

The Internet - PART ONE

Some Interesting Questions

- Why do we have an Internet?
- How did it start?
- What is the difference between the Internet and the Worldwide Web?

And even more questions

- What is a "Browser"?
- What is a "Search Engine"?
- What is a link?
- What does [http://](#) at the start of a link mean?
- Why do some addresses start with [https://](#) ?

Remember these two?



Intercontinental Ballistic Missiles

ICBM

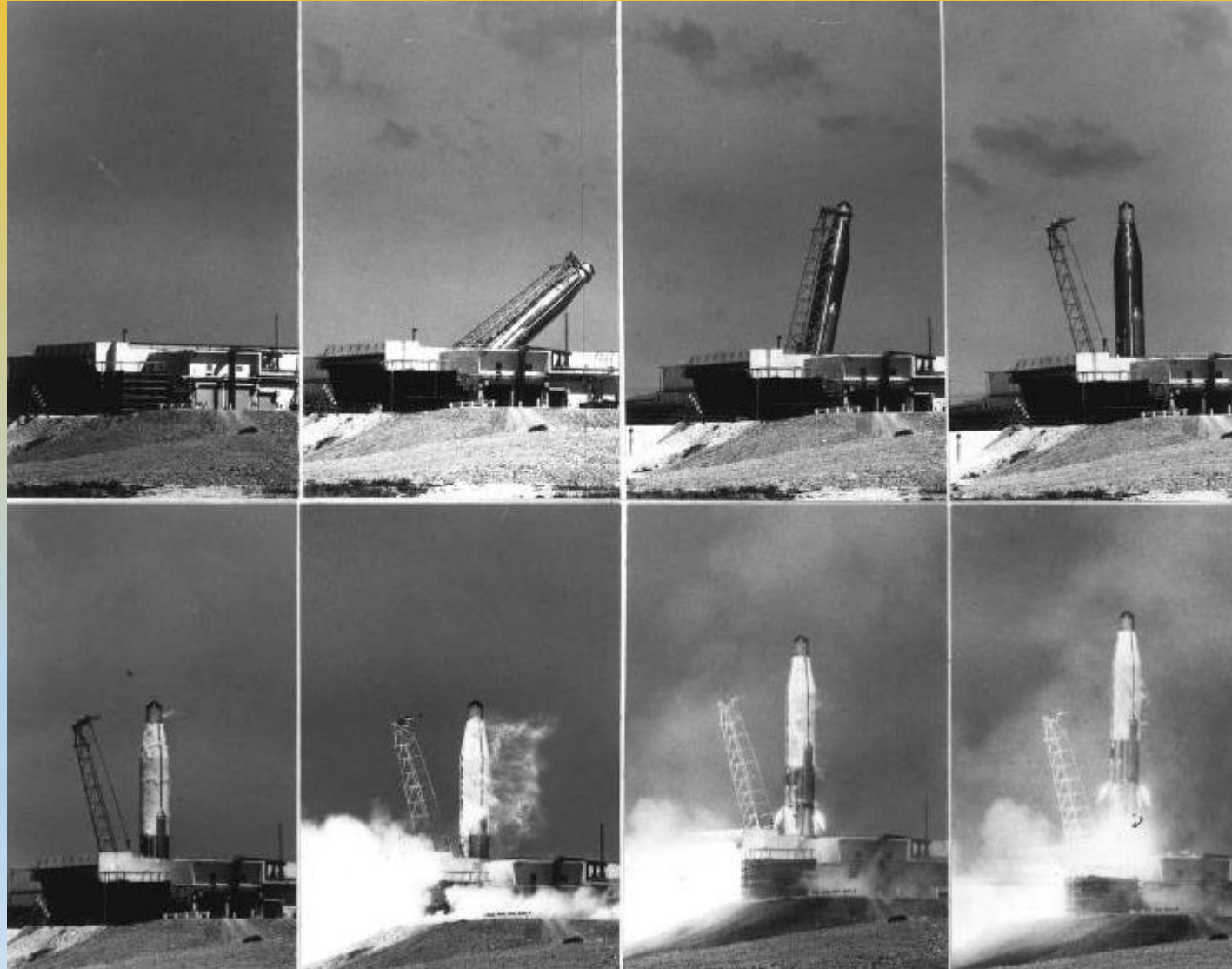
Mutually Assured Destruction



Twelve Atlas F intercontinental ballistic missile sites were planned and constructed around parts of eastern Nebraska

