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Odyssey
Oxford Debates for Youths in Science Education

Internet Access and Development
Debate Topic:
„Worldwide Internet Access should be done only through wireless networking”

Worksheets and teaching material
Student’s Edition

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Subject: Internet Access and Development

Debate Topic: „Worldwide Internet Access should be done only through wireless networking"

Vocabulary:

Internet: It is a global system of interconnected computer networks, which use an established group of protocols (usually called "TCP/IP"), to serve millions of users every day in the world. The interconnected computers in the world, which are in a common communication network, exchange messages (packages) using various protocols (standard communication rules), which are implemented at the hardware and software level. (Source: Wikipedia).

Cyberspace: The set of Internet sites that the user visits by "surfing".

Fiber Optic: It consists of a glass or plastic conductor (core) surrounded by an insulating coating (mantle), which is surrounded by a protective covering. As the mantle has a lower refractive indexthan the nucleus, it acts as a mirror, causing light to move through the nucleus, undergoing successive reflections on its walls. The rate of light transmission within the optical fiber has a maximum limit determined by the physical properties of the fiber. The light source trasmitted, is either laser or LED (light emitting diode) with wave lengths 800 nm – 1500 nm.

Wireless Networking Technologies: Modern wireless networking technologies such as Bluetooth, WLAN and WiMAX, enable the wireless connection between the telecommunications devices and data processing devices. Depending on the technology they use, these devices have different frequencies and operating ranges. The communication and the transmission of information is done by transmitting and receiving electromagnetic waves.

Satellite Internet: The possibility of accessing the Internet via satellites. Recently, an attempt has been made to access the Internet via low orbit satellite. This is the space internet.

Internet of Things: The term Internet of Things (IoT) describes the co-ordination between many machines, devices and gadgets connected to the Internet through multiple wired and wireless connections.

Big Data Analytics: The use of advanced and analytical techniques for large and diverse data sets that include structured, semi-structured and unstructured data from different sources and in different (large) sizes from TerraBytes to ZetaBytes. Big data is a term applied in data sets whose size or type is beyond the ability of the traditional relational databases to record, manage and process these data. For instance, the needs nowadays and the shift of more and more enterprises to e-commerce, further enhances data production. The largest e-commerce companies accept thousands of transactions from customers in just a few minutes and the need to analyze this data is urgent.

Artificial Intelligence / AI: The term refers to the field of Informatics, which deals with the design and implementation of computing systems which imitate traits of human behaviour that imply even basic intelligence: learning, adaptability, drawing conclusions, contextual understanding, problem solving etc.

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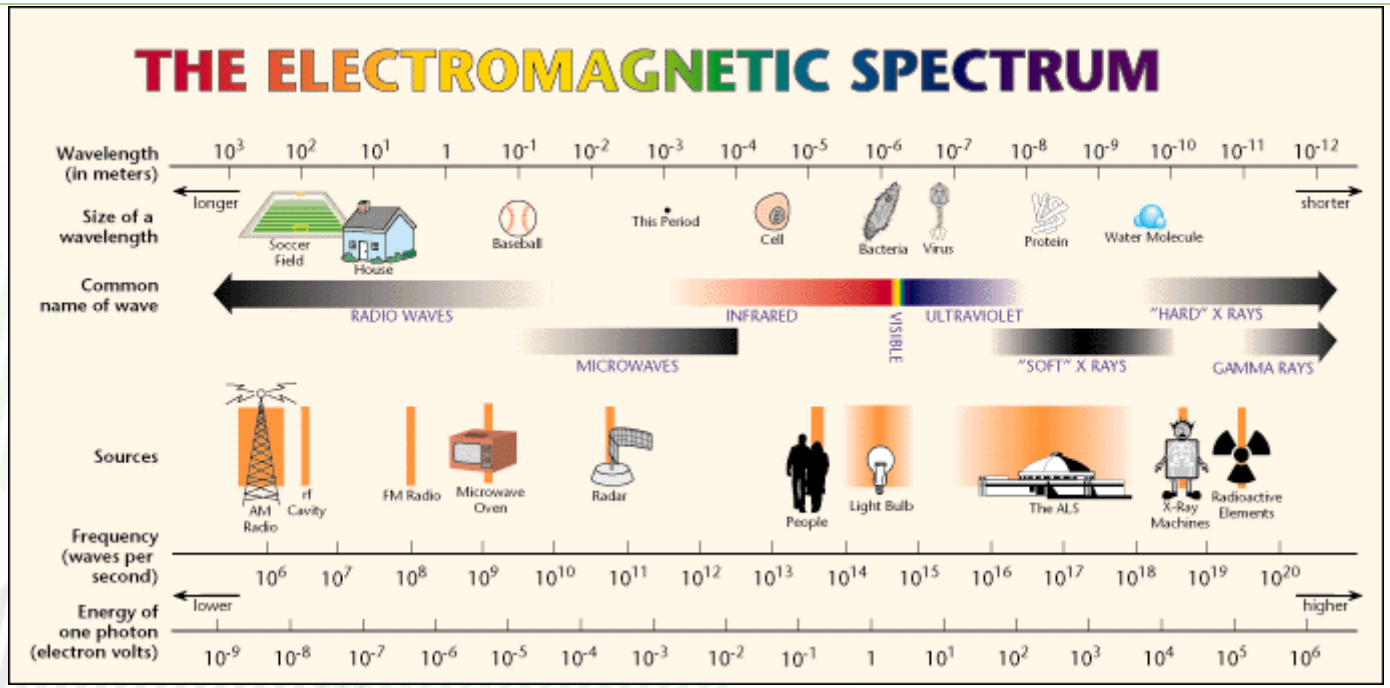
Electric fields: Electric fields created by power transmission devices are related to the value of voltage at the power lines, as well as the geometry of the device. The voltage in the power lines can be considered the cause of the electricity transmission, in proportion to the change in the water pressure in a water supply network which causes the movement of water. In general, the higher the voltage is, the stronger the electric fields are. Electric field strength is measured in volts per meter (V / m). Often, the multiple kV / m (1 kV / m = 1000 V / m) is also used. The electric fields, which appear in nature are due to the electric charges that are concentrated in the earth's atmosphere and create near the surface electric fields of the order of 100V / m, in good weather conditions. These fields usually range from 500 V/m to 1000 V/m during thunderstorms. Electric fields are shielded by building materials, trees, high fences, etc. (unlike magnetic fields). In other words, electric fields cannot penetrate such materials. For this reason, electric fields in a house near an overhead power line do not pass inside. That is, people, plants, houses, etc. are opaque to the electric field. In addition, the electric fields generated by any source weaken as the distance from the source increases.

