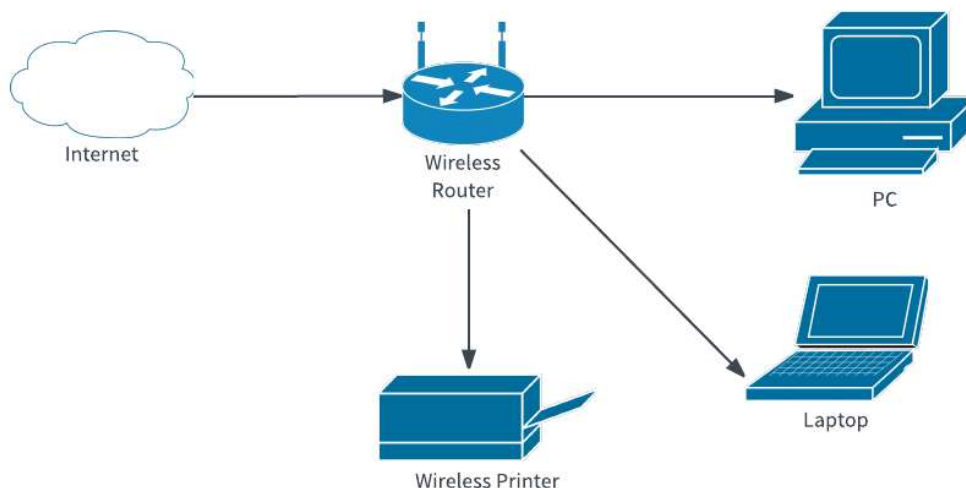# Networks

4 Networks

A network is a collection of computers and other computing devices (typically servers and printers) that are connected to one another to share resources and possibly exchange data, files etc.

In its simplest form the computers and printers are connected to a central hub or switch either wirelessly or using cables (or a combination of both). These days the network is usually created in conjunction with an Internet connection that allows the Internet connection to be shared between multiple devices such as computers, tablets and phones. Other devices such as servers, printers and scanners may also be connected so they can be shared between the various computers (and tablets, phones etc.).

4.1 Home network

4.1.1 Components of a home network:

1. Router – the router is used to connect various devices to the network. Devices may be connected to the router by cables (hard-wired) or wirelessly (Wi-Fi). Usually the router is connected to the Internet so all the local devices can access the Internet.
2. Modem – The modem might be separate from the router or built-in. The most common Internet systems are ADSL and cable. The modem converts the electrical signals to computer code.
3. Computer – usually there is at least one computer, it might be a laptop or a desktop (workstation), or maybe both or more.
4. Printer – if there is more than one computer there may also be a printer that can be shared between the computers.
5. Tablet or phone – usually connected wirelessly.