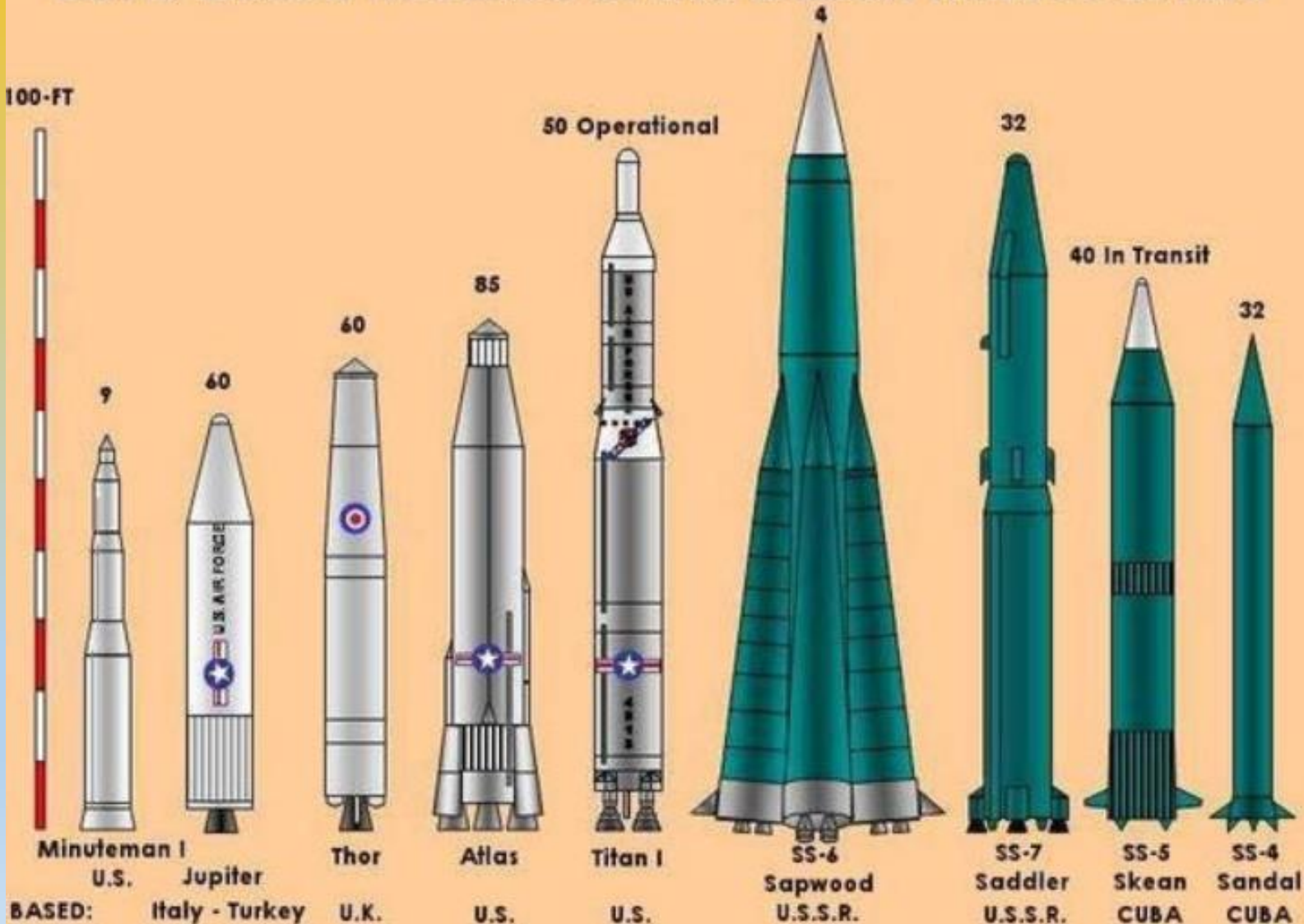


THE ATLAS ICBM



The nuclear face-off in October 1962

Land Based Missiles of the Cuban Missile Crisis



How could NATO and the Western world ensure mutually assured destruction?

