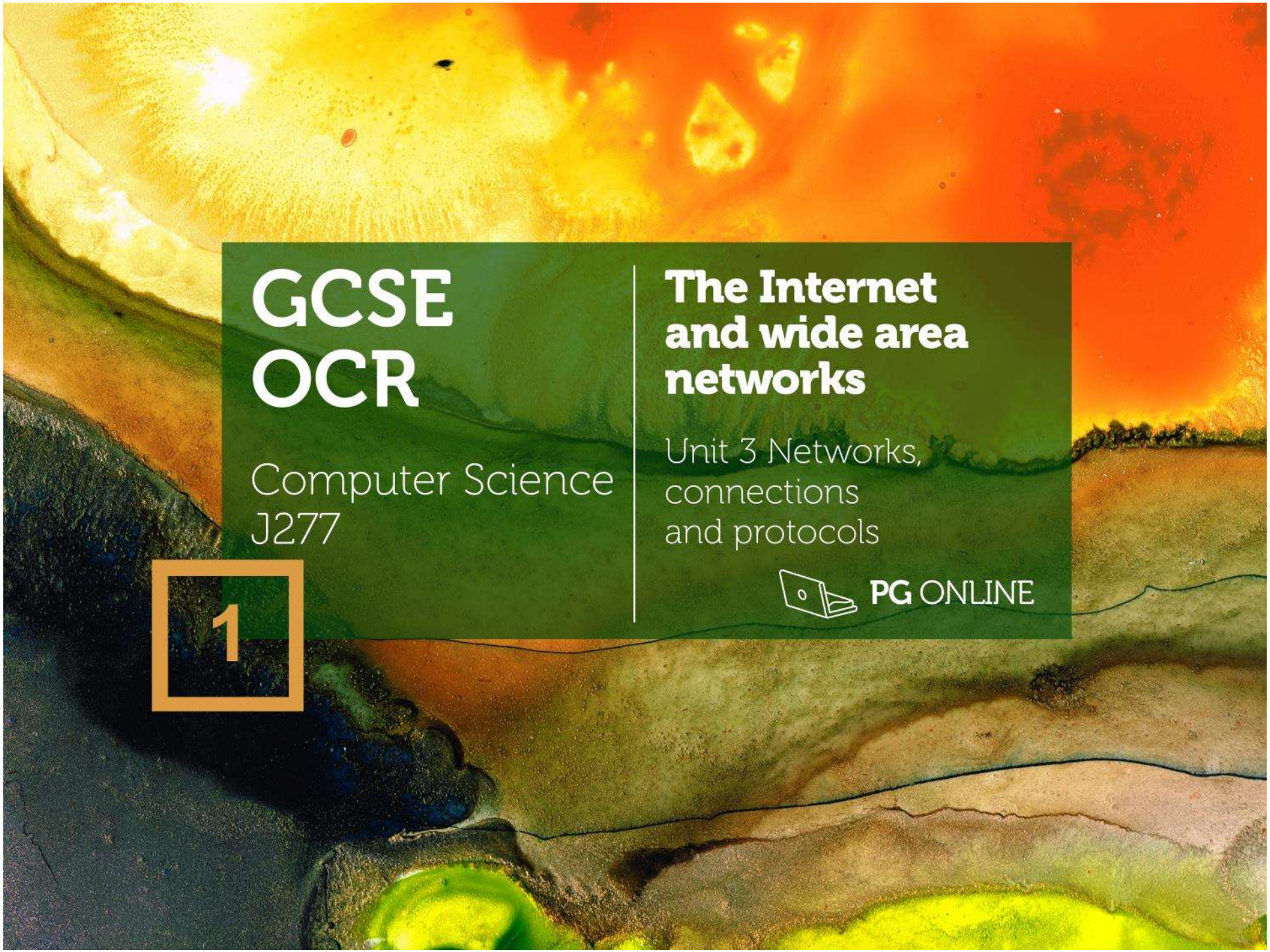
GCSE
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