

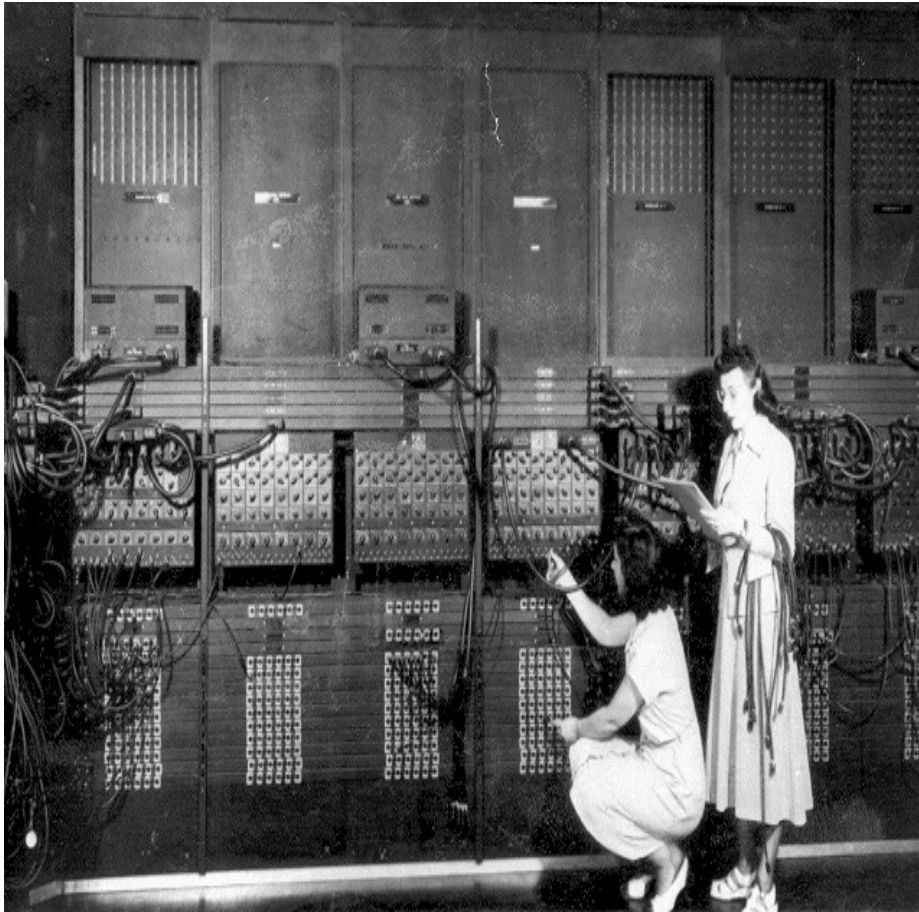
Operating system

Part Review: OS's big picture now

Operating System Timeline

- ❑ First generation: 1945 - 1955
 - Vacuum tubes
 - Plug boards
- ❑ Second generation: 1955 - 1965
 - Transistors
 - Batch systems
- ❑ Third generation: 1965 - 1980
 - Integrated circuits
 - Multiprogramming
- ❑ Fourth generation: 1980 - present
 - Large scale integration
 - Personal computers
- ❑ Next generation: ???
 - Systems connected by high-speed networks?
 - Wide area resource management?

First Generation (1945-1955): Direct Input



Eniac, 1945

- ❑ Run one job at a time
 - Enter it into the computer (might require rewiring)
 - Run it
 - Record the results
- ❑ Programming languages were unheard of
- ❑ Assembly languages were not known
- ❑ No reason for an OS

A Famous Quote

- "I think there is a world market for maybe five computers."
 - Thomas Watson, Chairman of IBM - 1943