Magnetic Fields: The magnetic fields generated by electricity transmission devices depend on the magnitude of the electricity transferred (electric current) in the conductors, as well as on the geometry of the device. For a given voltage, the magnitude of the current in the conductors determines the amount of energy transferred by the device. The flow of electricity in a pipe can be compared to the movement of water in a pipe. In general, the higher the current is, the stronger the magnetic fields are. Magnetic fields are usually measured in microtesla (μT - Europe). The unit of measurement of milligaus (mG - America) (10mG = 1μT) is also used. The natural magnetic field of the Earth is about 45μT in Greece. Magnetic fields are hardly affected by the presence of trees, fences and most building materials unlike electric fields. Thus, the magnetic field generated by lines of electricity outside our homes can penetrate walls and ceilings (only ferromagnetic materials do not allow that). Magnetic fields, like electric ones, weaken as the distance from their sources increases.

Electromagnetic radiation: The term refers to oscillations of electric and magnetic fields that propagate in space perpendicular to each other and perpendicular to the direction of propagation in space in the form of a wave and transfer energy (Poynting vector). The different types of electromagnetic radiation are distinguished from each other depending on the frequency or wavelength of the propagating wave. Frequency is measured in Hz (oscillations or cycles per second), kHz (thousands of Hz), MHz (millions of Hz) and GHz (billions of Hz). Wavelength is measured in units of distance (e.g. meters). Electromagnetic waves appear in many different forms (meaning different frequency, wavelength). For example, radio waves, microwaves and visible light are forms of electromagnetic waves.

Extremely Low Frequency Electromagnetic fields / ELF:
The changing electric and magnetic fields generated by electrical devices are also called Extremely Low Frequency (ELF) fields. ELF fields differ from radio waves which are generated by high-frequency electromagnetic fields emitted by broadcasters, mobile phone base stations, radar devices, etc. ELF fields and radio waves along with infrared, visible and ultraviolet radiation make up the spectrum of non-ionizing radiation. Unlike ionizing radiation (radioactivity), which includes X-rays, gamma rays, etc., non-ionizing radiation can not break chemical bonds and scavenge electrons from atoms or molecules. That is, it cannot cause particles ionization.

Electromagnetic spectrum



In vivo studies = The Latin expression in vivo, which in Greek means "alive", refers to what takes place within a living organism. In Biology, the term refers to experiments performed on tissues in a living organism as opposed to the term in vitro (= "in a test tube").This term refers to corresponding experiments on detached parts outside the living organism, as well as to research and experiments “ex vivo”. In general, clinical trials and animal experiments are forms of “in vivo” research. This type of research is a holistic way of experimenting. It is suitable for studies more than “in vitro” studies, due to the fact that it gives more accurate, safe and reliable results ready for use through the performance of an experiment.

SAR= Specific Absorption Rate of radiation in the head and body area.

NCRP = National Council of Radiation Protection and Measurement: National Council for Radiation Protection of the USA.

WHO = World Health Organization: World Health Organization is a specialized agency of the United Nations, responsible for international public health. It was founded in 7 April 1948 and it is headquartered in Genève, Switzerland.

GAEC = Greek Atomic Energy Commission: It is the national regulatory authority in the field of radiation safety and protection. GAEC is responsible for monitoring compliance with the limits of public exposure to electromagnetic radiation. The tests for the measurement of the radiation are carried out by GAEC or by bodies authorized by it. Its official site ishttps://eeae.gr/

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Lesson 1: Introductory Seminar - Webinar

Introductory questions: During the 1st lesson but possibly after the completion of the 1st lesson, where the topic of the debate was introduced (through the material of the presentations and the videos in the webinar) the following introductory questions were asked which will be used as based on the beginning of the second lesson (and which may have been partially answered before the beginning of the second lesson).

1) What are the ways to access the internet?
2) Is there internet access in all countries?
3) What technologies are related to internet access?
4) Does internet speed play a role in the economy?
5) Does the radiation used in wireless networking have an effect on human health?
6) Is there an issue to be researched in your opinion associated with health issues from the use of 5G?
7) Do you think satellites will play a role in the future in internet access?
8) Will the global economy be helped and equal opportunities (for the global community) be enhanced with the help of satellite internet access?

Students'answers

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Activity 1

During your preparation for resolving the Internet Access argument, prepare a series of arguments, classifying them into three categories: the ones in favor of the resolution, the ones against the resolution and the arguments that can be used by both cases. The questions asked by your teacher during the "Introduction" phase, will support the development of your arguments.