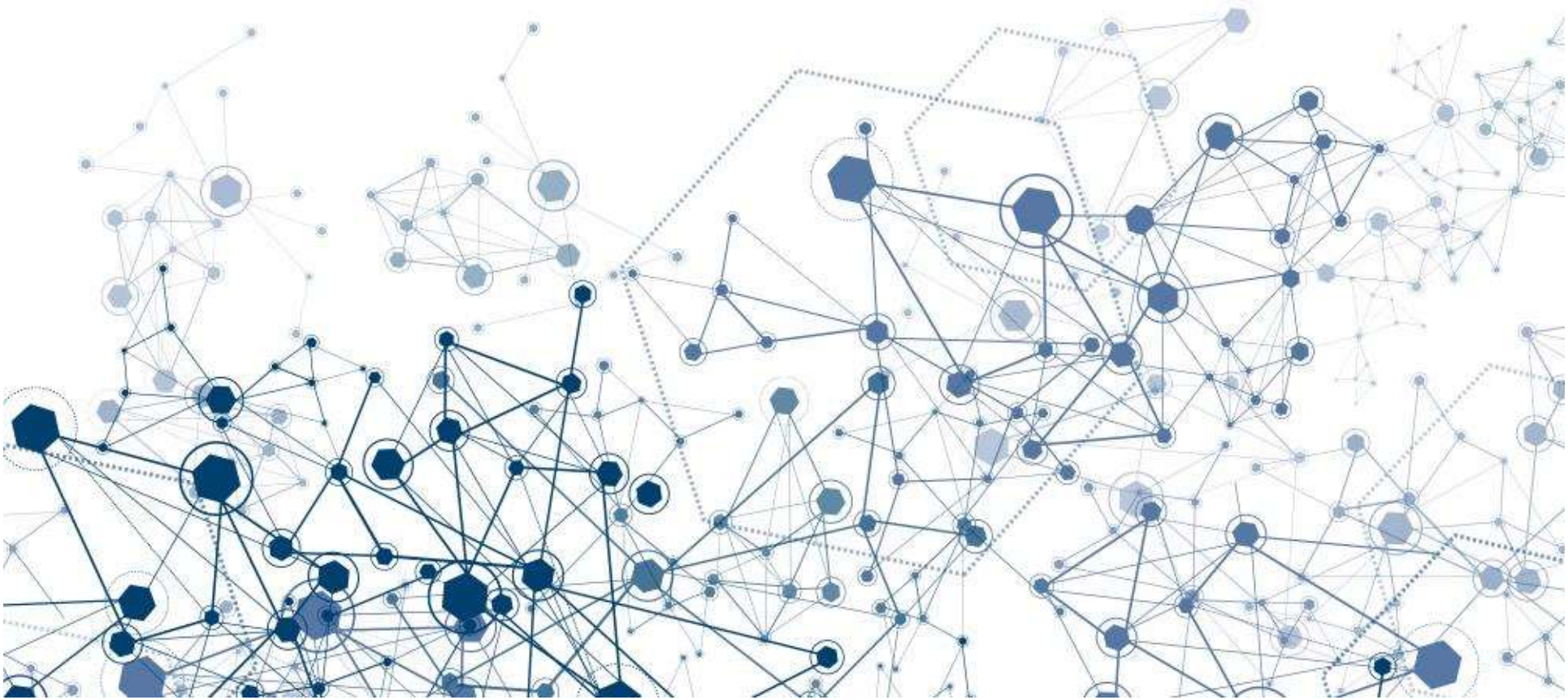
1
The Internet and wide area networks
Unit 3 Networks, connections and protocols
PG ONLINE