The key was indestructible and flexibly adaptable communications between missile sites

Genesis of The INTERNET

The Internet started as **ARPANET**, a 1960s defence force project in the US which had the objective of connecting several super-computer sites in the country with one another so that if any one of them was destroyed by a nuclear explosion, for example, then the remaining computers would continue to function.

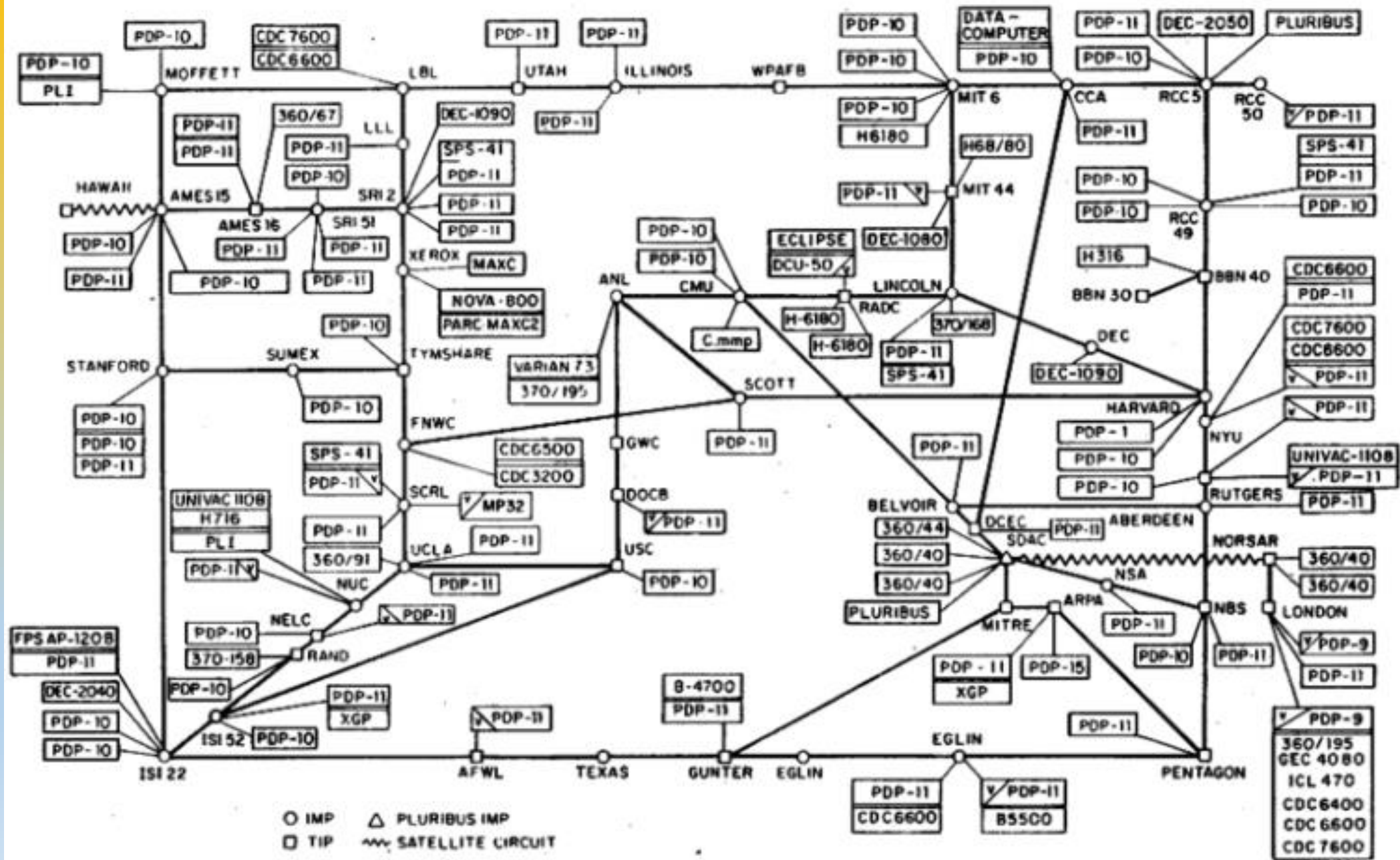
ARPANET

ARPANET was the network that became the basis for the Internet. Based on a concept first published in 1967, ARPANET was developed under the direction of the **U.S. Advanced Research Projects Agency (ARPA)**. In 1969, the idea became a modest reality with the interconnection of four university computers. ARPANET established the first ever computer-to-computer link on 29th October 1969.