FOR	GREY AREA	AGAINST

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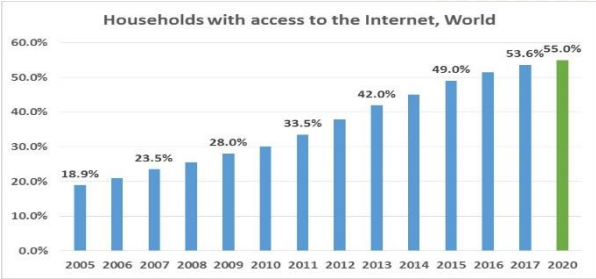
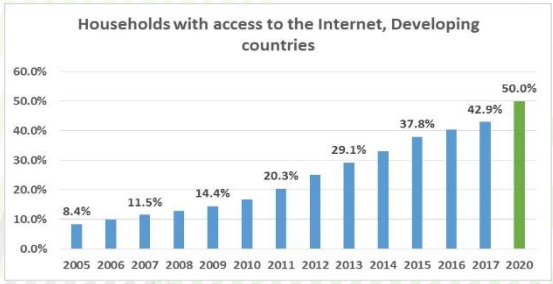
Lesson 2. Study material and formation of arguments

Below you will find Info Cards (IC) and Story Cards (SC) below. Read them carefully and analyse them, in order to formulate your arguments through the answers to the questions.

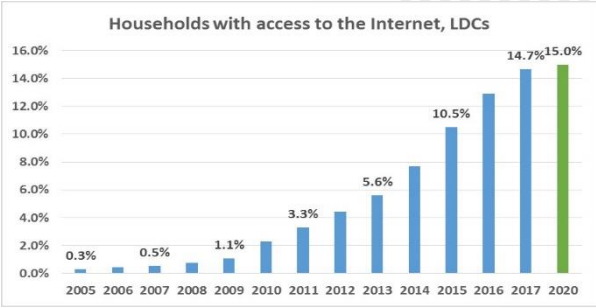
INFO CARD 1

Domestic Internet users in 2017 & Goals for the end of 2020





A. Households with Internet Access (Worldwide).



B. Households with Internet Access (in under-developing countries)

Today (2019) it is estimated that 3.3 billion people do not have Internet access. In fact, according to a study by '*Strategy&*', Internet connection could lift 7% of the world's population out of absolute poverty and increase the Gross World Product by 6.7 trillion dollars.

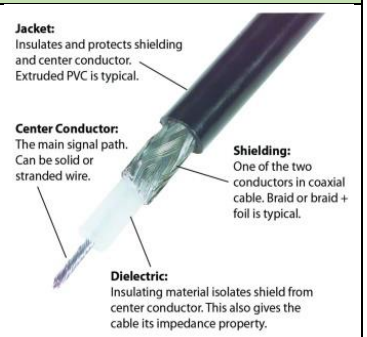
C. Households with Internet Access (less developed countries)

Source: Dreyfuss E., (2018), *Global Internet Access is Even Worse Than Dire Reports Suggest* @ wired.com & Strategy&, (2016), *Connecting the world, Ten mechanisms for global inclusion*, Report & Strategy&, (2010), *The rise of Generation C, Implications for the world of 2020*, Report & UN, (2014), *The State of Broadband 2014: Broadband for all*, A report by the Broadband Commission.

Images A, B, C: The numer of domestic Internet users by 2017 aiming for 2020, as a percentage of the world's population. Source: International Telecommunication Union. https://www.itu.int/en/annual-report-2017/goals/Pages/goal1.aspx

INFO CARD 2

Coaxial Cable Lines



Electricity transmission lines, despite the positives in their use, present high construction cost but also signal loss due to 'copper, dielectric materials, induction & radiation'.

More thoroughly:

- *Due to copper*: Metals display resistance (due to electron collisions to the crystal lattice and heat production) which is proportional to the length of the cable lines and inversly proportinal to their cross-sectional area.
- *Due to dielectic materials*: Due to the heating of the dielectric material, the voltage at the conductors and the frequency of the transmitted signal are affected.
- *Due to induction**: As the electromagnetic field of the conductor induces current in nearby metal objects, there is 'loss' of energy transferred to the environment.
- *Due to radiation**: When the electric line has specific dimensions (in relation to the elements of the transmitted signal), it can act as an antenna and radiate the frequency partially in space, instead of transmitting it.

**The last two problems can be solved with the correct termination of the line with shielding and grounding. Source: Tsichlis Chr. (2012), Conductors and Cables for the electricity Transmission, Thesis, TEI of Kavala & Information Technology (EMY 007) @ ceid.upatras.gr*