Objectives

- Define a Wide Area Network
- Describe the nature of the Internet as a worldwide collection of computer networks
- Explain the need for IP addressing of resources on the Internet and how this can be facilitated by the role of DNS services
- Understand the need for Network Interface Cards and the uses of MAC addressing
- Explain packet switching

Starter

- What is the Internet?
  - How is it different from the World Wide Web?



Starter

Answers

- The Internet is a collection of **inter**-connected **net**works
  - Many services make use of the Internet such as the web, voice over IP (VoIP), email and file sharing
- The World Wide Web is one service that makes use of the Internet
  - The World Wide Web is the information system of interlinked web pages and other resources
  - It is accessed from a web browser such as Chrome, Safari, Edge or Firefox
  - It makes use of HTTP to send and receive data

Wide Area Networks

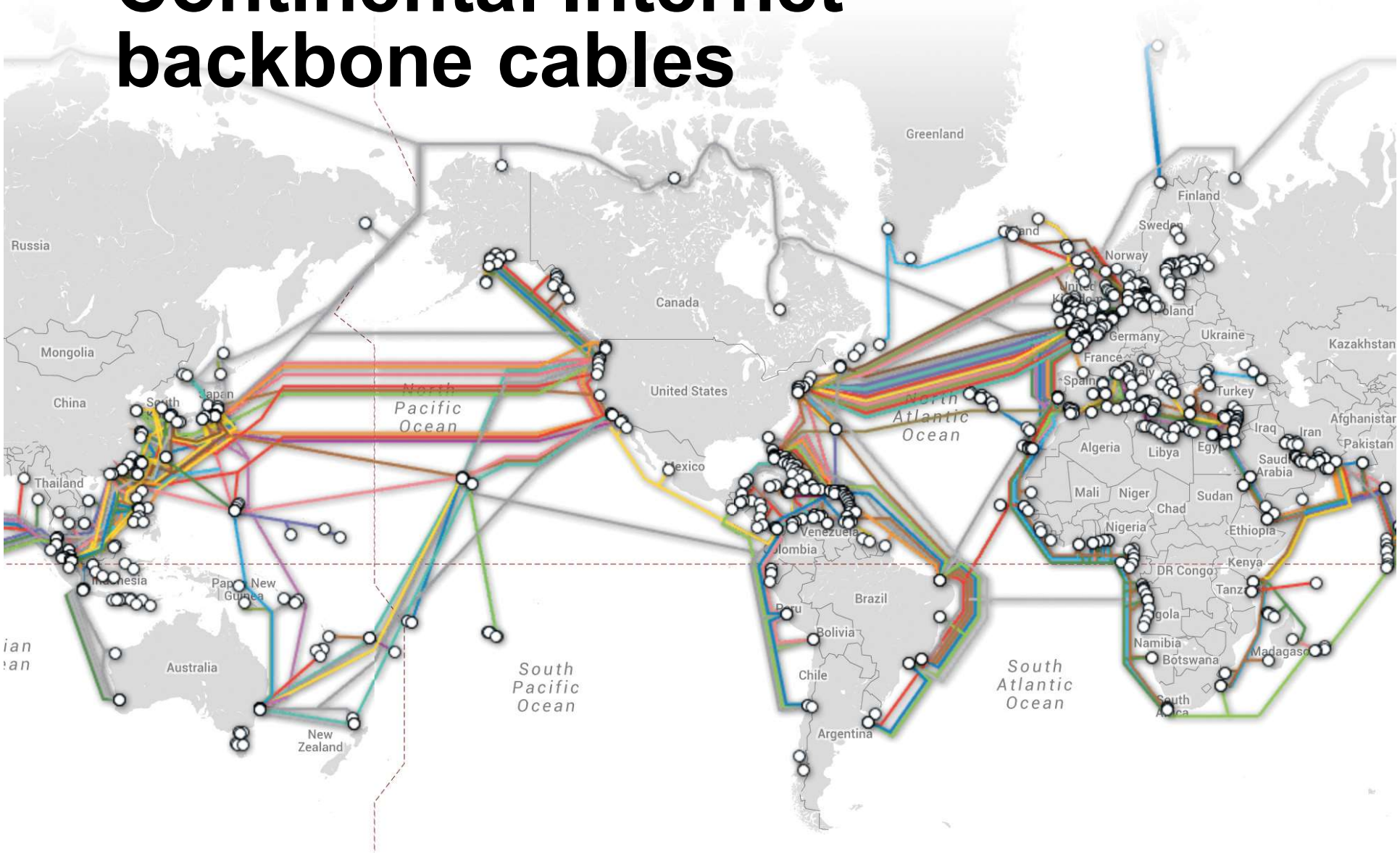
- **Any** network in which the computers communicate using resources supplied by a 'third party carrier' such as BT, is a WAN
- A WAN uses cables, telephone lines, satellites or radio waves to connect two or more remote locations
- The Internet is the largest Wide Area Network (WAN) in the world
  - Name **three** organisations that may be using a WAN to connect locations