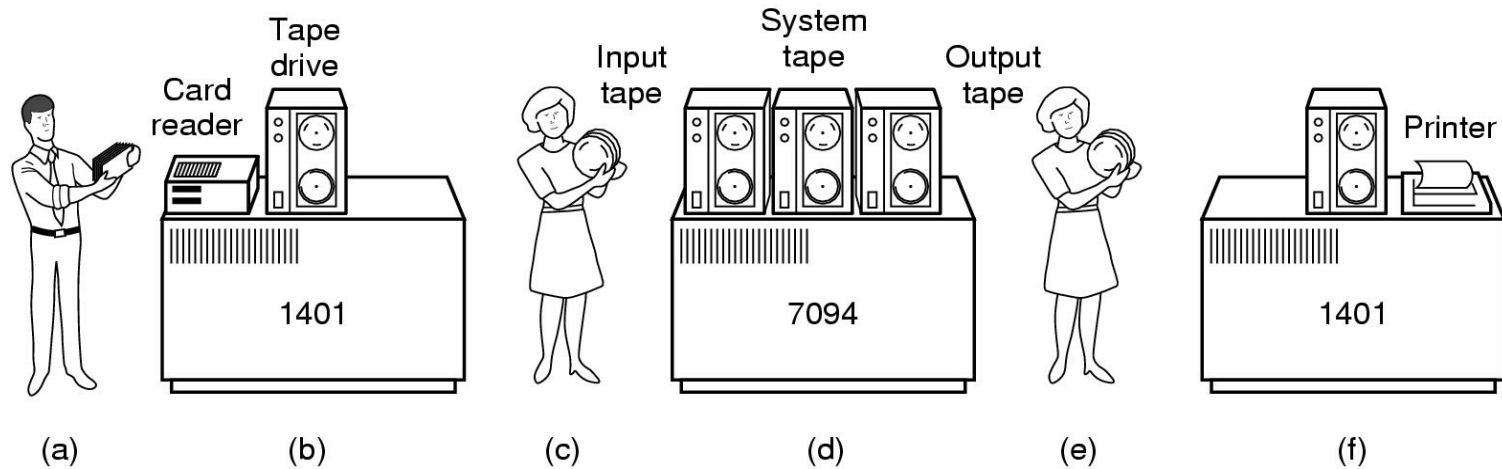


Second Generation (1955-1965): Batch Systems

- Programs were written on paper in either FORTRAN or COBOL, punched into cards, and then sent down to the input room where operators would load the cards into the computer and wait back later for results

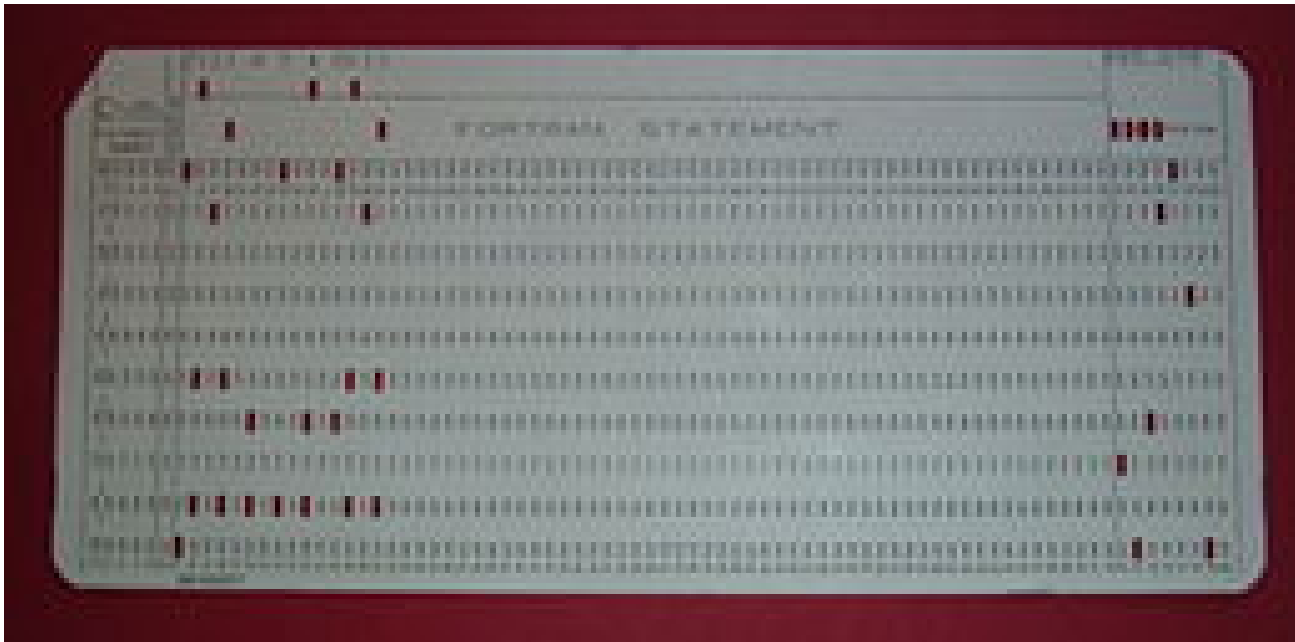


Second Generation (1955-1965): Batch Systems



- The programmer is waiting for this:
- Bring cards to 1401
 - Read cards onto input tape
 - Put input tape on 7094
 - Perform the computation, writing results to output tape
 - Put output tape on 1401, which prints output

