

1953

Invention of High Level
Programming Languages

1958

Integrated Circuits

1973

Mobile Phones and
Interconnected Computers

1977

First modern PC -
Apple II

1980

The W

1973

Mobile Phones and Interconnected Computers

Learning Outcomes addressed in this section are listed below.

-
- 1.8** evaluate the costs and benefits of the use of computing technology in automating processes
-
- 1.11** discuss the complex relationship between computing technologies and society including issues of ethics
-
- 1.12** compare the positive and negative impacts of computing on culture and society
-
- 1.13** identify important computing developments that have taken place in the last 100 years and consider emerging trends that could shape future computing technologies
-
- 1.15** consider the quality of the user experience when interacting with computers and list the principles of universal design, including the role of a user interface and the factors that contribute to its usability
-
- 1.16 compare two different user interfaces and identify different design decisions that shape the user experience**
-
- 1.17** describe the role that adaptive technology can play in the lives of people with special needs
-
- 1.18** recognise the diverse roles and careers that use computing technologies
-
- 2.15** explain what is meant by the World Wide Web (WWW) and the Internet, including the client server model, hardware components **and communication protocols**
-

When other Learning Outcomes are addressed, for instance in classroom activities or through related online resources, the LO is numbered.

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The World

At the launch of the iPhone in 2007, Steve Jobs, CEO of Apple, claimed to have re-invented the phone. In many ways Apple did re-invent our idea of a phone by enabling the phone to access all modes of communication, from voice to email to text to internet connectivity.



In 1973 Martin Cooper, a Motorola researcher, made the first ever call on a mobile phone. As you can see in the picture, mobile phones were a lot larger in size than today's handsets. His first call was on a device weighing in excess of 1 kg. This event was every bit as momentous as Alexander Graham Bell's first patent for a telephone in 1876.



Bell built upon advances in telegraphy, among them Samuel Morse's famous system of communication. For the following 100 years, a phone was essentially fixed to a landline. You, the user of the phone, had to be physically beside the location of the phone. The concept of a phone being as mobile as the user, with the only restriction being the strength of a signal, revolutionised our idea of communication. In America the [mobile phone](#) became known as a cell phone, because the local networks were called cells.

The following quotes are from Alexander Graham Bell, accredited with inventing the telephone.

"The day will come when the man at the telephone will be able to see the distant person to whom he is speaking."

"I truly believe that one day, there will be a telephone in every town in America."

Check out some [predictions about mobile phones](#) beyond 2020. Which ones do you think will become standard?

Watch a [video of 10 examples](#) of how hard it is to predict technological advances or measure the impact of current technology.

LO 1.12, 1.13, 1.18



Brain Buster

The limitations on the size of early mobile phones were due to the technology. It was not possible, at that time, to manufacture smaller handsets. Today the limitation on the size is determined less by the technology and more by what is practical for an average human. As the manufacturing process shrinks to the atomic and cellular level, should our phones shrink to the same level so they can be embedded within the person's body? It might give new meaning to the word cellphone!

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🔧 Classroom Communication Activity

To design your own system of communication or use an existing system to communicate within an LCN (Local Class Network!!!).

The activity requires a minimum group of 3 students. It can be an unplugged physical computing algorithm, a programmed solution using Python, Javascript, Scratch, Snap, etc., an embedded microprocessor system solution or a combination of ideas. Each solution must be robust and systematic, with evidence of computational thinking.

Below are some ideas for activities.


UNPLUGGED

- ▶ Using only a system of blinks, design a system for giving directions to a person or automata to exit any room or labyrinth. For example, construct a simple maze from which the person must be guided towards the exit. Remember behaviours such as the length of a step or the degrees of a turn must be pre-configured.
- ▶ [Morse code](#) was a hugely successful system of telegraphic communication from the mid 19th to mid 20th century. It is in many ways an early form of binary in the sense that all signals are either a dot (·) or a dash (-). The dash should last 3 times longer than the dot. The following letters are represented in the following way: M (- -) O (- - -) R (· - ·) S (· · ·) E (·). How would you signal SOS in Morse code? The dot and dash can be represented by light, by sound, or as suggested below in the plugged section, by strings sent over radio waves.
- ▶ In his book the [Diving Bell and the Butterfly](#), later a film, Jean-Dominique Bauby described his life with locked-in syndrome. How did he write the text? His method was to blink out each letter to a helper who transcribed it to paper. He used a system of frequency analysis. "E is the most common letter (in both English and French), for example. He therefore got the helper to read out the letters in order of how common they are: their frequency. In English, the order is "E..T..A..O..". In French, Bauby's language, it is "E..S..A..R.." ¹⁰. However there are other even more efficient ways to communicate in this fashion, in particular using binary search algorithms. The following [London School of Computing booklet](#) gives an excellent overview of this problem.

🔧 Communication Activity

This activity addresses a [vast number of LOs](#). In particular:

- ▶ *Computational Thinking* LOs in Strand 1 **(LO 1.1-1.10)**
- ▶ *Abstraction and Algorithms* LOs in Strand 2 **(LO 2.1-2.9)**
- ▶ *ALT3 Modelling and Simulation* LOs in Strand 3 **(LO 3.8-3.9)**

Stephen Hawking famously communicated through adaptive technology. As his Motor Neuron Disease (known as ALS in the US) progressively removed all physical movement,  [the technology advanced in parallel to ensure he could still communicate effectively.](#)

How would the advances in adaptive technology have helped Jean-Dominique Bauby (see unplugged activity) to write his book? Would it be a more efficient, but less personal experience for him?

