1989
The World Wide Web

Learning Outcomes addressed in this section are listed below.

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

1.18 recognise the diverse roles and careers that use computing technologies

1.22 read, write, test, and modify computer programs

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.

The world wide web, was invented by Tim Berners-Lee while working at the CERN laboratories in Switzerland. "The things that happened with the web blow us away, they are much more than we originally imagined. ...There is still huge unlocked potential"[13] Originally invented as a means of sharing research and data, the web has transformed itself into a vital part of all our lives, transforming our lives in the process. The Internet and the world wide web are not the same thing.

The Internet is a global network that connects computers and computer networks. The linking of computer networks is called internetworking, from which we get the name internet. The communication system governing this global network is known as Internet Protocol (IP). The Internet evolved from a US military project in the late 1960s known as ARPANET, from which IP and other protocols (TCP, UDP) evolved.[14]

The World Wide Web is the information space that can be accessed by the Internet. Resources on the web are requested and retrieved by **uniform resource locators** or URLs. A URL is usually in the form:

scheme://serverhost:port/pathname?query_string

The *scheme* indicates the protocol (*http* is the default scheme, *https* is the more secure protocol)

serverhost is the domain name or IP address (A DNS is a Domain Name Server or System whose job is to convert human-friendly domain names into internet-friendly IP addresses. It is in essence a database.)

port and *pathname* are optional and seldom included in modern usage.

HTML stands for HyperText Markup Language, and was invented by Tim Berners-Lee. <start tag> A file written in html contains text and content (videos, images, etc..) interspersed with <*begin tags*> and <*/end tags*> . The tags allow the content to be easily read and formatted by any Web Browser (explorer, firefox, chrome, etc..). </end tag>. Each programming concept on the NCCA website contains a Computational Thinking Challenge written on a html platform, designed to be edited by teachers and students.

Watch Tim Berners-Lee TED talk from 2009 and answer the following prompts.

- Who is Hans Rosling?
- What are TBL's 3 rules for using the web?
- What is linked data?
- What is Database Hugging?

LO 1.13, 1.18

An overview of a Lesson Plan on the Internet using code.org.

You can sign up your class to view these lessons on the Internet.

Follow the setup instructions, including a video on how it works, to create an Internet Simulator, as part of the code.org lesson plan.

LO 2.15

Facilitate a walking debate on Tim Berners-Lee quotes.

For example:

"I think in general it's clear that most bad things come from misunderstanding, and communication is generally the way to resolve misunderstandings, and the Web's a form of communications, so it generally should be good."

LO 1.13

Open the html demonstration file for CT Challenges in section 0 of Programming Concepts on the ncca website.

Visit ncca.ie Computer Science

LO 1.22

13 https://www.ted.com/talks/tim_berners_lee_on_the_next_web#t-225527

14 Wang (2016) *From Computing to Computational Thinking* CRC Press.

Computer Network Protocols

Think of how many different types and brands of computers you can buy, and then think of all the different Operating Systems working on those computers. For these computers to communicate over the network they have to agree rules and conventions known as Network Protocols.

A brief introduction to Network Communication Protocols.

From the CS Field Guide (Tim Bell)

LO 2.15

The OSI (Open System Interconnect) model of networking layers provides a standard view of how protocols operate. The table below shows how TCP/IP maps against the OSI layers. TCP/IP is the dominant protocol.

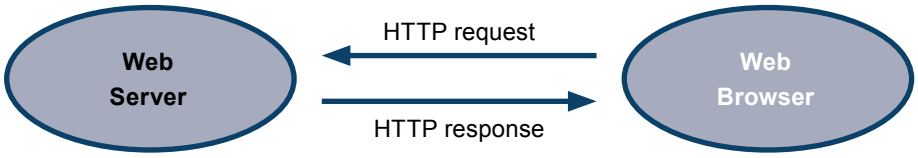
The TCP/IP and OSI Models of Networking Layers

TCP / IP	OSI Layers		Example Protocols
Application	Data	Application Transfer html to your computer	http, dns
	Data	Presentation Format the data (Network Translator)	SSL
	Data	Session Coordinate different processes	NetBIOS
Transport	segments	Transport Reliable end to end Transfer	TCP, UDP
Internet	packets	Network Determine physical path data takes	IP
Network Interface	frames	Data Link Physical Addressing	PPP, Ethernet
	bits	Physical Media and Binary Transmission	USB, Bluetooth

The design of network protocols is an important area of computer science. Note in particular the following ideas and examples.

Client Server Model When you email or video conference or browse the web, the network service you are using involves a client program (MS Outlook, Google Chrome, etc) communicating on your behalf with a server program running on a specific host.

HyperText Transfer Protocol (HTTP) Web browsers and web servers communicate using this protocol. Its job is to transfer hypertext, like html, to your computer.



Internet Protocol (IP) Addresses In the lower layer of the OSI model, every host will have its own network address that identifies the host (usually your computer) for communication purposes. A typical IP address would look like 83.141.127.255. This is an IPv4 address. It is made up of 4 bytes. In binary it is 32 bits and would be 01010011 10001101 01111111 11111111. The rapid expansion of the Internet is now accommodated by IPv6, which supports 128 bit addresses.

Transmission Control Protocol (TCP) is the transport layer that ensures data arrives reliably. The system of handshakes, ordering and acknowledgement that data has arrived, trades off speed for accuracy. Given the number of nodes (computers, routers, etc..) that packets of data must go through, data inevitably gets delayed or corrupted by interference. Play the Packet Attack Game to see why TCP is the most commonly used transfer protocol on the internet.