Programs on Punched Card



$Z(1) = Y + X(1)$ //Fortran statement

Spooling

- ❑ Eventually tape drives were replaced with disks
- ❑ Disks enabled simultaneous peripheral operation on-line (**spooling**)
 - Computer overlapped entering punched cards to disk of one job with execution of another
 - Still only one job active at any given time
 - CPU often underutilized
 - Example: What if the job needs data from the disk?

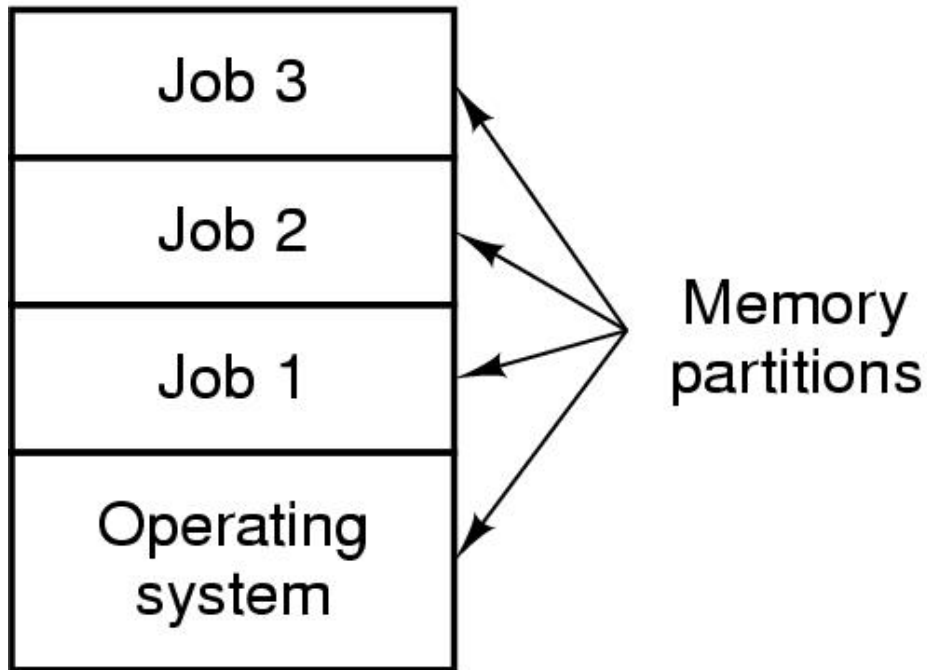
OS/360

From Computer Desktop Encyclopedia
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OS for this generation is IBM
operating system



Third Generation: Multiprogramming (1965-1980)



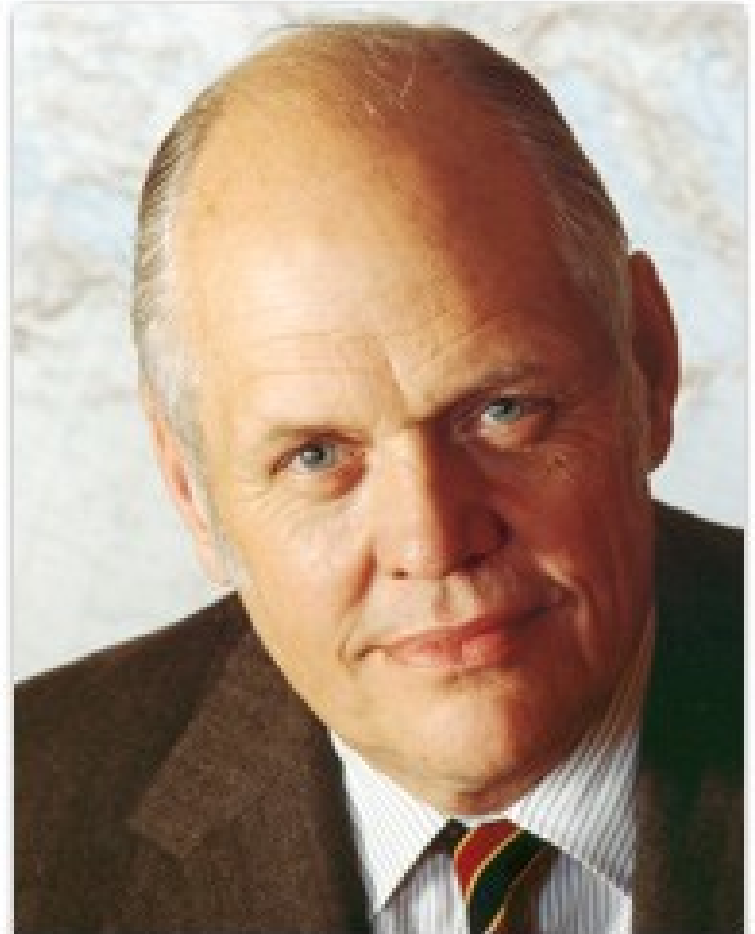
- ❑ Multiple jobs in memory
 - Protected from one another
- ❑ Operating system protected from each job as well
- ❑ Overlap I/O of one job with computing from another job