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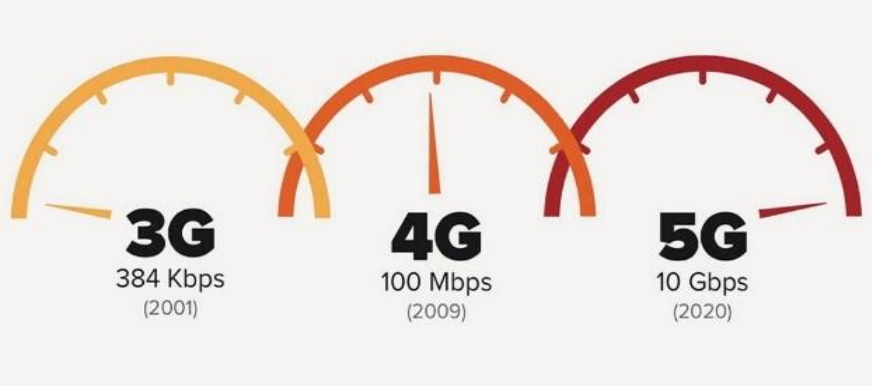
INFO CARD 3	INFO CARD 4
WLAN - Wireless Local Area Network It is used for networking devices at distances from 30m to 100m and in the free space up to 300m. Remote computer networks can be connected via WLAN and external working positions can be interconnected in businesses or uviversities to the internal data network. Moreover, WLAN offers wireless Internet access in hotels, airports and other similar places. **WLAN operates mainly in the 2400-2483.5 MHz frequency band (like Bluetooth technology) and it is not widely available at 5 GHz.** The maximum allowable transmitting power from terminal devices and central points (access points) depends on the operating frequency range, as follows: 100 mW at frequencies from 2400 to 2483.5 MHz, 200 mW at frequencies from 5150 to 5350 MHz for indoor use, 1000 mW at frequencies from 5470 to 5725 MHz for indoor and outdoor use. The 5 GHz band can only be used by terminals which have the ability to automatically adjust the emitted power. The **use of highly directional antennas is not permitted.**  *Note here that domestic wireless modems operate in a range of a few tens of meters and, despite the obstacles (=walls), the signal is strong at a distance of at least 10m. *Source EETT (2019b), Electromagnetic Radiation and Mobile Telephony – Frequently Asked Questions*	**Mobile Telephony Networks**  Replacing existing 2G to 3G or 4G / LTE networks with 5G networks could reduce costs by 60% to 70% per MB for the benefit of the emerging markets, increasing the profitability of Internet Service Providers (ISPs) and offering to an additional 2 billion people Internet connection. Moreover, (Mozilla 2017) 57.8% of global population cannot pay \ have a(n) (domestic) Internet connection and 39.5% of global population cannot pay \ have an Internet connection on a mobile device (e.g. on their mobile phone). *Source: Strategy&, (2016), Connecting the world, Ten mechanisms for global inclusion Report, Mozilla (2017), moz://a v_0.1 internet health report, (image from What Mobile)*

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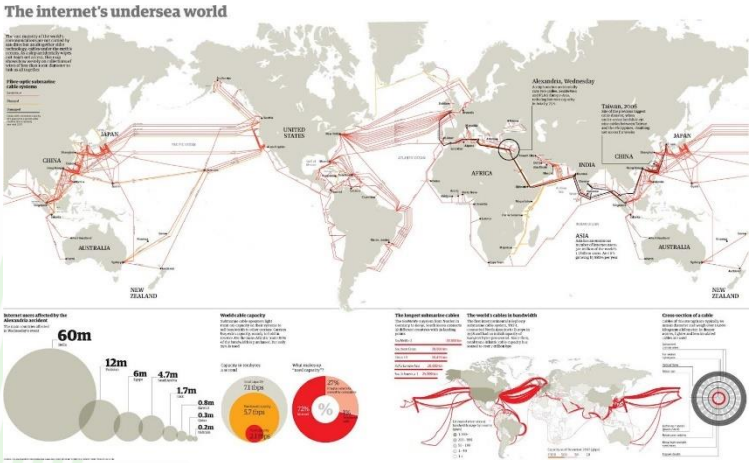
INFO CARD 5

Fiber Optics and Networks

Fiber Optics are mainly used by telecommunicatios organisations for long-distance terrestrial and submarine connections connections replacing coaxial cable lines and terrestrial and satellite microwave links.

They find application in Local Area Networks (LAN), in Wide Area Networks (WAN), in Cable TV Networks, in applications with high requirments in transmission of secure data (e.g. military), in industrial applications (as fiber optics are 'immune' to industrial noise) etc.



Advantages	***Disadvantages***
-There is no information loss. -The attenuation of the signal is due to the quality of the material. -They are impervious to environmental interferance and interferance due to environmental magnetic fields. -Zero hazards from spark explosions. -They are not sensitive to wet environments. -They provide insulation to the connecting systems. -They have very small size and weight. For example: a copper cable with 1000 pairs and 500 meters length weighs about 4000 kilos, while a fiber optic of the same length, which contains the same number of channels, weighs only 45 kilos.	-There is difficulty in making connections, since high adjustment and alignment of the light source are required, so that there is no scattering and any losses are minimized. -There is need for trained installers. -There is difficulty in connecting multiple users on a single cable. -Expensive cost.

Source: HMY 007 (Information Technology) @eng.ucy.ac.cy
Image is from here: https://electricalnews.gr/texnika-arthra/isxyra-reymata/kalodia/item/468-upobruxia-kalodia-epikoinonion-kai-xartes-diadromon-stous-okeanous-binteo

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INFO CARD 6

Advantages – Disadvantages of Wireless Networks

The general benefits (either for the consumer / business or for the companies that implement them) could be summarized as follows:

- Easy network development, as no cable restriction exists. In fact, in historic buildings or outdoors (squares, etc.), where the possibility of developing wired networks is not provided, WiFi networks can be very easily implemented.
- Reduced Cost.
- User Mobility: Users have the ability to move within the range of a specific wireless network (i.e. in an area where they will receive a satisfactory signal) and thus maintain their connection to it. This leads to a further increase in productivity but also to the effective completion of cases and issues concerning work environment and beyond.
- Ease, flexibility and simplicity of installation: With the use of wireless networks, cable installations belong to the past, while simultaneously connection to the network can be made even in places, where wiring is impossible or even undesirable (for instance offices located at a distance from each other). Thus, following some basic installation rules wireless networks can be easily installed.
- Escalation, scalability: Wireless networks have the ability to be configured from certain network topologies so that they can be harmonized with any requirements arising from their applications. These topologies are highly volatile with scalability, ranging from simple networks with a small number of users to large and complex network structures with hundreads of thousands of users and roaming capabilities.