Wide Area Networks

Answers

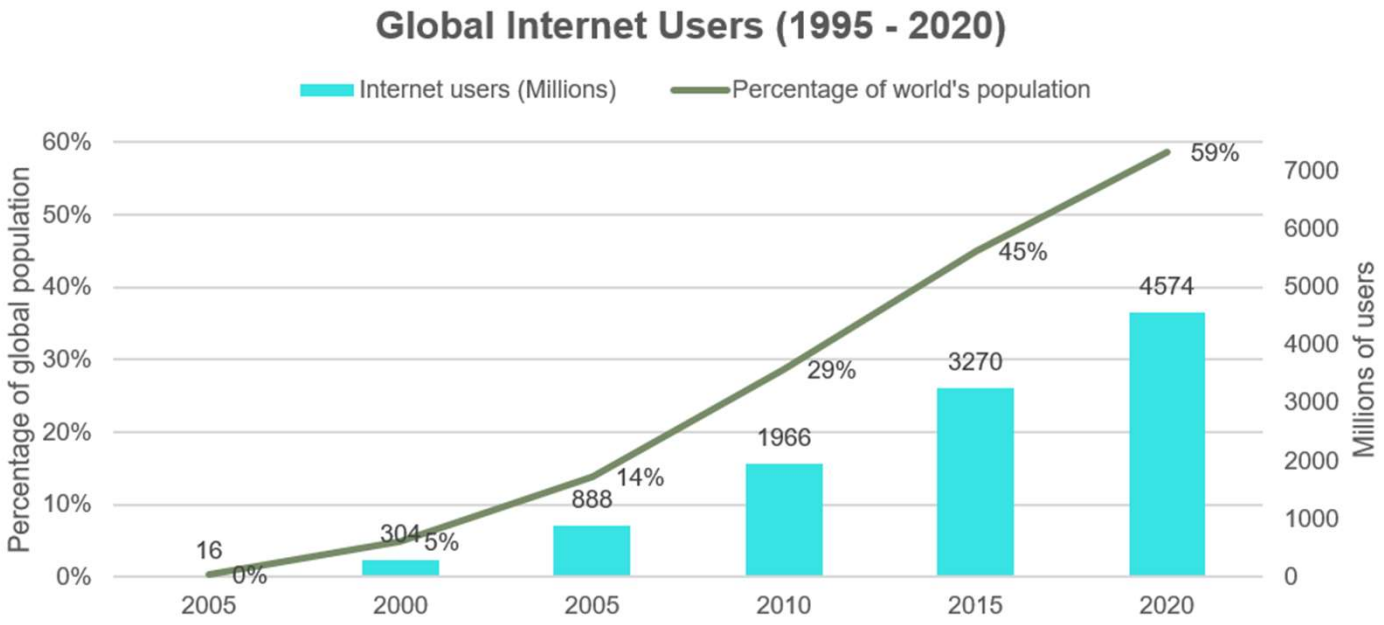
- Organisations such as universities and schools may have a number of geographical locations
  - Each one will have its own network. When these networks are joined together they will create a WAN
- Other organisations may use WANs including:
  - Large companies with many offices such as banks
  - Governments which have employees in many locations
  - Research organisations which are located in more than one place

