The Internet

A Quick Guide

Introductory Level

Designed for iPad. Applicable to other devices.

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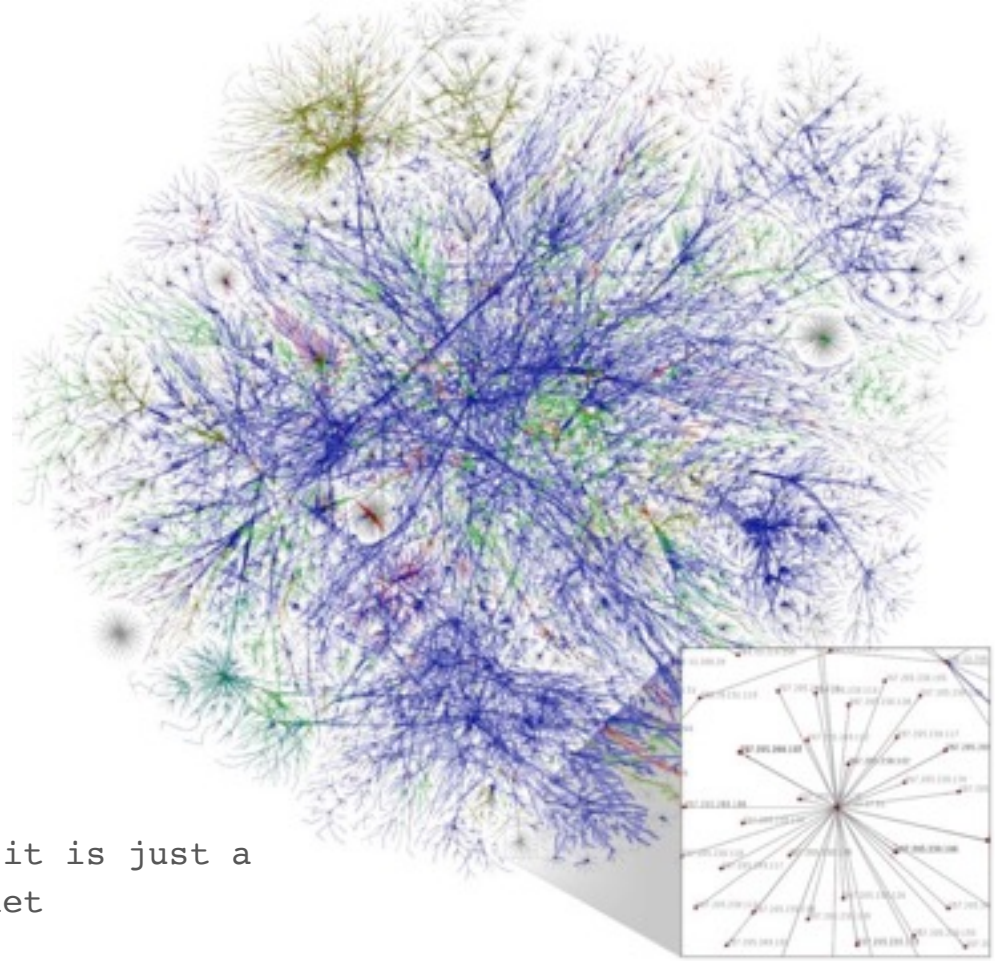
GUARDRAIL Tutorials

the Internet

The **Internet** is really a network of networks. These networks are connected by a lot of internet infrastructure. At the hardware level the infrastructure consists of countless routers, servers, cell phone towers, satellites etc all interconnected through a web of different types of cables, nodes and wireless transmission points etc. The web of the internet looks something like this:



... well actually it is just a part of the internet

The Internet

… components

The internet is complex, and with so many potential points of failure, it is a wonder that it even works at all. However, there is an incredible amount of redundancy built into it. If a section, or sections, of the internet go down, internet traffic will be routed, or redirected, through alternative routes that cross various other networks. This is achieved by intelligent routers that monitor the status of connections and send data packets along the path of least resistance.