Despite the positives that exist from the use of electromagnetic waves and radio waves for transmission of information in a wireless network, there are some negative elements too, as we can potentially contend with the following problems:

- Interferance due to multiple routes.
- Loss of information
- Radio Signal Interference (Interference from other radio signals)
- Energy Management (if no autonomy of the network exists).
- System incompatibility (because of incompatibility among products of different manufactures).
- Network Security (mainly concerning security issues of lower layers – e.g. data encryption – to make it difficult to intercept the transmitted information).

Sources: Kalonikis Georgios (2019). Study for the installation of a wireless network in the area of Diasello, Arta. Thesis. University of Ioannina.
Tanenbaum, A. S. (2000). Computer networks. Athens: Papaswthriou & Koutsikos Ch. Publications, (2014), Wireless Network Security, Thesis, TEI of Epirus.

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INFO CARD 7

Satellite Communication

From the first satelite, Sputnik I, which had the size of a soccer ball and was launched by the Soviet Union in the 1950s, until today, the word 'satellite' has acquired a variety of uses and applications in Meteorology, Astronomy, for Military purposes, in Telecommunications, GPS etc.

Their use allows easy and direct communication among remote areas of the Earth, ensuring the 'visual contact' required to transmit radio waves used in telecommunications. They move in thousands kilometers distance (37.000 Km) from the Earth and they 'observe' very large areas. Three geostationary satellites in equatorial orbit can cover the entire surface of the Earth and modern satellites can handle more than 33.000 telephone calls with 3 television channels **simultaneously**.

Advantages	***Disadvantages***
-The cost of Communication is independent of the distance between the endpoints. -Useful for communication in remote areas or areas that have experienced some urgent situation. -Ability to broadcast simultaneously in multiple locations. -Wide range of frequencies that ensures high communication speeds.	-High signal propagation delay due to the long distance the signal has to travel. In cases where more than one satellite is used, the propagation delay between terrestrial transmitter and receiver increases. -The signal can be affected by the state of the Earth's atmosphere.

Source: EMU 007 (Information Technology) @eng.ucy.ac.cy

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INFO CARD 8

Radio frequency Fields

Radio waves are electromagnetic fields which can be radiated in all directions **using antennas**. The intensity of the electric field created depends on: (a) the total radiated power, (b) the radiation diagram of the antenna and (c) the distance from the antenna (the intensity of the field decreases significantly with increasing distance – **e.g. at a distance of 100m from the radiation source, the power is attenuated 10,000 times compared to the power generated at a distance of 1m from the source**.

Source: Hellenic Telecommunications and Post Commission *(HTPC (2019a), Electromagnetic Radiation and Mobile Telephony – The Scientific Data, http://bit.ly/eett-2T63HoX & HTPC (2019b), Electromagnetic Radiation and Mobile Telephony – Common Questions, http://bit.ly/eett-2YGJAz1 (Image by Digital Trends).*

INFO CARD 9

IARC classifies materials, material mixtures and environments into five groups.

Group 1: Carcinogenic to humans.
Group 2A: Probably carcinogenic to humans.
Group 2B: Possibly carcinogenic to humans. Group 3: Not classifiable as to its carcinogenicity to humans.
Group 4: Possibly not carcinogenic to humans.
It is noted that in group 4 until the beginning of 2009 the institute has classified only one material, caprolactam.

IARC: International Agency for Research on Cancer (CIRC in french) is an international Organisation, part of the United Nations Health Organisation.

By Rystheguy – Work of the uploader
https://commons.wikimedia.org/w/index.php?curid=38014980

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INFO CARD 10

Biological Effects of Radio waves

In addition to the known thermal effects of radio waves (i.e. the increase in temperature of tissues exposed to non-ionizing radiation by at least 0.1°C)**, there is nowadays an increasing interest in studies concerning the existence of other non-thermal mechanisms of radio wave interactation with biological tissues.** Some studies have shown that, **under certain conditions, radio waves can cause non-thermal biological effects on cell cultures or experimental animals, without, however, these effects being directly related to causing harm to the human body**. Furthermore, in some of these studies, the results seem to be contradictory, while in others they could not be repeated. It is obvious that there is uncertainty and a need for further investigation of the mechanisms associated with non-thermal phenomena and their association with harmful, biological effects and potential impacts on human health. Global research is still carried on under the coordination of WHO (World Health Organisation). During this period, if one feels concerned, one can take certain precautionary measures (the important Principle of Precaution) such as e.g. to avoid the use of mobile phones indoors (elevators, basements, underground, etc.), to use "hands free kits" accessories when talking on the phone and to discourage the use of mobile phones by children.

Source: Alexandrou A. (2016), Low frequency Electromagnetic fields 50/60 Hz, Diploma Thesis, Cyprus University & HTPC (2019a), Electromagnetic radiation and Mobile Telephony – The Scientific Data, http://bit.ly/eett-2T63HoX & Calvente I., (2014) Characterization of Indoor Extremely Low Frequency and Low Frequency Electromagnetic Fields in the INMA-Granada Cohort, PLoS One. 2014; 9(9): e106666, doi: 10.1371/journal.pone.0106666