Third Generation: Multiprogramming (1965-1980)

- ❑ Multiprogramming allowed several jobs to be active at one time
- ❑ Computer use got much cheaper and easier
- ❑ These developments allowed for interactive use

Yet Another Quote

- "There is no reason any one would want a computer in their home."
 - Ken Olson, president, chairman and founder of Digital Equipment Corp. - 1977



Fourth Generation (1980-) Personal Computers

- ❑ Personal computing changed the computing industry
- ❑ Intel came out with the 8080
- ❑ Lots of companies produced 8080-based computers
- ❑ The Control Program for the 8080 from Digital Research was the first operating system



Altair 8080, 1975

256 bytes of memory

Enter data through one of toggle switches on the front

Results were indicated by flashing lights on the front panel

Fourth Generation (1980-) Personal Computers

- ❑ Motorola produced an 80800.
- ❑ Group of Motorola engineers started a company to manufacture and market it.
- ❑ CPU used in early system



Apple 1 Ad

Apple Introduces the First Low Cost Microcomputer System with a Video Terminal and 8K Bytes of RAM on a Single PC Card.

The Apple Computer. A truly complete microcomputer system on a single PC board. Based on the MOS Technology 6502 microprocessor, the Apple also has a built-in video terminal and sockets for 8K bytes of on-board RAM memory. With the addition of a keyboard and video monitor, you'll have an extremely powerful computer system that can be used for anything from developing programs to playing games or running BASIC.

Combining the computer, video terminal and dynamic memory on a single board has resulted in a large reduction in chip count, which means more reliability and lowered cost. Since the Apple comes fully assembled, tested & burned-in and has a complete power supply on-board, initial set-up is essentially "hassle free" and you can be running within minutes. At \$666.66 (including 4K bytes RAM!) it opens many new possibilities for users and systems manufacturers.

You Don't Need an Expensive Teletype.

Using the built-in video terminal and keyboard interface, you avoid all the expense, noise and maintenance associated with a teletype. And the Apple video terminal is six times faster than a teletype, which means more throughput and less waiting. The Apple connects directly to a video monitor (or home TV with an inexpensive RF modulator) and displays 960 easy to read characters in 24 rows of 40 characters per line with automatic scrolling. The video display section contains its own 1K bytes of memory, so all the RAM memory is available for user programs. And the

Keyboard Interface lets you use almost any ASCII-encoded keyboard.

The Apple Computer makes it possible for many people with limited budgets to step up to a video terminal as an I/O device for their computer.

No More Switches, No More Lights.

Compared to switches and LED's, a video terminal can display vast amounts of information simultaneously. The Apple video terminal can display the contents of 192 memory locations at once on the screen. And the firmware in PROMS enables you to enter, display and debug programs (all in hex) from the keyboard, rendering a front panel unnecessary. The firmware also allows your programs to print characters on the display, and since you'll be looking at letters and numbers instead of just LED's, the door is open to all kinds of alphanumeric software (i.e., Games and BASIC).

8K Bytes RAM in 16 Chips!

The Apple Computer uses the new 16-pin 4K dynamic memory chips. They are faster and take $\frac{1}{4}$ the space and power of even the low power 2102's (the memory chip that everyone else uses). That means 8K bytes in sixteen chips. It also means no more 28 amp power supplies.