Hardware components of the internet consist mostly of telecommunications cables and equipment, including the following:

- Cables
- Routers
- Servers
- Wireless transmitters
- Cell phone towers
- Communications Satellites

Cables

Many types of cables make up the internet and peripheral connections, some examples of which are:

T1 Cable
A trunk line, usually of fibre optic cable (can also be copper) with the familiar RJ45 connector. Capable of carrying 24 digitised voice channels, or data at 1.54Mbps.

T3 Cable
Normally 24 T1 lines bundled together, increasing the throughput potentially to 42.23Mbps.

Fibre Optic Cable
These contain strands of glass fibre and can carry large amounts of data over vast distances, virtually at the speed of light. Some unique features are:

- data is transmitted as light pulses through the cable
- a laser transmitter is used to encode light pulses into data
- unaffected by 'noise' and electromagnetic interference

One of the main drawbacks with fibre optic cable however is its high cost and fragile nature. It cannot be spliced like copper cable. If a cable breaks, the entire length will normally have to be replaced.

Ethernet Cable
Any type of coaxial cable used to connect network devices, however, these days we generally refer to CAT5 and CAT6 cables with the familiar RJ45 connector as 'ethernet' cables (also commonly known as network cables). Some common uses are:

- connecting computers to routers and modems
- connecting routers to servers

... and many more

Routers & Servers

Router

Network connecting device. Routers are located between networks and they direct messages from one network to another based upon 'packet data'. They generally:

- contain configuration tables of network addresses
- prevent unwanted traffic from entering a network
- manage the flow of data across networks
- forward TCP/IP packets on to the next hop (or stage)
- store and translate domain names and IP addresses

... and many other functions

Cisco router rear end with numerous network connection ports

Server

A computer running a special server operating system which performs tasks for numerous client computers on a network, such as:

- providing email services
- storing and delivering web content
- providing protective firewalls
- storing and translating domain names and IP addresses (DNS)

... and many other functions

Most **web servers** on the internet (roughly 55% in 2013), run **Apache** web server software on a **Linux** operating system.

WiFi Antenna

Yagi Wireless Antenna

A type of high gain directional radio antenna used to extend the range of WiFi networks.

Parabolic WiFi Antennas

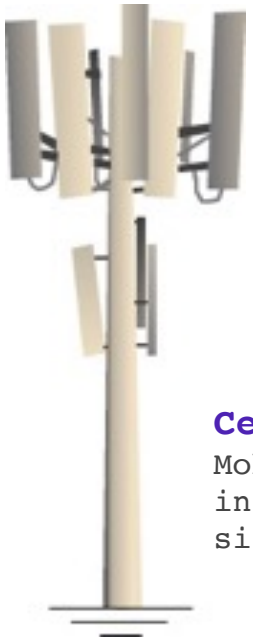
These come in a range of shapes and sizes, such as:

Dish Parabolic Antenna

Grid Parabolic Antenna

Parabolic Antennas can be sheet metal, metal screen or wire grill. A screen reflector, or wire grill, will work as long as the spaces are less than one tenth of a wavelength.

Above & Beyond



Cell Phone and 4G Towers
Mobile phone towers and associated infrastructure also make up a sizeable part of the internet

Telecommunications Satellites
Satellites and earth based relay stations comprise part of the internet also.

Different types of hardware are bundled together to form networks of varying sizes. Networks are linked to networks and encompass the entire globe. Everything is interconnected by various cables and wireless links that comprise the global telecommunications infrastructure. These consist mainly of complex terrestrial systems, submarine cables and satellites out in space.

New ways of connecting are being developed all the time. Right now Telstra (Australia) is planning to beam 4G internet to planes on domestic flights within Australia using upward facing antennas that send data to fin shaped receivers on the underside of aircraft in what is called **Skinet.**

Protocols

The **protocols** that define and control communications across the disparate systems of the internet are what make it work. **Transmission Control Protocol (TCP)** and **Internet Protocol (IP)** grouped together as **TCP/IP** define the rules by which devices on the internet communicate with each other. Each device connected to the internet has an **IP Address** which help other devices to find it (for example, a 32bit IPv4 address - **176.254.163.1**).

