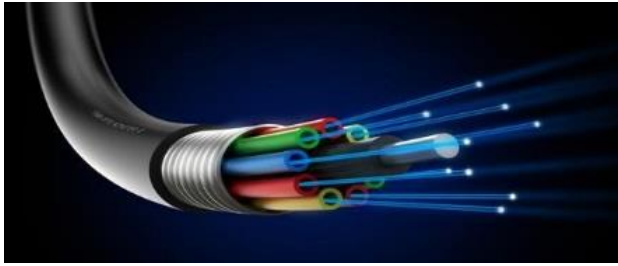


In this example of a home network, a wireless router is being used to share out internet access to all wi-fi enabled devices in the home. Additionally, by plugging in the hub/switch to the router, internet access is also being shared to the two desktop computers wired into this network.

Cabling



In order to make any network work or connect together, cabling (sometimes referred to as media) of some kind is required. **Ethernet cabling** is extremely common and has several types. The higher the cable rating i.e. Cat5, Cat6, Cat7, the higher the bandwidth (speedier the connection) the cable can support.



Recently there has been a growth in the use of **fibre optic cabling**, which is more expensive. **Wireless** has become popular in homes due to the ease and low expense of setting up a network. The media for a wireless network is the air, through which the wireless NICs transmit radio signals that carry information.

Software (Protocols)

Software is required so all of the components function together. Network protocols define a language of instructions for communication between the network nodes. It is essential that a networked computer have one or more protocol drivers. Usually, for two computers to connect on a network, they must use the same protocols. Network protocols like HTTP and TCP/IP offer a basis on which much of the Internet stands.



Watch embedded video: [What is TCP/IP?](#) (6:10m)

Principles of Network security

With network security in place, your home or business network is protected against security threats which spread over the Internet (network).



The most common include: (Sanchez, 2010)

Viruses: A small piece of software that can spread from one infected computer to another. The virus could corrupt, steal, or delete data on your computer.

Trojan horses: Users can infect their computers with Trojan horse software by downloading an application they thought was legitimate but was in fact malicious. Once inside your computer, a Trojan horse can do anything from record your passwords to hijacking in-built video camera to watch and record your every move.

Worms: They can copy themselves from one computer to another, without your interaction. They can replicate in great volume and with great speed. For example, a worm can send copies of itself to every contact in your email account.

Spam: This is unwanted messages appearing into your email inbox. Spam, or electronic junk mail, is a nuisance as it can clutter your mailbox as well as potentially take up space on your mail server.

Phishing: Pronounced "Fishing"- these threats are fraudulent attempts by cybercriminals to obtain private information. For example, you could receive a very legitimate looking email from your bank trying to lure you into giving your personal information.



Watch embedded video: [Computer Security Tutorial](#) (9:24m)

Simple ways to protect your Network

Install all updates

The first step is to make sure that all of your devices have the latest operating system, web browsers and security software. This includes mobile devices that access your wi-fi network. This is the best defence against viruses, phishing and other online threats.

Protect your router

Change the name and password of your router. When creating a new password, make sure it is long and strong, using a mix of numbers, letters and symbols.

Plug and scan

USBs and other external drive devices can be infected by viruses. Use your security software to scan them.

Protect banking information

If banking or shopping online, check to be sure the sites is security enabled. Look for web addresses with "https://" or "shttp://," which means the site takes extra measures to help secure your information. "Http://" is not secure.

Back it up

Protect your valuable work, music, photographs and other digital information by making an electronic copy and storing it safely. (Hayward, 2016)

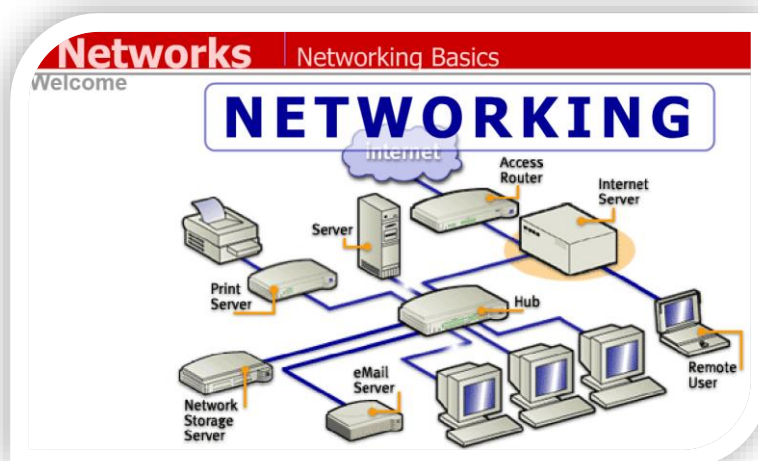
4. Student Engagement with Topic

Interactive Networking Tutorial – complete a ten-minute course online



Follow this link to open the tutorial (10:00m):

http://flytrapinteractive.com/~personal/networking/Networking_Basics.swf



Hang the skeleton – play an interactive game to test your understanding of Networking Fundamentals.



Follow this link to open the game (5:00m):

http://www.teach-ict.com/gcse_new/networks/computer_networks/quiz/hgm_networks.htm



Multiple Choice Questions – What do you remember?



Follow this link to open the Quiz (5:00m):

https://forms.office.com/Pages/ResponsePage.aspx?id=z0c6mHesd0qIU_tNhYhZKBtkP7o_mKVBj-tYrTzB_IRUNkpMU0sxR0k2TklXWk4zQIFaMlBRQzc2Ry4u



Advice for Teachers

The quiz has been embedded in the SWAY presentation so you can complete it as an in-class exercise.