The system is fully expandable to 65K via an edge connector which carries both the address and data busses, power supplies and all timing signals. All dynamic memory refreshing for both on and off-board memory is done automatically. Also, the Apple Computer can be upgraded to use the 16K chips when they become availa-

ble. That's 32K bytes on-board RAM in 16 IC's—the equivalent of 256 2102's!

A Little Cassette Board That Works!

Unlike many other cassette boards on the marketplace, ours works every time. It plugs directly into the upright connector on the main board and stands only 2" tall. And since it is very fast (1500 bits per second), you can read or write 4K bytes in about 20 seconds. All timing is done in software, which results in crystal-controlled accuracy and uniformity from unit to unit.

Unlike some other cassette interfaces which require an expensive tape recorder, the Apple Cassette Interface works reliably with almost any audio-grade cassette recorder.

Software:

A tape of APPLE BASIC is included free with the Cassette Interface. Apple Basic features immediate error messages and fast execution, and lets you program in a higher level language immediately and without added cost. Also available now are a dis-assembler and many games, with many software packages, (including a macro assembler) in the works. And since our philosophy is to provide software for our machines free or at minimal cost, you won't be continually paying for access to this growing software library.

The Apple Computer is in stock at almost all major computer stores. (If your local computer store doesn't carry our products, encourage them or write us direct). **Dealer inquiries invited.**

Byte into an Apple \$666.66*

* includes 4K bytes RAM



Fourth Generation (1980-) Personal Computers

- ❑ Now came the 16-bit system
- ❑ IBM designed the IBM PC 86 on the inside with an 8086
- ❑ IBM needed an OS for the schedule
- ❑ Who did they turn to?



IBM PC, 1981

Retail at \$2880

64 kilobytes of RAM

Single-sided 160K 5.25 floppy drive

Famous Quote

- “We don't see Windows as a long-term graphical interface for the masses.”
 - A Lotus Software Development official, while demonstrating a new DOS version - 1989

Fourth Generation (1980-) Personal Computers



- ❑ Bill Gates suggested to IBM that they should look at CP/M (one of the the most successful OS for microcomputers at that time, by Gary Kildall)
- ❑ The biggest mistake of all:
 - Kindall refused to sign a non-disclosure agreement

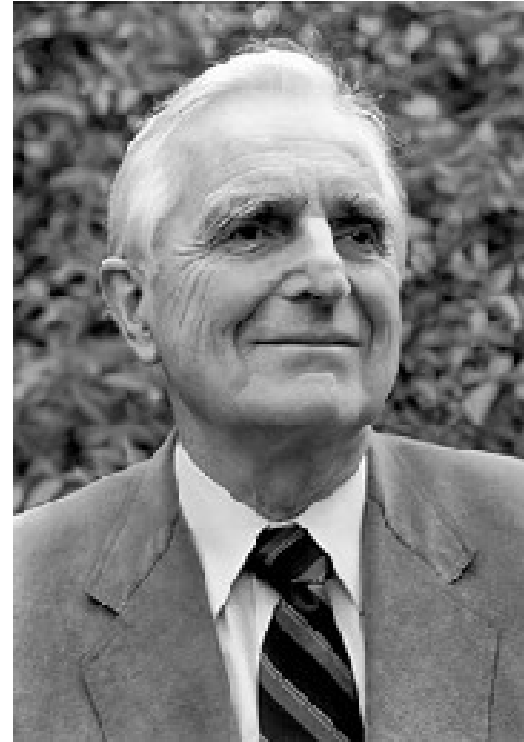
Fourth Generation (1980-) Personal Computers



- ❑ IBM went back to **Bill Gates**
- ❑ Gates offered an OS called **DOS**
- ❑ DOS came from a company called Microsoft
- ❑ Microsoft hired Bill Gates to improve it
- ❑ The new OS was renamed MS-DOS

Fourth Generation (1980-) Personal Computers

- ❑ Up to this point all operating systems were command line
- ❑ Doug Englehart at Stanford invented the Graphical User Interface (GUI)



Fourth Generation (1980-) Personal Computers

- **Steve Jobs** saw the possibility of a user-friendly PC
- This led to the **Apple Macintosh** in 1984



Steve Jobs was also the co-founder of **Pixar** which has created very successful animated films: Toy Story ; A Bug's Life; Toy Story 2; Finding Nemo; Monsters.