Continental Internet backbone cables



Internet growth

- In 1969, there were four Internet connected networks
  - By 1989, there were 100,000 connected networks
  - By 2019, 4.5 billion people were Internet users



The Internet of Things (IoT)

- In 2020 there were over 31 billion IoT items connected to the Internet
- These include:
  - Mobile devices
  - Parking meters
  - Smart meters
  - Cars
  - Kitchen appliances
  - Cat trackers

IPv4 Addressing

- Like every front door in the world, every computer in the world has an IP (Internet Protocol) address
- IPv4 addresses are four 8-bit numbers (0-255) separated by dots
  - For example 72.129.214.16
- Newer IPv6 addresses are 128-bit numbers represented in hex
  - For example 1023:0ef1:0000:0000:34dd:00fe:0189:2233

Worksheet 1

- Complete **Task 1** on **Worksheet 1**

A circuit switching network

- When you make a telephone call, a dedicated connection is set up between you and the person you are calling for the duration of the call
  - This is called ‘circuit switching’
  - It works fine for phone calls, but there could never be enough lines for all the billions of people sending data across the Internet
- Packet switching solves this problem

Packet switching

- Suppose you want to send a file of 3 MB to someone via the Internet
- The file is broken up into data ‘packets’ of 512 bytes
- Each packet is given a header containing
  - The IP address it is going to
  - The IP address it has come from
  - The sequence number of the packet
  - The number of packets in the whole communication
  - Error checking data

Data packets

- Each data packet will contain the same number of bytes
  - The packets may flow through the Internet via different routes
  - Each packet is marked with the packet number so that the packets can be put back together by the receiver

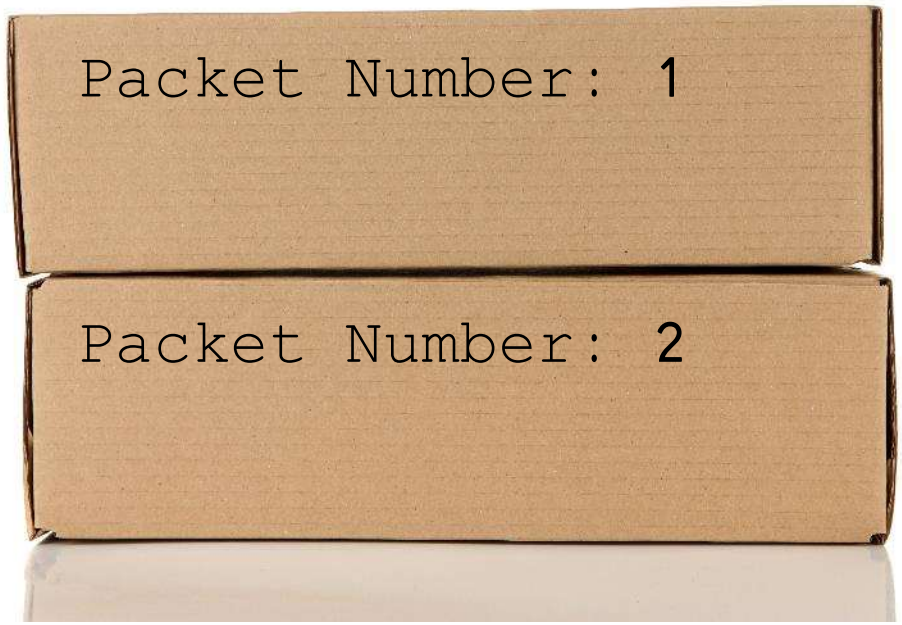
Internet packet routing

Worksheet 1

- Complete **Task 2** on **Worksheet 1**

Reassembling the data

- The recipient computer re-orders the packets into the correct order
- Each packet is checked for errors
  - Corrupt packets are requested to be resent