Alternatively, the same quiz has been created in Kahoot, a free game-based learning platform that makes it fun to learn.

Test the student's knowledge of IT with this fun, interactive quiz.

Students: They require a pc, laptop or smart phone with internet connection. They answer the questions with their devices.

Teachers: You will need to launch this quiz using a laptop or PC connected to a projector, as students will need to see the questions. Copy the link below into an internet browser:



<https://play.kahoot.it/#/k/32b1fc28-dbd4-4d9f-a867-8ce9e792d95c>

Create a Kahoot account in order to play the quiz.

Once logged in, press 'Play' and then 'Start Now'. Select the 'Classic' player option on the left.

Now ask the students to go to kahoot.it and enter the Game PIN at the top of the screen.

Once they have done this, they can enter the quiz. It is against the clock so the fastest correct answer gets the most points!

5. Industry Exposure

Prepare for a career in Networking – Things you can do straight away!

Be a good communicator

Take part in group projects at school. While networking has been perceived as being a loner's job, the opposite is actually the case! If you work for a company, you will be part of a development team and be expected to communicate and work well with others. Simple practices such as reading text out loud, publishing an article on the web or facing

critiques can help you prepare for working in a team environment.

Approach problems logically

Compare networking to putting a jigsaw together: you need to work out how to connect one piece of your programme to another, and it is not always easy. Break it down and make it simpler. Learn to draw out your topology into flowcharts. Simple things like making jigsaws and playing sudoku will also help!

Be patient and set realistic goals

If you are looking to eventually have a networking job full-time, lots of patience is a must because you are expected to spend a great deal of time working with anomalies and trying to solve system errors. Learn to tackle problems in small pieces rather than entire chunks. Set achievable and realistic goals for yourself!

Learn how a computer works

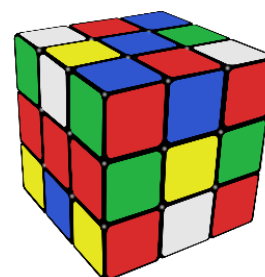
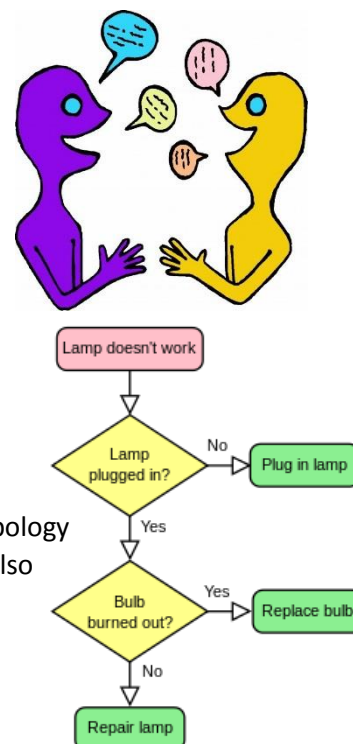
It will help in the future, if you have a solid understanding of the workings of a computer. Knowledge of operating systems, network technologies and software can also help! There are lots of excellent free video tutorials and presentations available online to help.



Watch embedded video: [Inside your computer](#) (4:12m)

Learn how to create small networks online

The internet is full of free resources and videos demonstrating how to create small Networks. Also, see our 'Follow on Resource Pack' for help.



Delve in and see if you like it!



I want to be a Network Technician

Sometimes called "Tech Support", the technician generally services, troubleshoots and fix problems on the network. It will be helpful to know about the different operating systems such as Microsoft, Novell and Unix. Investigate courses which include qualifications in Microsoft Technology Associate (MTA), Cisco Career Certifications and CompTIA.

I want to be a Network Administrator

If you want to get into the admin side of networking, you should find out more about creating network user accounts and managing resources on computers in the network. Experience in correcting problems on the network involving nodes and peripherals will help.

I want to be a Network Engineer

To work in this area, you will have to perform tasks such as installing and configuring network hardware and software, troubleshooting operations to ensure continuous network availability and providing technical support and assistance.

I want to be a Network Analyst

A network analyst assesses the success of the current network solution always looking for improvements. Their role is to research and coordinate system enhancements (updating software and hardware). They also produce network policies and procedures.

What do the experts say...?



Watch embedded video: **Careers in IT Networking** (2:46m)

6. Course Conclusion

Thank you for completing the **Computer Network Fundamentals** Taster Course and being part of the GYIT programme.

All students who participate in the GYIT programme will also receive a **Follow on Resource Pack**. This will comprise a comprehensive list of free and open source websites and tutorials so students can continue on their programming journey.



For further information on the GYIT programme, please visit our website: **[Click here>>](#)**

7. Appendix

Hayward, D. (2016, April 17). *How to secure your home network from hackers*. Retrieved from Trusted Reviews: <http://www.trustedreviews.com/how-tos/how-to-secure-your-home-network-from-hackers>

Network Topologies. (2016, November 15). Retrieved from Edraw Visualisation Solutions: <https://www.edrawsoft.com/Network-Topologies.php>

Sanchez, M. (2010, December 9). *The 10 most common security threats explained*. Retrieved from Blogs.cisco.com/: <http://blogs.cisco.com/smallbusiness/the-10-most-common-security-threats-explained>

Understanding the differences between client/server and peer-to-peer networks. (2016, November 15). Retrieved from IT-ASEAN: <http://it-asean.blogspot.ie/2014/10/understanding-differences-between.html>

Woodford, C. (2016, March 18). *Computer Networks*. Retrieved from Explain that stuff!: <http://www.explainthatstuff.com/howcomputernetworkswork.html>