INFO CARD 11

The urban myths surrounding electromagnetic radiation are once again being debunked by science. The Interational Scientific Community and the World Health Organisation (WHO)**, evaluating thousands of scientific studies over the past 30 years, have made it clear that there is no scientific evidence by now linking electromagnetic radiation of networks and antennas with impacts on health and other unwanted actions**. Often, due to misinformation and fiction, obsessive and unconfirmed perceptions are developed about the use of the necessary telecommunication networks and mobile antennas, but also for every technology surrounding us, from the microwave oven to the hair dryer, wi-fi and mobile phone. **"Experts" are flooding the Internet** with various patents, which they market. Finally, the strictest limits have been established in Greece among the countries-members of the European Union, as far as electromagnetic radiation is concerned, taking into account the Principal of Precaution, **since there is practically no proved scientific evidence** leading to stricter limits than those recommended by WHO and ICNIRP (International Commission on Non-Ionizing Radiation Protection*).*

World Health Organisation (WHO), (2006) Electromagnetic Fields and Public Health, Base Stations and Wireless Technologies, Fact Sheet N°304 & WHO, (2007), Electromagnetic Fields and Public Health, Exposure to extremely low frequency fields, Fact Sheet No 322 & WHO, (2014) Electromagnetic Fields and Public Health: Mobile Phones, Fact Sheet No 193 (& From the website of the Greek Atomic Energy Commission (GAEC), Instructions., Photo

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INFO CARD 12

International and National exposure and absorption limits established for protection against non-ionizing electromagnetic radiation in mobile applications.

According to the Law 3431/2006, around any antenna construction, which emits electromagnetic radiation, there should be no areas accessible to general population places, where exposure levels exceed 70% of the ICNIRP limits. Moreover, in the event of an antenna installation less than 300 meters from the perimeter of nurseries, schools, nursing homes and hospitals, public exposure levels should not exceed 60% of the ICNIRP limits. That is, even stricter limits are applied than those set by ICNIRP, as shown in Table A.

According to ICNIRP guidelines, a two-tier system is proposed as far as permissible exposure levels are concerned: lower limits for the general population and higher limits for the profesionals in areas exposed to electromagnetic radiation. Employees are typically exposed only during working hours (usually 8 hours a day), while general population may be exposed up to 24 hours a day. These are the fundamental reasons, which led to more severe exposure restrictions for the general population in comparison to those for the profesionally exposed population. It is pointed out that a safety factor (10 to 50) has been adopted to formulate the basic restrictions, which represents the uncertainty of estimating the limit of occurrence of harmful effects on health. The key value for quantificating thermal effects is the Specific Absorption Rate (SAR). The establishment of acceptable exposure limits by CENELEC and other standardized committees for full-body exposure to electromagnetic radiation has been based on prevention of behavioral disorders, observed in animals, when exposed to low levels of radiation. The term „behavioral disorders" refers to the animals' tendency to stop performing a complex, cognitive operation, when exposed to certain levels of electromagnetic energy. This is a thermal effect observed for a Specific Absorption Rate equal to 4 W/kg body weight, calculated as a mean value for the whole body. In order to take into account scientific uncertainties, this threshold level decreased further to obtain the values for human exposure limits (basic restrictions). By adopting a safety factor equal to 10, the maximum permissible value of SAR for humans was set (professional exposure) at 0.4 W/kg and by setting an additional safety factor equal to 5 W/Kg for the general population, the corresponding maximum value of SAR was set at 0.08W/kg, calculated as a mean value for the whole body and for a measurement period of 6 minutes (Table B).

Table A: Reference Levels, according to Greek legislation (these in parenthesis), for the general population concerning common wireless networks applications.

Application	Electric Field Intensity (V/m)	Magnetic Field Intensity (A/m)	Power Density of Electromagnetic Wave (W/m^2)
Mobile Telephony 900 MHz (GSM)	28.7 (24.6)	0.08 (0.066)	3.15 (2.7)
Mobile Telephony 1800 MHz (DCS)	40.6 (34.8)	0.11 (0.096)	6.3 (5.4)
Mobile Telephony 2100 MHz (UMTS)	42.7 (36.6)	0.11 (0.096)	7 (6)
Wireless Networks 2.4 GHz (WiFi)	42.7 (36.6)	0.11 (0.096)	7 (6)
Wireless Networks 3.5 GHz (WiMax)	42.7 (36.6)	0.11 (0.096)	7 (6)

Table B: Main restrictions for general population and employees* at common wireless networks applications.

Application	SAR (W/Kg) (mean value for the whole body)	SAR (W/Kg) (mean value for 10g of the tissue of the head or the torso)	SAR (W/Kg) (mean value for 10g of the limbs' tissue)
Mobile Telephony 900 MHz (GSM)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Mobile Telephony 1800 MHz (DCS)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Mobile Telephony 2100 MHz (UMTS)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Wireless Networks 2.4 GHz (WiFi)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Wireless Networks 3.5 GHz (WiMax)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)

Source: https://www.eett.gr/opencms/export/sites/default/admin/downloads/Informative_Documentation/hlktromagnitikh_Entypo_3.pdf

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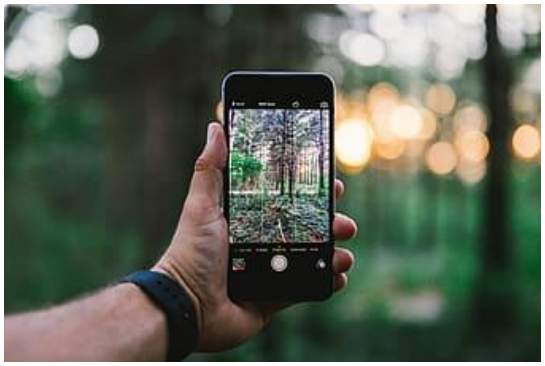
INFO CARD 13

Are mobile phones dangerous for public health?