4.2 Building a home network

Most people create a network at home to access the Internet from a computer and or a tablet or phone. The first step is to sign up with an Internet Service Provider (ISP) (eg Telstra, Optus, iiNet, MyRepublic, etc). Typically, the deal will include a wireless router and, if necessary, a modem.
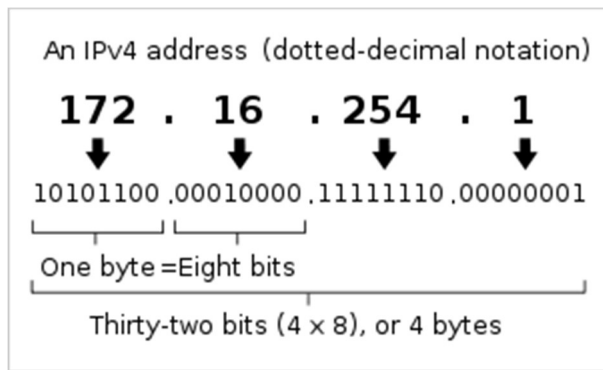
The router will usually come configured with default settings such as network name (SSID) and a password. It will also come with a set of instructions on how to get it working.
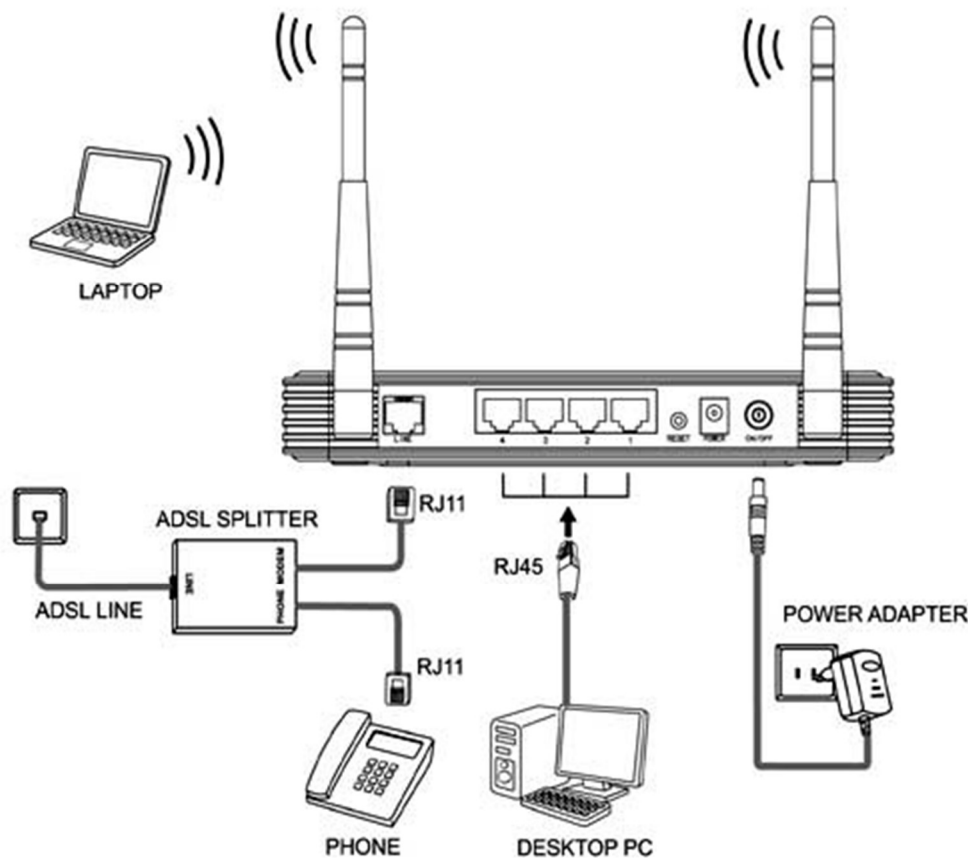
This diagram shows a cable wireless modem-router. Generally, all that is necessary is to plug the devices together and they should start working (at least that is ideal). The ISP will usually provide phone help, but if you need someone to help, there are companies that will do the work for a fee.

4.3 Communication between devices

Every device on the network has an address known as its *IP address*. This address is a 32-bit number expressed in a dotted-decimal format, to make it easier to read.

An IPv4 address (dotted-decimal notation)

172 . 16 .254 . 1

10101100 .00010000 .11111110 .00000001

One byte =Eight bits

Thirty-two bits (4 × 8), or 4 bytes

The router uses the IP address to direct messages to an individual device on the network. In the case of a home network, IP addresses are usually assigned by a DHCP (Dynamic Host Configuration Protocol) service in the router. On larger networks, fixed addresses for things like printers and routers are sometimes assigned by the network administrator, so that she can easily communicate with them when necessary.

The router on a home network will typically have an address like `192.168.0.1`.

4.3.1   Private addresses

IP addresses are normally allocated in ranges. There are public addresses (as used on the Internet) and private addresses (as used on home or business networks).

A typical home network uses an address range of `192.168.0.1` to `192.168.0.255`, which allows for up to 255 devices on the network – should be plenty for most people.

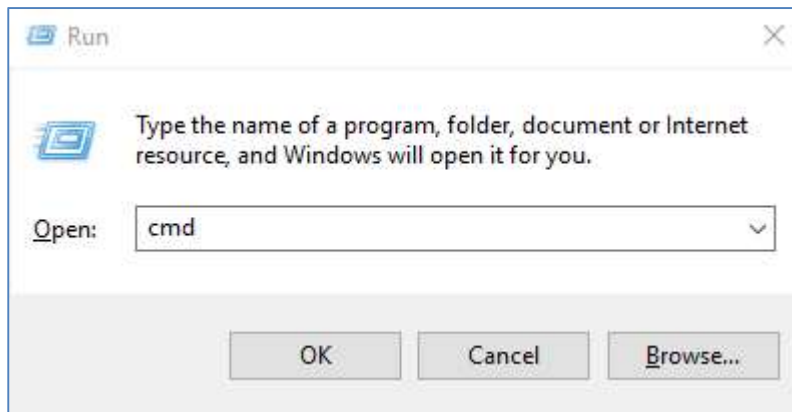| Start	End	Number of IP addresses
192.168.0.0	192.168.255.255	65,536
172.16.0.0	172.31.255.255	1,048,576
10.0.0.0	10.255.255.255	16,777,216

4.3.2   Find an IP address

4.3.2.1   Windows

To find the IP address of the Windows PC you are using and the IP address of the router:

1. Type `Win + R`

2. Enter `cmd` to get the command prompt

3. Run `ipconfig`

The IP address of the computer is shown as the IPv4 Address (`192.168.50.144` in this example).
The IP address of the router is shown as the Default Gateway (`192,168.50.1` in this example).