Packets and Protocols

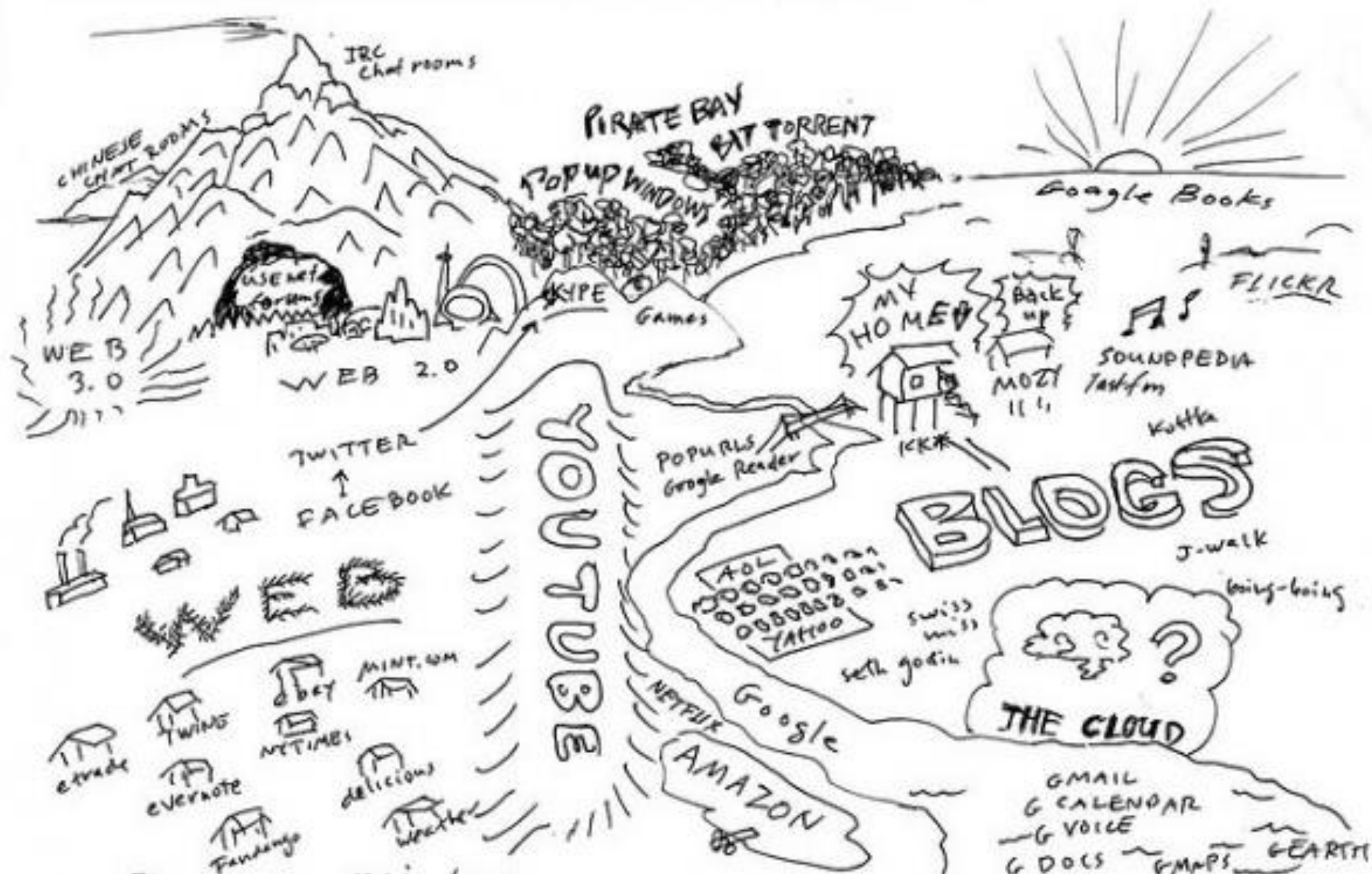
The Advanced Research Projects Agency Network (ARPANET) was an early *packet switching network* and the first network to implement the *protocol suite TCP/IP*. Together these technologies became the technical foundation of the Internet.