Moving packets on the net

- Points on a network diagram are called **nodes**
- Routers are any node that can route packets from one place to another
  - Your home router, routes packets to the different devices on your home network
  - Internet routers route packets around the world like a mail sorting office

Domain Name System (DNS)

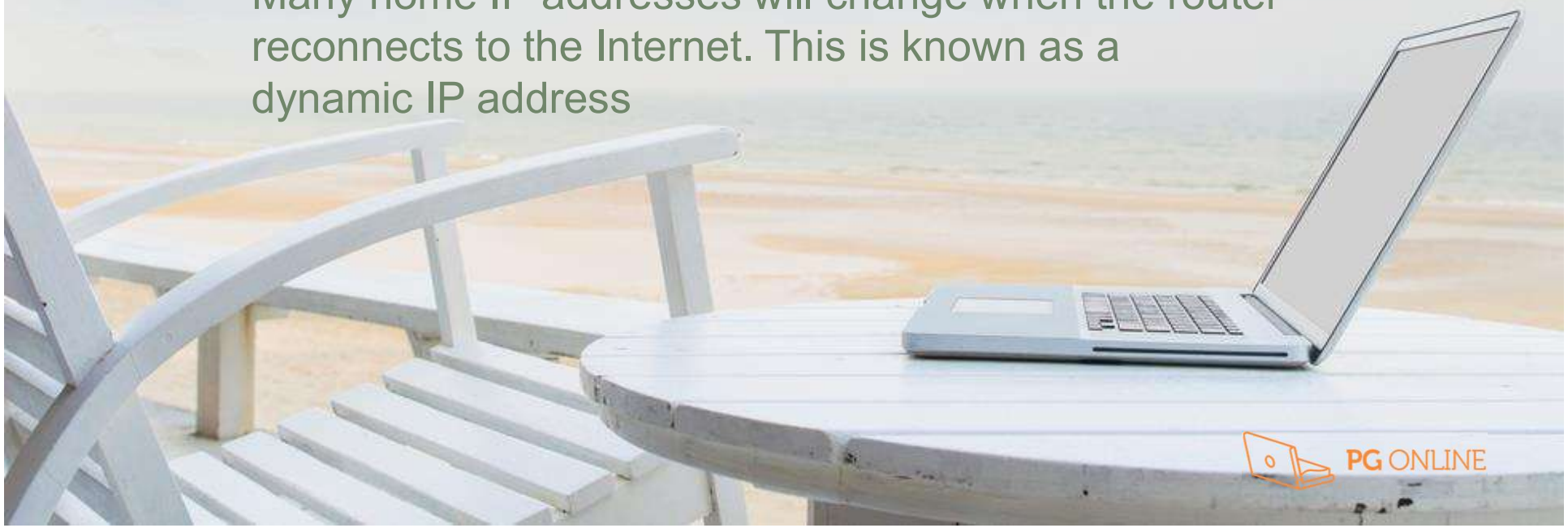
- The Domain Name System is made up of domain names
  - A domain name is a name used to refer to an IP address
  - Google.co.uk is an example of a domain name
- A DNS server translates a web address into an IP address
  - For example, google.com translates to 216.58.204.35
- What happens when you type an IP address into a browser?

DNS servers

- There are 13 DNS root servers worldwide which keep a complete database of all domain names and IP addresses
  - Other DNS servers lower down the hierarchy, hold parts of the database
  - When a DNS server receives a request not in its database, it will pass the request on to another server until it reaches one with the matching name and IP address
  - Lower level DNS servers are owned by Internet Service Providers (ISPs)