Take the Crash Course Video on Computer Networks including ethernet.

From the Crash Course Series on YouTube. Leads on to the Internet and WWW. (Carri Anne Philbin)

LO 1.12
LO 2.15

Play the Packet Attack Game which goes through 7 levels of Transfer: A simulation of TCP and why it is virtually impossible to stop level 7 TCP.

From the CS Field Guide (Tim Bell)

LO 2.15

Classroom Experiment

It is quite straightforward to see how data is forwarded by routers through the network. Simply go to your command prompt (or terminal or shell prompt depending on your OS).

Type TRACERT followed by a url for a website.

For example, the command "tracert www.compsci.ie" yielded the following path:

```
Tracing route to compsci.ie [193.1.33.39]
over a maximum of 30 hops:

  Hop  3 Round Trip Time Delays  Some router info, including [IP address]

  4    15 ms     *       11 ms  eth-trunk103.hcore1.dbn.core.eircom.net [83.174.185.50]
  5    10 ms     9 ms     9 ms  lag-201-corea-dbn-hcore1-dbn.corea.dbn.core.eircom.net [83.174.185.12]
  6    10 ms     9 ms     *     lag-61.br1.csg.border.eircom.net [86.43.9.212]
  7    11 ms    10 ms    10 ms  te0-0-0-1-cr2-kp.hea.net [194.88.240.15]
  8    13 ms    13 ms     *     bundle-ether700.cr2-cwt.nn.hea.net [87.44.50.2]
  9    13 ms    11 ms    13 ms  te1-1-pw-sr1.services.hea.net [193.1.236.86]
 10    10 ms    11 ms    11 ms  193.1.33.39.pdst.ie [193.1.33.39]

Trace complete.
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User Datagram Protocol (UDP) is also a transport layer, but it loses reliability for speed. It is used when transmission of all the data is not so important, say for example in video or music streaming.

Voice Over Internet Protocol (VOIP) uses access to the internet to transmit voice messages, bypassing telephone lines. It is also called IP telephony and is one of the most significant developments in telephony since the invention of the telephone itself. Skype is the most well known example, so much so that often the word skype has become synonymous with online video calls.

Our society has become normalised to putting our data on the web. One of the core concepts of the LCCS specification is Data. Many ethical and privacy questions have been raised in recent years around ownership of data. GDPR, a General Data Protection Regulation act, became law across the entire EU on May 25th 2018.

Stimulate a Debate on how much data, and the kinds of data, governments and giant multi-nationals should be allowed to keep on citizens and consumers.

The model for this activity is explained in A Summary of Teaching & Facilitation Methodologies.

1. Watch a Stimulus Video or read a stimulus piece.

Watch this stimulus on ordering a pizza

Read this piece on rules around patients' medical records.

"The key principle for doctors under Medical Council guidelines is that they must not disclose information about your care or illness to any other person, without your consent. A doctor who breaches confidentiality can be reported to the Medical Council and may face a hearing into his or her conduct. Confidentiality is the cornerstone of medical care. This rule does not apply however, when the information is needed by a court of law."[15]

2. Prompt questions to provoke class discussion and elicit initial viewpoints.

- What were the pros and cons of the Pizza company being able to access the customer's data?
- Did they have too much access to data, or was their usage of the data at fault?
- How much data do you think governments or hi-tech companies NEED to retain on citizens? Perhaps a certain amount is required for national security or in the case of online medical companies they could use AI on your data to prevent future illness, mine your data or suggest treatments?
- Consider the source of information for the stimulus video. Who are ACLU?
- Learn how Cambridge Analytica used Facebook data to influence the 2016 US Presidential election.
- Read the story of how JJ DeAngelo was convicted three decades after his crimes.

LO 1.12

Students should be able to compare the positive and negative impacts of computing on culture and society

15 Irish Health website http://www.irishhealth.com/article.html?con=546

3. Divide into research groups to explore the topic from key standpoints.

Personal online data is essential to allow governments protect and nurture its citizens and to allow multi-nationals to offer a better service to its consumers.

Themes for different groups:

- Governments should be allowed unlimited access to citizens' online data.
- Governments should be allowed no access to citizens' online data.
- Major institutions, such hi-tech medical or financial firms, should be allowed access to all consumer online data.
- Major institutions, such hi-tech medical or financial firms, should be allowed no access to consumer online data.
- When citizens or consumers put their data online, or data is requested from the person, that data is their sole property and should not be consumed by any organisation.
- When citizens or consumers put their data online, or data is requested from the person, that data ceases to be their sole property and should be allowed to be consumed by organisations that store the data.

4. Choose a teaching / facilitation methodology.

a. Students first research each topic in research groups of 3.
b. Use a Jigsaw technique to create groups of 3 comprising one student from 3 different themes. Each person discusses their research within their new group.
c. Reassemble into original groups.

Each group has up to 5 minutes in the *Hot Seat*
OR
The government could be in the *Hot Seat* followed by an informed citizen or a consumer, followed by a social media multinational. OR

A *Power of Persuasion* technique is used to group students into their preferred category and try to convince other students over to their viewpoint.
OR
A *Think-Pair-Share-Snowball (TPSS)* exercise to broaden out the findings and conclusions of each research group.

LO 1.11

Students should be able to discuss the complex relationship between computing technologies and society including issues of ethics