The International Agency for Research on Cancer (IARC) of the World Health Organisaion (WHO), after analyzing published researches on the exposure of employees to electromagnetic fields (radars, microwaves), public exposure to the fields of radio, television and wireless communication networks, as well as personal exposure to wireless devices-phones, ranked in June 2011 the electromagnetic fields in the radio frequency spectrum in group 2B, i.e. „Possibly carcinogenic to humans", based on the limited data on the occurence of specific types of brain cancer (glioma, auditory neuroma) for mobile phone users. Data on other types of cancer in mobile phone users, as well as data on profesional exposure and data on public exposure to radio frequency fields in the environment, were found to be inadequate to make inferences. Until now, thousands of researches have been conducted regarding the dangers of electromagnetic fields, more than any regarding any other factor. If, even a small percentage of the research on electromagnetic fields had been conducted in time for the effects of factors, such as radioactivity or asbestos, which have been classified as carcinogenic to humans at group 1, their unpleasant effects on health would have been discovered much earlier. Besides, it is practically impossible to prove scientifically that any factor is completely harmless for human health, while on the contrary it is much easier to prove that it is dangerous, even to a small degree.

Source: Electromagnetic Radiation. Questions and Answers about cellular antennas and mobile phones. Athens, March 2015. GAEC

Author: Dimitrios I. Sotiropoulos

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Odyssey
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INFO CARD 14

Does the exposure to electromagnetic radiation increase or decrease (quantitatively and qualitatively) with 5G technology?

- New „smart" networks will reduce their power (advanced sleep mode), when no communication load exists (low traffic).

- Small Cells will be used close to users, covering small areas with minimal transmission power. This reduces the total charge according to the measurement experience.
- There are three main reasons, why the actual transmitted power is much lower than the nominal value: a) it is not expected to use all the antenna lobes at the same time (ie 100% use of system resources for 24 hours), b) the emission of antenna radiation to the user („down link radiation") lasts only for certain periods of time and not continuously („Time Division Duplex Technique"), c) because of the introduction of the new technique („Massive MIMO & Beamforming Technique"), all the power never concentrates in the same direction for a long time.
- With special software, automatic control of the power transmitted from the network will be performed (so that it is constantly below 25% of nominal power of the 5G antennas) and there will be a significant reduction of the user exposure. The technique of narrow „lobes" leads to zero burden from the radiation, which is emitted by the antenna for inactive users and passing citizens.
- Providers will „share" the Base Stations. Two providers will broadcast from the same antenna systems at the same time. The total exposure turns out to be less than the sum of the exposure by two separate base stations.
- With increasing frequency, electromagnetic waves are reflected at a very high rate. Typically, at 60 GHz, about 40% of the incident power is reflected on the surface of the skin. Simultaneously, the absorbed energy in the tissues is limited to the skin and not to the deep tissues, where the low frequency radiation penetrates.
- We are aware of the fact that the maximum absorption of radio wave (RF) radiation in human tissues is detected at about 80 MHz. 5G technology is expanded to high frequencies of non-ionizing radiation away from 80 MHz frequency.
- The advanced technology of 5G antennas will allow the reduction of the burden from electromagnetic fields of entire areas and their inhabitants.

Kostas Kappas. Professor of Medical Physics – Radiophysics of The General Uniersity Hospital of Larissa and the Medical Department of the University of Thessaly
http://artinews.gr/%CE%BA%CE%B9%CE%BD%CE%B7%CF%84%CE%AE-%CF%84%CE%B7%CE%BB%CE%B5%CF%86%CF%89%CE%BD%CE%AF%CE%B1-5g-%CE%BA%CE%B1%CE%B9-%CF%80%CF%81%CE%BF%CF%83%CF%84%CE%B1%CF%83%CE%AF%CE%B1-%CF%84%CE%B7%CF%82-%CF%85%CE%B3%CE%B5%CE%AF%CE%B1%CF%82?fbclid=IwAR00PRXhwEO1g7XYMcfy_QiQ5kMEzHA7uyb2flOocdL1uel9EMIBaKYEVFo
Photo: https://www.bruegel.org/wp-content/uploads/2019/10/KK0319410ENN.en_.pdf

Author: Dimitrios I. Sotiropoulos

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INFO CARD 15

The intensity of emitted radiation at the environment of a mobile telephony base station

At base stations (antennas) there are several factors which determine the levels of radiation in the places where a person can be found.

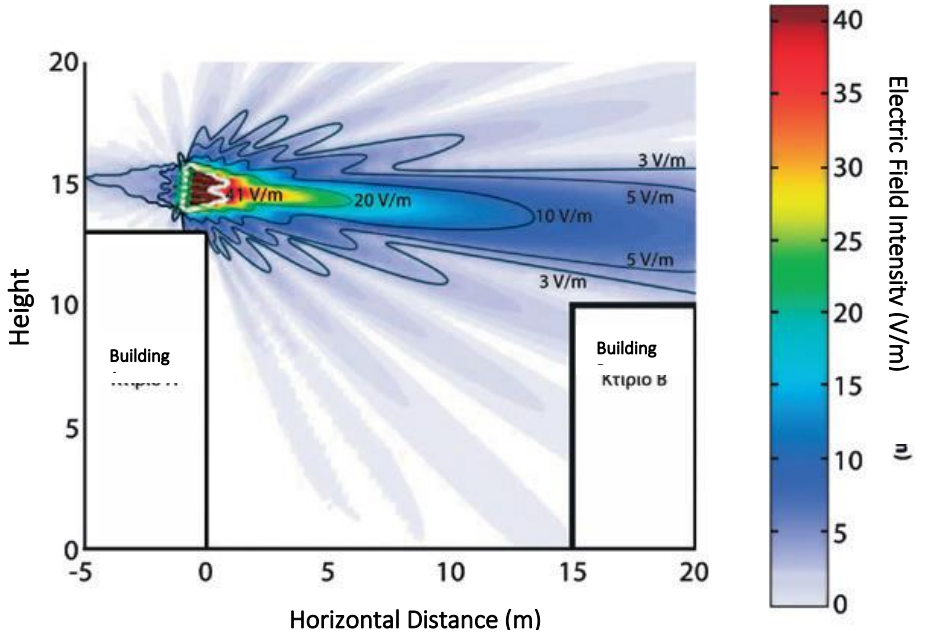
• The Emission Power: the total power transmitted by antenna systems. The higher the emission power is, the greater the radiation is. Typical power values at mobile base stations range from 10W to 40W in sparsely populated rural areas and below 10W in densely populated areas.