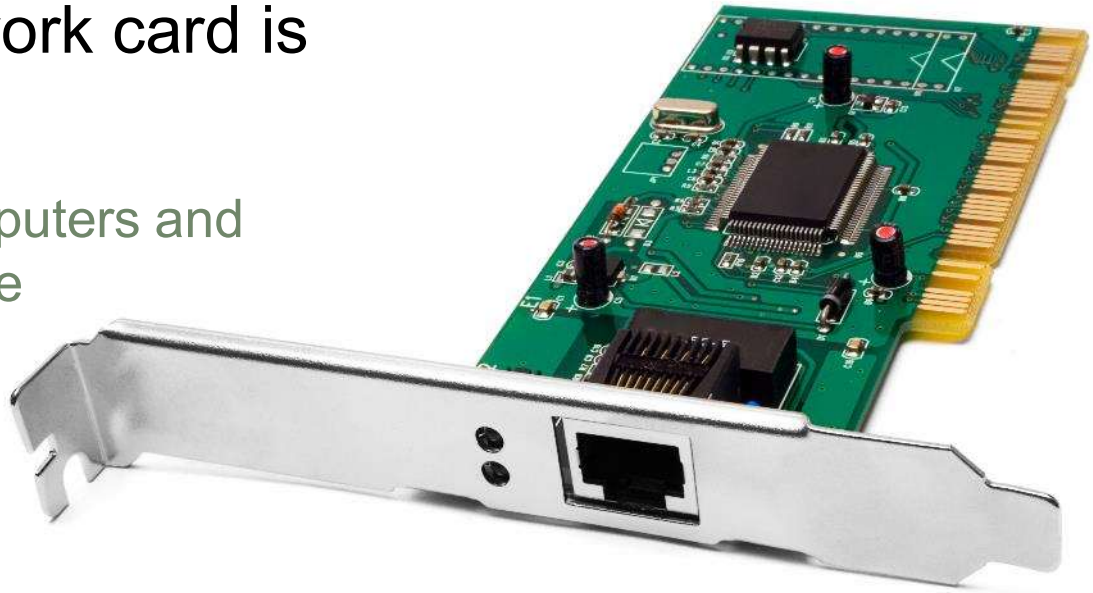
Your IP address can change

- If you use a laptop at home, its IP address is the one belonging to the router at home
- But if you take the laptop on holiday your laptop will be assigned a new IP address
  - Many home IP addresses will change when the router reconnects to the Internet. This is known as a dynamic IP address



Network Interface Cards

- A Network Interface Card (NIC) is built into every networked device
  - It may be wireless with an antenna or wired with a network cable socket
- A removable network card is shown here
  - Most modern computers and phones incorporate the NIC into the motherboard



MAC addressing

- A **Media Access Control** (**MAC**) address is assigned to each Network Interface Card (NIC) by the manufacturer
  - Your computer may have more than one MAC address if it has both an Ethernet and Wi-Fi connection
- A smart phone will have two different MAC addresses
  - One will be for Wi-Fi and one for Bluetooth
- A MAC address looks like this:

3B:14:E6:39:0A:2C

MAC address

- Every networked device in the world has a unique MAC address
- There are 2^{48} possible addresses – enough for 40,000 NICs per person with a world population of 7.125 billion
  - Why doesn't the Internet use a MAC address instead of an IP address to locate a web address?

The role of the MAC address

- The actual geographical location of a networked device can be determined by its IP address
  - If you take your laptop to another part of town, or to another country, its IP address will change
- When you request a web page, each router along the way uses the MAC address of the next router to send the data packet on the next leg of its journey
  - The MAC address of a NIC is unique and never changes

Worksheet 1

- Complete **Task 3** on **Worksheet 1**

Plenary

- Work with a partner asking alternate questions
- What do each of the following words or acronyms mean?
  - WAN
  - Packet
  - Routing
  - DNS
  - IP address
  - MAC address

Plenary

Answers

- WAN – Wide Area Network (large geographical area)
- Packet – one unit of data sent through an IP network
- Routing – directing IP packets to their destinations
- DNS – Domain Name System
- IP address – Internet Protocol address. Where packets of data are sent to or received from
- MAC address – Media Access Control address. The unique identifier of each device (or network interface card)

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