ARPANET LOGICAL MAP - MARCH 1977



THE INTERNET MAPPING PROJECT

Please draw a map of the internet, as you see it. Indicate your "home."



Let's go back a bit

Dial up communications - the MODEM

MODEM is a portmanteau word comprising
MODulator and DEMODulator

The MODEM is used to convert your message
into a digital format which can be sent OUT
over an analogue phone line and
to convert INBOUND digital messages into a
format that you can use

Dial up communications - the MODEM

MODEMs arrived long before the Internet and were used for dialling up a connection to (e.g.) bureau computing services

The first MODEMs were associated with a phone handset

The user had to dial up a service number; waiting until the right connection tone was established. Speeds were very low

BITS and BYTES

- The smallest atom of data is a BIT - short for binary digit
- A BIT can either have value of 0 or 1
- A BYTE is formed of 8 BITS, so can have a value between 0 and 255
- So one BYTE can represent 255 different characters
- MODEM raw speeds are measured in BITS per second (bps)
- One megabit is 1,048,576 BITS
- One Kilobyte is 1024 Bytes
- One Megabyte is 1,048,576 Bytes
- One Gigabyte is 1,073,741,824 (or 2^{30}) Bytes or 8,589,934,592 bits
- Typically your PC will have a 4 megabits of random access memory

How many bytes do you really need?

- 1 Kilobyte will store 2 or 3 text paragraphs
- 1 Megabyte will store 873 pages of 1200 per page plain text
- 1 Gigabyte will store 4,473 books of 200 pages plain text

OR 640 Web pages (1.6 Mb average size)

OR 340 digital photos (3 Mb average size)

OR 256 audio MP3 files

How fast is fast?

| | | |
|---------------|------------------------|--|
| 1958 | 110 bps | The very first MODEM, used for linking Teletype machines |
| 1962 | 300 bps | AT&T introduce the first commercial computer modem |
| 1980s | 1200 bps | First internal PC modem |
| 1981 | 2400 bps | Hayes smart modem introduced. No more dial-up and wait |
| 1980s onwards | 4800 bps | IBM dominate the scene but more 2400 modems come to market |
| 1990s | 14400 bps to 28800 bps | "Voice over IP". Modem prices continue to fall |
| 1990s | 57600 bps | Theoretical limit reached for analogue phone lines |
| 2000s | ADSL arrives | Asymmetric Digital Subscriber Line |

How fast is fast?

Between 1958 and the 2000s the speed has increased by a factor of over 500 - and that's before FIBRE!

Going fully digital

Asymmetric Digital Subscriber Line = ADSL

- The digital telecommunications signal is separated from the analogue phone signal by really clever techniques, which assure faster and faster rates of transmission and reception
- The line is **ASYMMETRIC** - allowing for faster **DOWNLOAD** of data **FROM** the Internet but relatively slow **UPLOAD** of data **TO** the Internet

The ADSL filter



The "BT" connection has just two wires to carry both phone and internet signals

And so to FIBRE - I

Glass monomode fibres with diameter ten times narrower than a human hair are capable of transmitting data in the form of light. These fibre "cables" can transmit data many times faster than the copper wires used heretofore.

BT Openreach has a massive distribution infrastructure of twisted pair copper cables from domestic premises which terminate in the familiar (light or dark) green boxes.

