History of the Internet

How did the Internet of today develop, particularly in Australia?

Outline:

- Computers
- Computer communication
- Computer networks
- User's perspective
- Discussion

The age of the dinosaurs

Electronic computers were invented during the second world war

They were used in code breaking and developing the atom bomb (earlier mechanical computers were used in ballistics calculations)

The US Department of Defence has always been a major funding body for computing research

The first Australian computer, CSIRAC, was built in 1948 (you can see it in the Melbourne Museum)

In the 1950s they were used for many applications and commercialised but few existed, they were huge (a whole room), extremely slow and with tiny storage capacity (by today's standards)

Mainframe, Mini and micro computers

In the 1960's, large "mainframe" computers became more widespread in larger companies etc

Instead of a single "console" which controlled all the operations, there were also multiple "terminals" for entering data, programming, and submitting jobs

In the 1970's, "mini"-computers (the size of a fridge) became available — they were cheaper and less tightly controlled

In the late 1970's and 1980's, "micro"-computers and "personal comuters" (comparable in size with a terminal) became cheap and popular with hobbyists, then widespread

"Portable" computers (the size of a small suitcase and weighing several Kg) eventually led to laptops and hand-held devices

Communication: Phone lines and modems

The phone network was the first widely used communication medium between distant computers (and also between computers and remote terminals)

Digital signals (for the computer) were converted to and from audio signals using "modems" and transmitted over phone lines

In early versions you would manually dial the number of a computer then put the phone handset in your modem; later the phone was bypassed

Computers could also phone each other occassionally and transmit information

For large quantities of data, magnetic tapes had to be moved around because the connections were too slow

Coaxial cable, fibre-optics and wireless

The old phone system was based on twisted pairs of copper wire, which doesn't support high communication speeds (110 bits per second in the early days to 56Kbps)

In 1976 Ethernet was developed. It used coaxial cable (used for cable television) and in the 1980s became the most common way for comuters to communicate in "Local Area Networks" (LANs)

Ethernet speeds went from 10Mbps initially, up to 1Gbps

Fibre-optic technology has achieved more than a 1000-fold increase in speeds again

Wireless communication has also seen huge increases in speed and is increasingly important due to mobile devices

The old copper wire network is becoming obsolete

Computer networks

The origins of the internet go back to the creation of ARPANET

During the cold war there was "the space race" (as well as "the arms race")

In 1957, the USSR lauched the first successful satellite – Sputnik

One of the reponses in the USA was to form the Defence Advanced Projects Agency (DARPA), to fund and coordinate many projects

In the 1960's a decision was made to support a research project to build a computer network between its research centers, ARPANET

The first four nodes (at universities etc) were connected in 1969

There is some debate over how much the design was influenced by the motivation for surviability after a nuclear attack

A decentralised packet-switching network

First, one design decision was to to communicate using only small "packets" of data

Sending larger files etc required breaking them into small chunks, sending each chunk as a packet and then re-assembling the packets

If some packets don't get through properly, they can be resent

Packets from multiple different files etc can be interleaved in a single communication channel (and the converse)

Second, there was no central point of control

Potentially, any computer or communication link could fail (or be destroyed by the Russians) without the whole network failing

The faulty parts of the network could be repaired and the network could grow easily

These characteristics of robustness, resilience and scalability live on

The growth of networks

ARPANET grew in the number of nodes and the quantity of data transmitted (20+ nodes in 1972, 100+ in 1976 and 200+ in 1981)

In 1981 the USA National Science Foundation set up CSNET, for research institutions not on ARPANET

With the advent of micro-computers, hobbyists set up "bulletin boards" (BBS) to share messages, computer software etc using dial-up connections over phone lines

Local Area Networks of computers became common in Universities and other organisations, and some Wide Area Networks were used in larger organisations

In the 1980s there were many different networks with many connections between them — the "internet" was the name given to this collection (500+ hosts in 1983, 5,000+ in 1986, 100,000+ in 1989)

Protocols

In order for computers (or anything) to communicate, a common language and set of rules (a *protocol*) must be used

Early networks used a variety of different protocols

Special hardware and software was needed to connect one network to another

There is generally a heirarchy of protocols: hardware, transmission of basic chunks of data, more meaningful larger chunks of data, e-mail messages, encrypted web server connections, etc

In 1983 the Internet Protocol and Transmission Control Protocol were adopted and TCP/IP became standard protocols for the internet

Store and forward

Most of the early networks for e-mail etc were "store and forward" networks

Distant computers would not be permanently connected to each other

They would occasionally call each other (maybe once per day), pass on e-mails etc and these would be stored on that computer

The e-mails would be forwarded on to the next computer in the chain at the next available opportunity

Gradually, connections were made more frequently, then on demand, then there were permanent connections

The first permanent connection between Australia and the rest of the world was in 1989, from Melbourne University, via Sydney and a NASA satellite, to the University of Hawaii

The growth of networks

Through the 1980's, the domain name system was adopted in individual networks (from 1985) and eventually the whole internet

A domain such as `cs.mu.oz.au` could be used on any computer connected to the internet

"au" means Australia, "oz" was the sub-domain which was originally set up for Australian University Computer Science departments, "mu" means Melbourne university and "cs" means the Computer Science department

In 1990 Tim Berner-Lee in CERN devised the HyperText Transfer Protocol and in 1992 the "World Wide Web" was established

The first graphical web browser, XMosaic, was released in 1993 (more than one million hosts on the internet)

Then the secret got out . . . you could order from Pizza Hut online in 1994 (2M+ hosts, 6M+ in 1995)

A personal perspective — e-mail

1979: My e-mail "address" was lee

1980: mupecs!lee or muvax!lee

1984: . . . !decvax!mulga!lee

1986: UUCP: . . . !{hplabs,mcvax,nttlab,ukc,uunet}!munnari!lee
ACSNet: lee@mulga.oz,

1988: ARPANET: lee%mulga.oz.au@uunet.uu.net
JANET: lee%mulga.oz.au@uk.ac.ukc
munnari!lee@seismo.css.gov.us

1990: lee@cs.mu.oz.au :-)

1995: the same, but with spam:-(

2013: + lee@unimelb.edu.au, lee@csse.unimelb.edu.au, . . . @gmail.com

Usenet/"news"

Usenet was a global bulletin board/discussion forum

People could post messages, which be distrubuted throughout the network

It was divided into a heirachy of "news groups"; for most of them, anyone could post a message but some had a "moderator" who could reject some messages

There *many* different groups eg, comp.ai, comp.lang.prolog, comp.binaries.apple2, sci.physics.fusion, rec.climbing, rec.humor.funny, rec.food.recipes, soc.motss, alt.alien.visitors, alt.binaries.pictures.erotica

There were also newsgroups which had limited distribution, eg aus.politics, cs.343

FTP, Gofer, etc

In 1980 the primary way of distributing research technical reports, computer software etc, was posting hard copies or magnetic tapes

Once the internet was established, files could be put in a public place on a computer and copied by anyone on the network using the File Transfer Protocol

You could tell people via e-mail or news where the files were

The gofer system allowed you to browse different sites using links, but only supported plain text

Discussion points

Who was/is in control — techies such a Robert Elz initially, and eventually more "official' bodies

Who has the right to "own" a domain name such as cars.com.au, and on what basis?

Who should profit from the internet?

Who uses the internet, what do they use it for, and how has this changed over time?

How important are search engines?

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