Fourth Generation (1980-) Personal Computers



- ❑ Used Motorola's 16-bit 68000
- ❑ 64 KB of ROM
- ❑ Of course it had the first GUI
- ❑ BTW, Apple only started using Intel processors in 2006

What about UNIX?

- ❑ Let's go back to the 60's
- ❑ MULTICS was the first large timesharing system developed jointly between MIT, General Electric (computing division eventually sold to Honeywell) and Bell Labs
- ❑ MULTICS introduced many seminal ideas
- ❑ But,.... OS was written in a language called PL/1
- ❑ Not a lot of these got sold but they were very popular with those who bought
- ❑ Last one was put out of commission in 2000
 - It was owned by the Canadian Department of National Defence

MULTICS



What about UNIX?

- One of the computer scientists at Bell Labs who worked on MULTICS was **Ken Thompson**



- He found a small PDP-7 minicomputer that no one was using
- He decided to write a stripped-down, one-user version of MULTICS in the C programming language
- This became **UNIX**.
- This was open source which led to other versions: **System V (AT&T)** and **BSD (Berkeley Software Distribution)**

What about MINIX?

- ❑ Eventually AT&T realized that UNIX was commercially viable
- ❑ Unix, Version 7's license prohibited the source code from being studied in courses
- ❑ A computer scientist, Andrew Tanenbaum, was appalled
- ❑ He created a new OS (using the C programming language) from scratch that would be compatible with UNIX but completely different on the inside
- ❑ This was **MINIX** or mini-Unix; released in 1987
- ❑ Better structured than UNIX
- ❑ MINIX-2 released in 1997
- ❑ MINIX-3 released in 2006

LINUX

- ❑ After MINIX was released a USENET newsgroup (think of this as a chatroom), *comp.os.minix* was formed.
- ❑ Quickly had 40,000 subscribers who wanted to add stuff
- ❑ One was a Finnish student named Linus Torvalds



LINUX

- ❑ Torvalds wanted to add features which led to other things
- ❑ Eventually this led to his own OS called Linux (August 1991)
- ❑ Linux is a notable success of the open source movement