Hyper-Text Transfer Protocol (HTTP) defines the rules by which data **packets** are sent over the internet. For example, when you send a file to a friend in Japan, the file is broken up into data packets normally 1kb to 1.5kb in size. Each packet contains information about **source** and **destination** as well as information needed to reconstruct the packets into a contiguous file (because different packets may take different paths to the destination).

Ethernet Packets

Overview of the frames that make up an ethernet packet

Ethernet Header & Trailer (or 'Footer' if you like) contain at least the frame's source and destination **MAC** addresses along with a frame trailer for accuracy checking (using an embedded **checksum**).

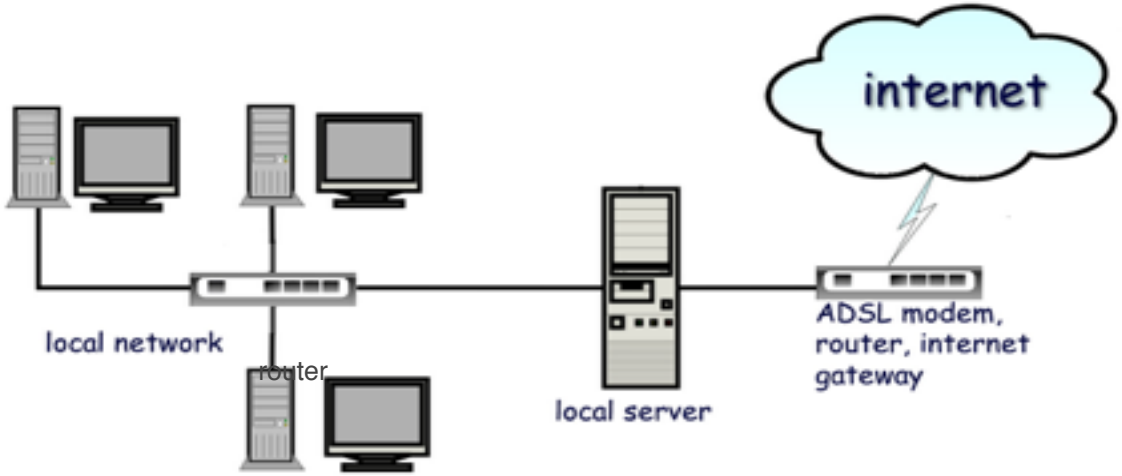
The **IP Header** contains, amongst other things, the **IP address** of both the source host and the destination host.

TCP Header - defines the **source port** and **destination port** of the **TCP packet** (eg Port 80 for HTTP requests). It also contains the **sequence number** for the packet to ensure the packets are re-assembled in the correct order at the destination computer.

HTTP DATA (payload) can contain almost any type of file, however in the case of a webpage being delivered from a web server, it will contain the **HTML** file (or parts thereof).

Thus, a simplistic overview of an ethernet packet which is used to transfer data over the internet.

Intranet & Internet



Your local network (often an **intranet**) whether at home or at work, connects to the internet through an **Internet Service Provider (ISP)** and temporarily becomes part of that network. The ISP's network normally connects to a higher level service provider which in turn connects to other service providers and networks through **Network Access Points (NAP).** Large providers often have their own **internet backbone.** There are about seven Tier 1 providers which include Vodafone, Verizon, AT&T and others, managing and maintaining the **internet backbone.** Industrial scale routers connect these networks and allow traffic to flow freely by forwarding packets on to the next network according to IP information in data packets. **Routers** ensure data flows without hindrance to the correct destination. Routers monitor their respective local regions of the internet and learn the best possible paths and connections. They are similar to postal distribution centres which know how to move mail/packages from one centre to another, and to distribute mail to individual local addresses according to the provided address information.

Summing Up

The **internet** is a vast network of networks spanning the globe. It consists of various types of servers, routers, switches, cables and wireless infrastructure spanning land, sea and space. So rather than being like a cloud, it is more like a web or net of interconnected cables for the most part. At numerous nodes, routers form the connection points between networks. Routers direct traffic through this maze of interconnected infrastructure in the most intelligent way possible.

Servers and client computers which connect to the internet, either permanently or temporarily, are not actually part of the internet as such, but use it to connect to other servers and client computers anywhere in the world.

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