4.3.2.2 Apple Mac
This is how to find the IP address of your Mac (and other Unix systems)through the Terminal:

1. Launch the Terminal located in /Applications/Utilities/
2. Type the following command:
   ```
   ifconfig |grep inet
   ```
3. You will see something that looks like this:
   ```
   inet6 ::1 prefixlen 128
   inet6 fe80::1%lo0 prefixlen 64 scopeid 0x1
   inet 127.0.0.1 netmask 0xff000000
   inet6 fe80::fa1e:dfff:feea:d544%en1 prefixlen 64 scopeid 0x5
   inet 192.168.0.100 netmask 0xffffff00 broadcast
   192.168.0.255
   ```
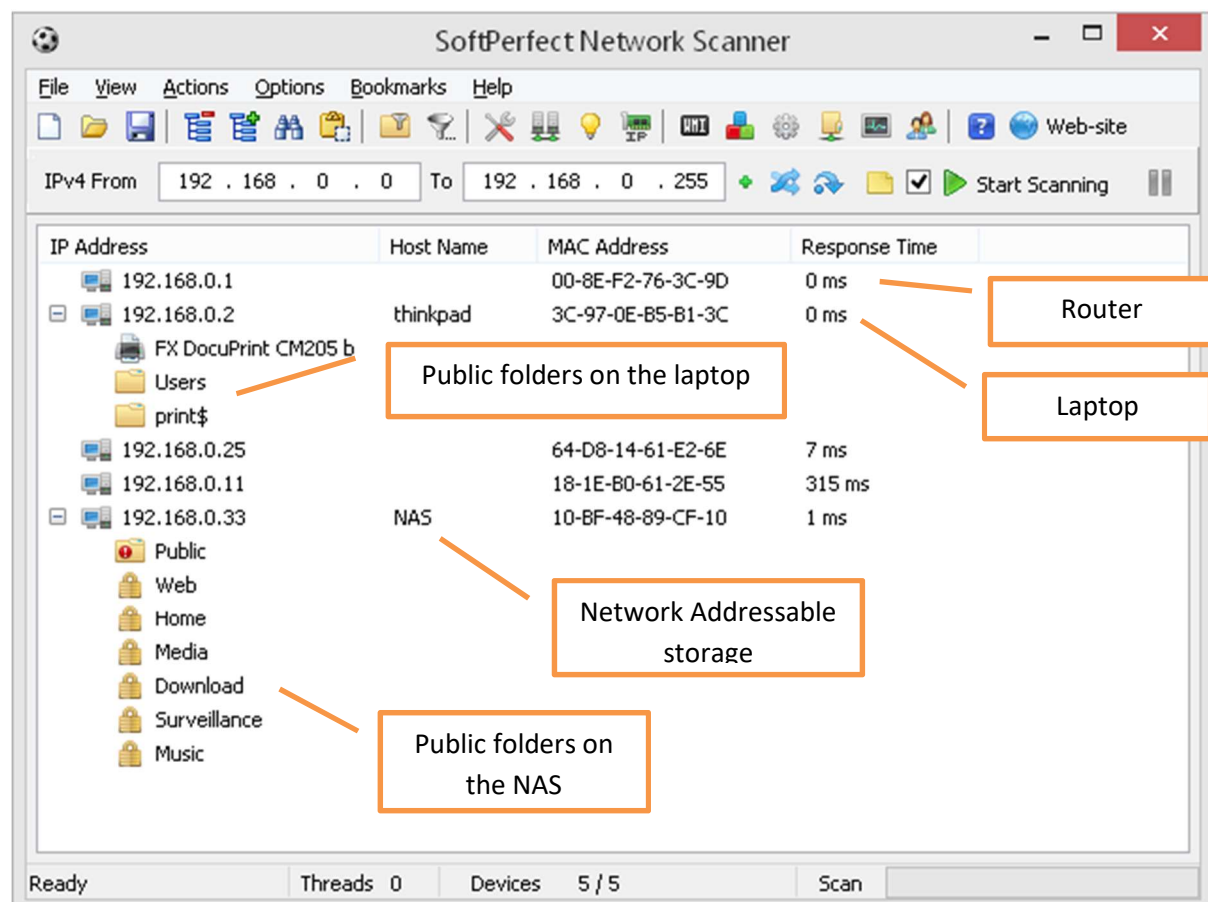
To find your router address:

1. type the following command:
   ```
   netstat -nr | grep default
   ```
2. You will see something like this:
   ```
   default 192.168.0.1 UGSc 50 46 en1
   ```

4.3.3   Network scanner

To find the IP addresses of all the local devices on your network, you need to use a network scanner such as netscan (on a PC and Mac) or iNet on an iPhone.

4.3.4   MAC address

4.3.4.1   *Windows*

From the command line (cmd) enter the command getmac:

This returns the MAC (Media Access Control) address of the network interface controller (NIC) in the computer. This is the hardware address of the computer expressed in hexadecimal. This address is often used to control access to a wireless (Wi-Fi) network.

4.3.4.2   *Apple Mac*

1. Launch the Terminal located in /Applications/Utilities/
2. Type the following command:
   ifconfig
3. You will see something that looks like this:

4.3.5   Access points

A wireless access point (WAP) is a device hard-wired to a network to add or extend Wi-Fi coverage.

4.4   Secure your network

Your router is used to join your local network to the Internet. It consists of two major parts:

1. LAN (Local Area Network) – everything connected to your home network (computers, phones, tablets, printers, etc). The router has an internal or private IP address on this side.
2. WAN (Wide Area Network) – in the context of a home network this means the Internet. The router has an external or public IP address on this side.

4.4.1   Secure your Wi-Fi network

Find the internal IP address of your router (gateway address) using the method shown above or as follows (Windows):
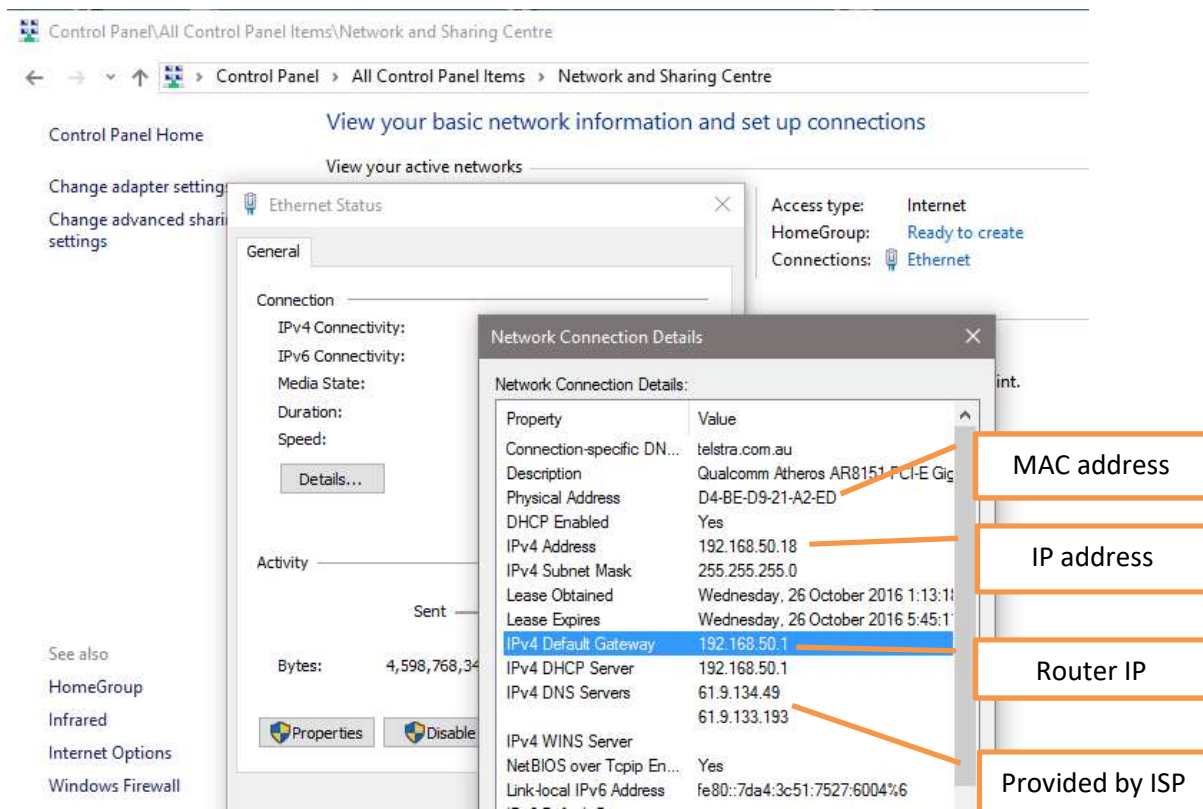
This is part of the LAN side and is possibly the most vulnerable part. Once you get the system working it is imperative that you configure the following on the router:

1. Connecting
   a. Locate the IP address of your router (listed as *Default Gateway*)
   b. Use your browser and enter the IP address of the router in the address line (`192.168.50.1` in the example)
   c. A login screen should appear:

   d. If you can't get to this point, then it is time to seek help.
2. Change default settings:
   a. Change the administrator's username and password.
   b. Change the network name (SSD). Helps you identify which network is yours (especially if you live in a block of flats).
   c. Change the Wi-Fi password (Network key), so that your neighbours can't get a free ride on your network.
3. Ensure encryption is set to WPA2

4. Disable WPS (Wi-Fi Protected Setup)

5. Turn off guest networks

6. Consider filtering network access by MAC address (see below).
7. Update the router's firmware (if possible).

Remember: your router is a computer, so it can be hacked.

4.5 Glossary

Term	Meaning
ADSL	Asymmetric Digital Subscriber Line. High speed data connection using the existing copper telephone lines.

ASCII	American Standard Code for Information Interchange
BIOS	Basic Input/Output System. The basic software that controls the computer.
Bluetooth	Short range wireless communication system
Bot	Short for robot. An automated program usually performing some function on the Internet, sometimes for no good purpose
Cache	(Pronounced cash) – An area in memory used for storing data for future use.
CPU	Central Processing Unit
DIMM	Dual In-line Memory Module
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Service
DOS	Disk Operating System
DoS, DDoS	Denial of Service, Distributed DoS
FTP	File Transfer Protocol. An Internet service used for transferring large files.
HTML	HyperText Markup Language. Language used to create web pages.
HTTP	HyperText Transfer Protocol. Protocol to send web pages over the Internet.
HTTPS	Secure HTTP. An encrypted version of HTTP.
Hub, switch	A basic device for connecting computers to a network.
IMAP	Internet Message Access Protocol. A protocol to allow email clients to retrieve email messages from a mail server.
IP address	Internet Protocol address. Unique address a computer has on a network.
ISP	Internet Service Provider. A company that provides a connection to the Internet.
LAN	Local Area Network. A network that connects computers locally – in the same room or building.
MAC address	Media Access Control address. Unique code that identifies a device on a network.
Modem	Modulator-Demodulator. A device that converts the Internet signals into ones that can be accessed by computers and Wi-Fi-enabled devices.
NetBIOS	The networking language used on Microsoft Networks.
OS	Operating System. A master program that runs the computer. Applications communicate with the outside world via the operating system.
PGP	Pretty Good Privacy
POP	Post Office Protocol. A protocol for retrieving email from a server. Similar to IMAP, but less powerful.
RAM	Random Access Memory
SMTP	Simple Mail Transfer Protocol. A method for sending email to a mail server.
SSID	Service Set ID. The name of a wireless network to allow devices to connect.
SSL	Secure Sockets Layer. A standard for encrypting communication across a network.

TCP/IP	Transport Control Protocol/Internet Protocol.
UAC	User Access Control. A method used by Windows to try to protect itself from unwanted system access (eg when installing software).
Unix	A widely-used operating system. OSX and Linux are based on Unix.
URL	Universal Resource Locater. An Internet address.
USB	Universal Serial Bus. A standard for connecting devices to a computer.
VPN	Virtual Private Network. A method used to connect a computer to another on another network using an encrypted link.
Wi-Fi	Wireless Fidelity

4.6 Links

- http://au.pcmag.com/networking/9898/feature/12-ways-to-secure-your-wi-fi-network
- http://howtogeek.com/168379/10-useful-options-you-can-configure-in-your-routers-web-interface/
- http://howtogeek.com/68403/how-to-secure-your-wi-fi-network-against-intrusion/
- http://jonstorm.com/glossary/
- http://pcrescue.com.au/jargon.htm
- http://tomsguide.com/us/home-router-security,news-19245.html
- https://whatismyipaddress.com/