LO 1.8, 1.17

¹⁰ Curzon P., McOwan P (2017) *The Power of Computational Thinking* World Scientific.

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PLUGGED

- ▶ Using a microprocessor, design a system to communicate remotely to another system. One system of communication could be Morse code or an adapted version of Braille. [Check out some other systems](#), including ciphers such as the Caesar cipher. Or communicate between 2 microprocessors using the serial ports. For example, the microbit serial communication mimics the 7 bit ASCII code referred to in a previous section.
- ▶ Use Python or JS to create basic communication systems within your group or perhaps an interactive webpage that uses html action forms or similar code, to allow communication within your LCN. (Local Class Network). Your group decides on the channel of information transfer, whether it is using emails, IP addresses, sms texts (if allowed under school policy), or a combination of unplugged and plugged communication systems.

In the same year, 1973, that the first call was made on a mobile phone, another concept that would eventually revolutionise the world became real and feasible: interconnected computers. The story behind the Internet begins much earlier. In 1957 the Soviet Union launched Sputnik, the first unmanned satellite in space. As part of the USA's response to this technological breakthrough, the US government set up the Defense Advanced Research Projects Agency ([DARPA](#)). Originally called ARPA, its aim was, and still is, to ensure the US stays at the cutting edge of technological advances.

"DARPA explicitly reaches for transformational change instead of incremental advances. But it does not perform its engineering alchemy in isolation. It works within an innovation ecosystem that includes academic, corporate and governmental partners, with a constant focus on the Nation's military Services, which work with DARPA to create new strategic opportunities and novel tactical options. For decades, this vibrant, interlocking ecosystem of diverse collaborators has proven to be a nurturing environment for the intense creativity that DARPA is designed to cultivate."¹¹



Stimulate a Debate on the role of the military, and in particular DARPA, in shaping some key technological developments in everyday society. (LO 1.11, 1.12)

In the 1960s, before the networking of computers, people could share a single computer by logging on to a terminal. They would then time-share the main computer. This multi-user approach spawned file sharing, emails and generally improved communication within the business, military and educational worlds. But only in a limited, localised fashion, generally known as Local Area Networks (LANs).

There are more resources and exercises on ncca.ie related to this area.

In the section on Lists and Dictionaries there is an advanced [CT challenge](#), which uses standard ASCII/utf-8 code to implement a basic Caesar shift encryption in Python, using a Tkinter UI and/or a simple txt file.

LO 1.22, 1.23

LO 2.5-2.7, 2.19

In the 1960s ARPA developed a system called NLS (oNLineSystem). Its pioneering [HCI](#) evangelist was [Doug Engelbart](#). In a now legendary "[Mother of all Demos](#)" in San Francisco in 1968, he stunned his audience with:

- ▶ Word processing of documents
- ▶ Windows on your working documents
- ▶ Collaborative online editing of documents
- ▶ Video Conferencing
- ▶ Hypertext links within documents
- ▶ The use of a new gadget he invented himself called a mouse!

LO 1.15, 1.16

¹¹ DARPA official site <https://www.darpa.mil/>

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In the late 1960s, DARPA decided to connect scientists and engineers in 4 separate locations using a network of interconnected computers called the ARPANET. It was successfully launched in 1969, and within a couple of years other networks sprung up all over the world (NPL (UK), ALOHANET (a wireless system in Hawaii), HLN (an airline network), CYCLADES (France)). Because these networks developed in isolation, their methods of communication and packet switching were incompatible. The interconnection of networks became a key goal of industry and of military. The UK and France were the first to experiment with internetworking. However it was ARPA's [Transmission Control Protocol / IP](#), first sketched out in 1973 by Vint Cerf and Bob Kahn, which would come to dominate the landscape of information transfer. ARPA at this stage had several networks and in 1977 demonstrated that it could connect them all. This became known as the internet. [Lynn Root and Vint Cerf explain the operation of packets and TCP](#) in this code.org video.

1973 was also the year the ethernet was invented. At the time there were many standards for interconnecting computers such as IBM's Token Ring. But the ethernet is the one, looking back, that became the standard. The big question is often why some technologies endure and others simply fade away. In the age of wireless communication, and increasingly as devices do not have any method for direct ethernet connection, [watch a tech experiment to connect an iPhone to the internet using an ethernet cable](#).

[code.org](#) designed an internet simulator for the classroom.

The activity is fully described in the section on the world wide web.

Watch a [PICOL animated video on the History of the Internet](#), including DARPA's role. (subtitled)

The SciShow have a [history of the Internet](#), followed by History of the Web. (subtitled)

Some prompts for the above video lessons:

- ▶ The early form of the Internet was known as the ARPANET. Which colleges did it initially connect?
- ▶ What is Packet Switching, and why has it superseded Circuit Switching?
- ▶ Name other networks that formed and outline their contribution to the development of the internet.

LO 2.15