**Inside the old fashioned
BT street cabinet**

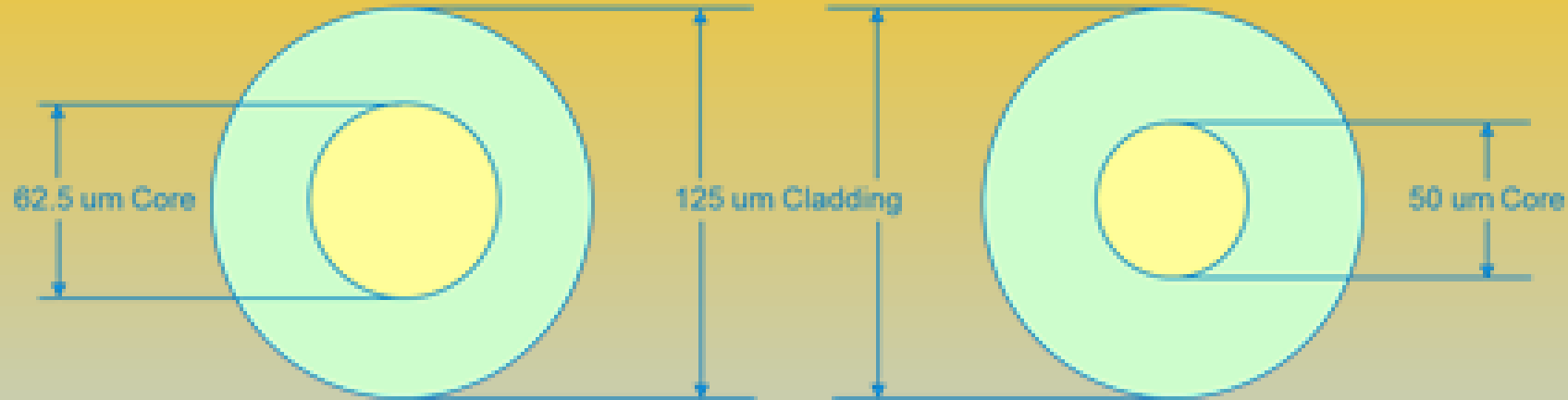




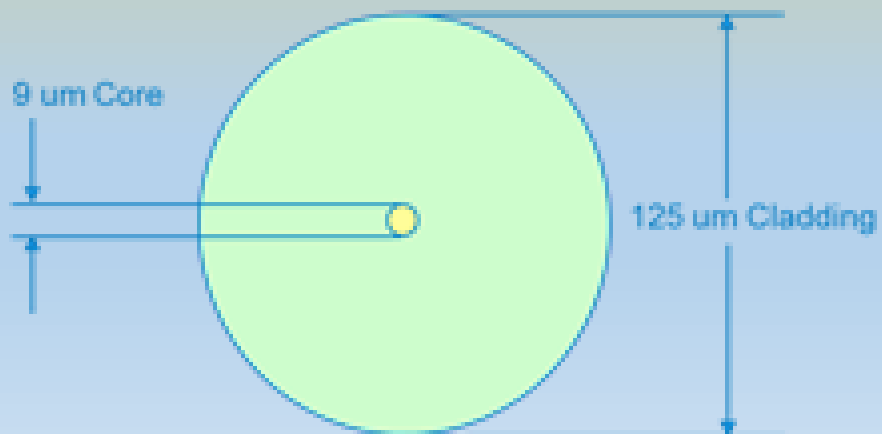
Inside the new FTTC BT street cabinet

Fibre dimensions

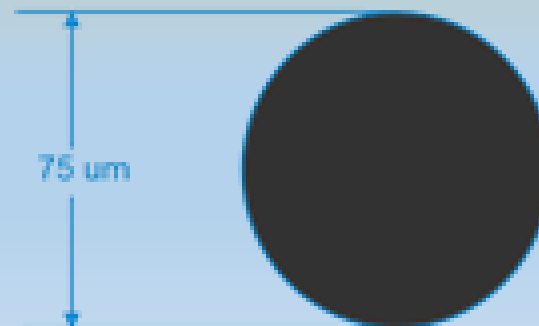
Typical Multimode Fibers



Typical Singlemode Fiber

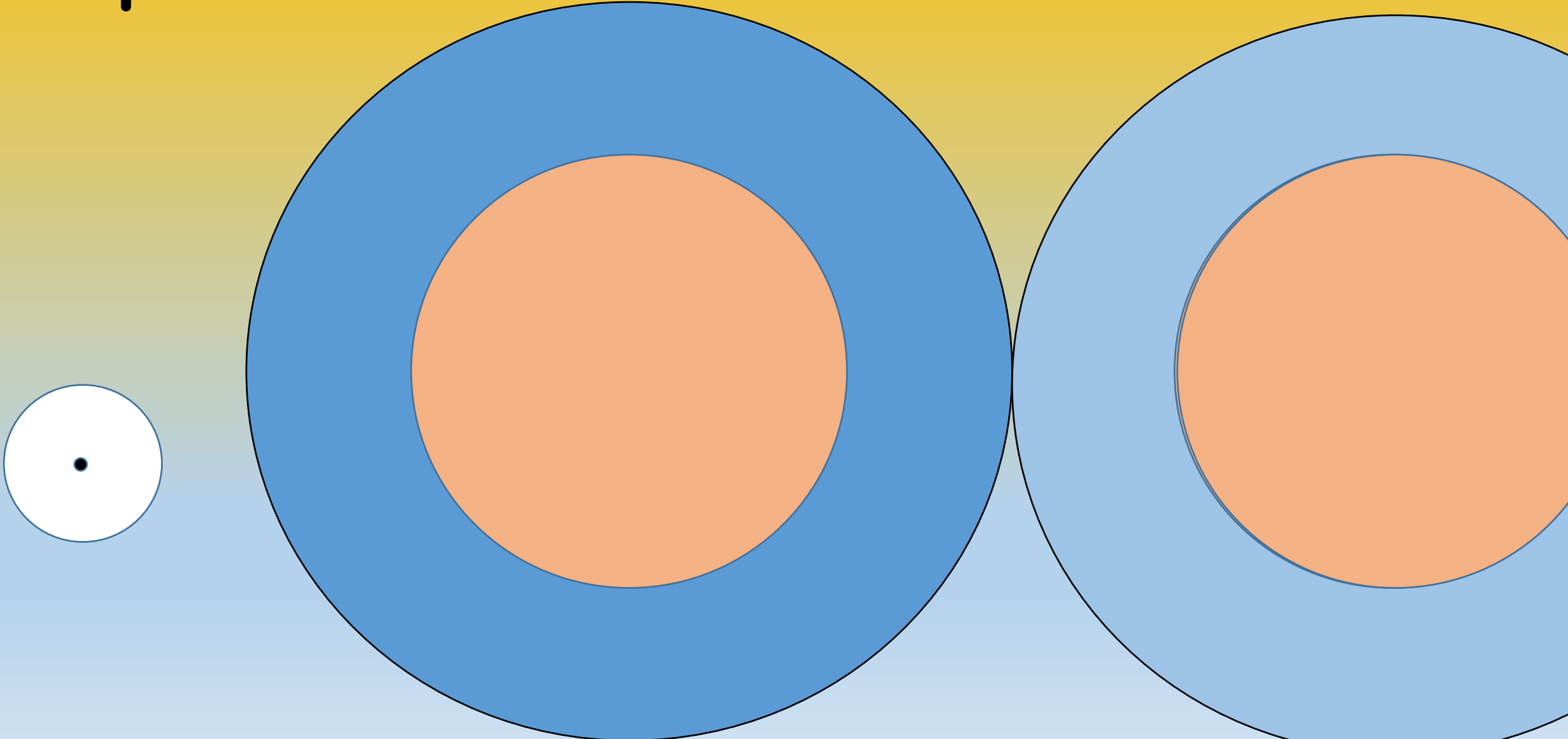


Typical Human Hair



1 mm = 1,000 microns
Or 1,000 μm

Twisted pair dimensions Compared with monomode fibre



Fibre vs Copper

- Glass fibres are not subject to electromagnetic interference
- Attenuation of signals is many times less than that experienced with copper pairs
- Cross talk between fibres is eliminated
- Massively increased bandwidth available
- Elimination of security risk - cannot be tapped
- Great care needed to align junctions between fibres or at fibre terminations

And so to FIBRE - II

FTTC

Over the past fifteen years or so BT have been replacing the copper pair lines which carry signals between the green boxes "cabinets" and the exchange with optical fibre.

This is a massive investment, known as "FTTC", or Fibre to the Cabinet. It is FTTC which gives you speeds of up to 34 MB. Over 26 million homes or businesses now have FTTC Fibre.

The ultimate FIBRE connection

FTTP. To replace the lines which travel between those green cabinets and your house is another much larger and more expensive step. This is known as "**FTTP**", or **Fibre to the Premises** - otherwise as **Superfast fibre**.

FTTP can give download speeds of up to 1 Gbps. BT Openreach have already rolled out 345,000 installations and plan to meet two million by 2020