Today

□ Mobile Devices



<http://osxdaily.com/2013/06/15/evolution-of-iphone-ios-home-screen/>

Today

□ Mobile Devices

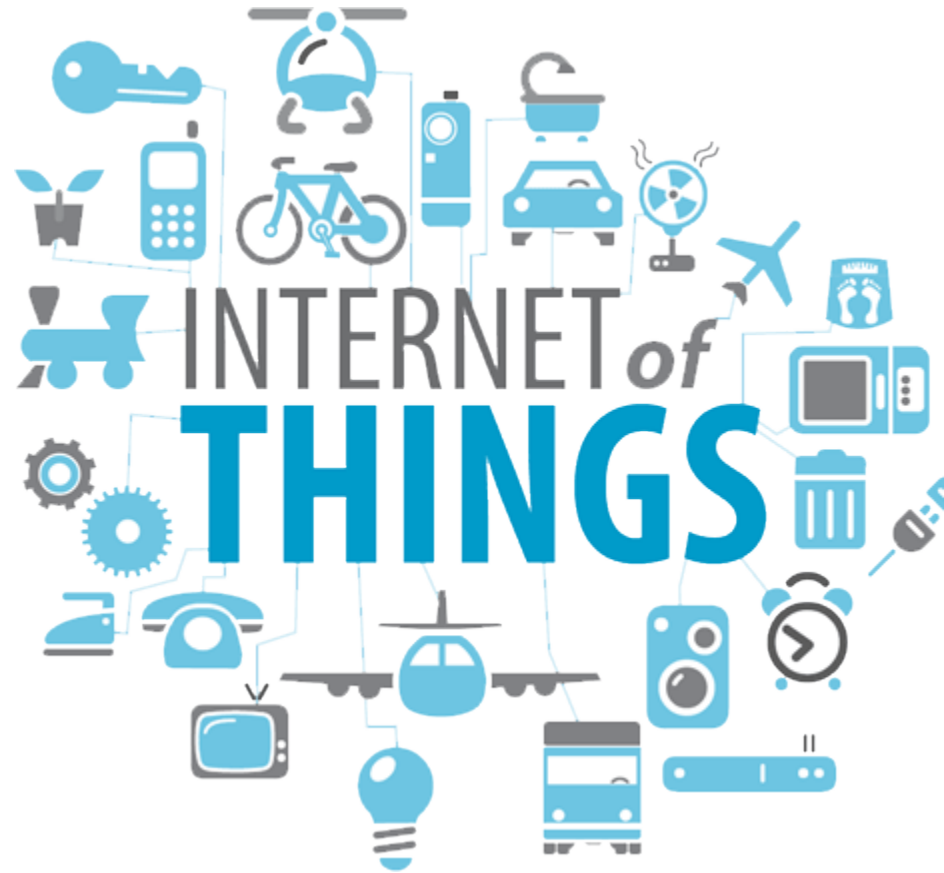
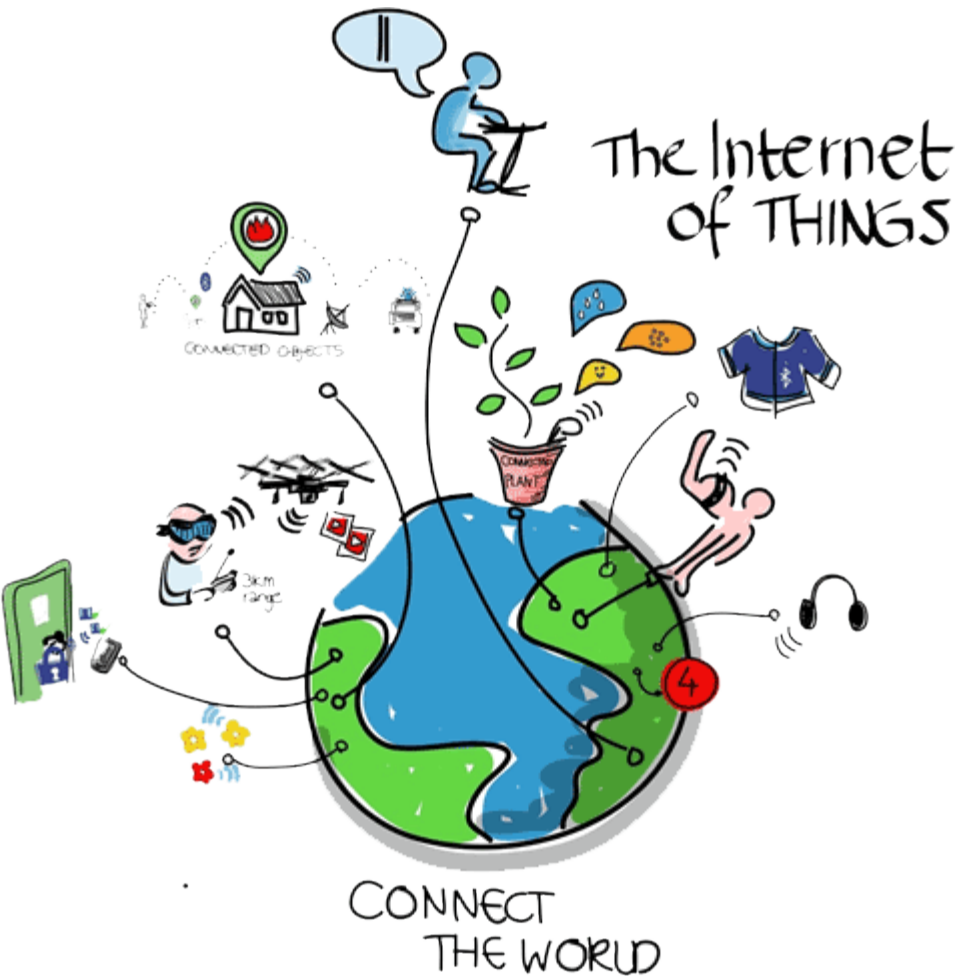
ANDROID



<http://sharein.org/wp-content/uploads/2015/01/android-nombres-postres.jpg>

Today

❑ Sensors - "Internet of Things"





Vehicle, asset, person & pet
monitoring & controlling



Agriculture automation



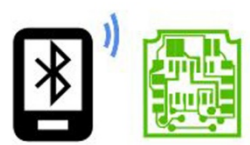
Energy consumption



Security &
surveillance



Building management



Embedded
Mobile

Internet of things

Everyday things
get connected  for smarter
tomorrow



M2M & wireless
sensor network



Everyday things



Smart homes & cities



Telemedicine & healthcare

Today

□ Data Centres/Cloud