• Radiation Diagram of the Antenna: depending on their construction, antennas usually do not emit radiation evenly (spherically) in their environment. Instead, there are directions in which antennas emit much more radiation than in others. The difference in the intensity of the radiation between two directions can be greater than 100 times. Antenna manufacturers provide diagrams showing how the power of the radiation in the environment of the antennas varies depending on the direction.

• The Distance from the Antenna: the radiated power from an antenna in one direction is not constant, but it decreases very fast with the distance (with the inverse square of the distance, (i.e. in double distance from the antenna, one quarter of radiation is incident and in ten times distance from the antenna, one hundredth of radiation is incident).

• Interfering Natural or Artificial barriers: electromagnetic radiation is extremely attenuated in areas behind walls or under building rooftops or ceilings.

At 1 meter height from the roof of building A, there is a mobile network antenna. Here the intensity of the electric field is depicted in the vertical plane in the direction of maximum radiation of the antenna. The limit recommended by the European Union is 41.25 V/m for the frequency at which this antenna transmits (900MHz).
It seems that the intensity of the electric field is below this limit at a distance of a few metres even in the main direction at which the antenna emits radiation. In the other directions, behind, above and below the antenna, the electric field strength is much less than the given limit, at a distance of only 1 meter from the antenna. Inside building A the radiation is much lower, due to the attenuation caused by the propagation of radiation from the roof. Building B is located at a horizontal distance of 15 meters from building A, in the direction in which the antenna radiates. It is one floor lower than Building A; however the main beam of radiation passes over it, without being prevented from the presence of the building. The intensity of the electric field at 2 meters height above the level of the roof of building B (position of the head of very tall man) ranges from 3 V/m to 5 V/m. In the balconies of building B towards the antenna's side, the intensity of the electric field is less than 1 V/m and inside the building it is many times lower due to the attenuation of the construction materials.



Source: Electromagnetic radiation. Questions and answers for mobile network antennas and mobile phones. Athens, March 2015. GAEC

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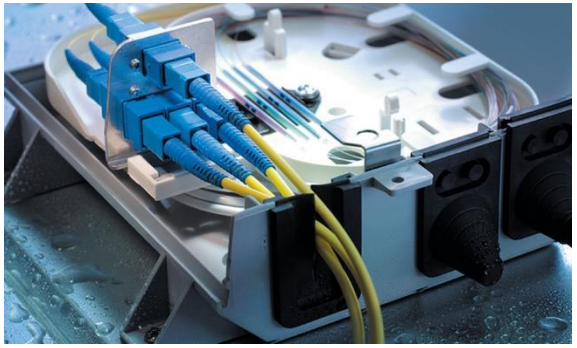
INFO CARD 16

FTTH (fiber to the home) in Greece



The next step in wired interface is to get the optical fiber to the house. Additional infrastructure is required here and according to the existing regulatory framework, providers, who have undertaken the upgrade of an area, are not required to proceed with the necessary infrastructure to have fiber optic connections available to the home. However, each provider has its own plan, which is related to the interest that exists in each region, and in practice it is estimated that by 2022 more than 1 million households throughout Greece will be able to obtain Internet connection through fiber optics. The aim of all stakeholders is that by 2025 50% of Greek households have a similar opportunity. In order to be able to provide FTTH (fiber to the home) connection, as these connections are known, the provider must create the necessary infrastructure and the fiber optic network must be very close to the buildings, almost in front of their doors. More specifically, it should reach the so-called ducts. Keep in mind that each of them is used to serve multiple neighboring buildings. In a way, the logic followed is similar to that of natural gas. Depending on how many ducts the optic fiber has reached is the coverage to which the providers refer. That is, when a provider claims to cover an area of 1000 households, it means that it has brought fiber optics to as many ducts as those serving buildings with a total of 1000 households.

What does a FTTH connection offer?

The biggest – and most well-publicized – advantage of FTTH connections is the access speeds they offer, which can reach 1 Gbps or if you prefer 1024 Mbps both for sending data (upload) and for receiving data (download). The 1 Gbps connection is currently considered impressively high and unnecessary, but ithere is no doubt that in a few years it may not even be enough to meet the needs of a household. Apart from the speeds, however, FTTH has some other advantages, such as “stability” in the connection and very low “delay”, the so-called latency. For applications such as online gaming, low latency may be even more important than extremely high speeds. In general, upgrading to FTTH from existing connections to copper connections is a move worth making for any consumer, who wishes to have reliable, fast and quality Internet connection.

What speeds can I have?

Theoritically, fiber optics home connections can offer speeds of up to 1 Gbps.

Source: https://www.cnn.gr/tech/story/138505/ola-osa-prepei-na-xerete-gia-tis-syndeseis-optikis-inas-mexri-to-spiti

Author: Dimitrios I. Sotiropoulos

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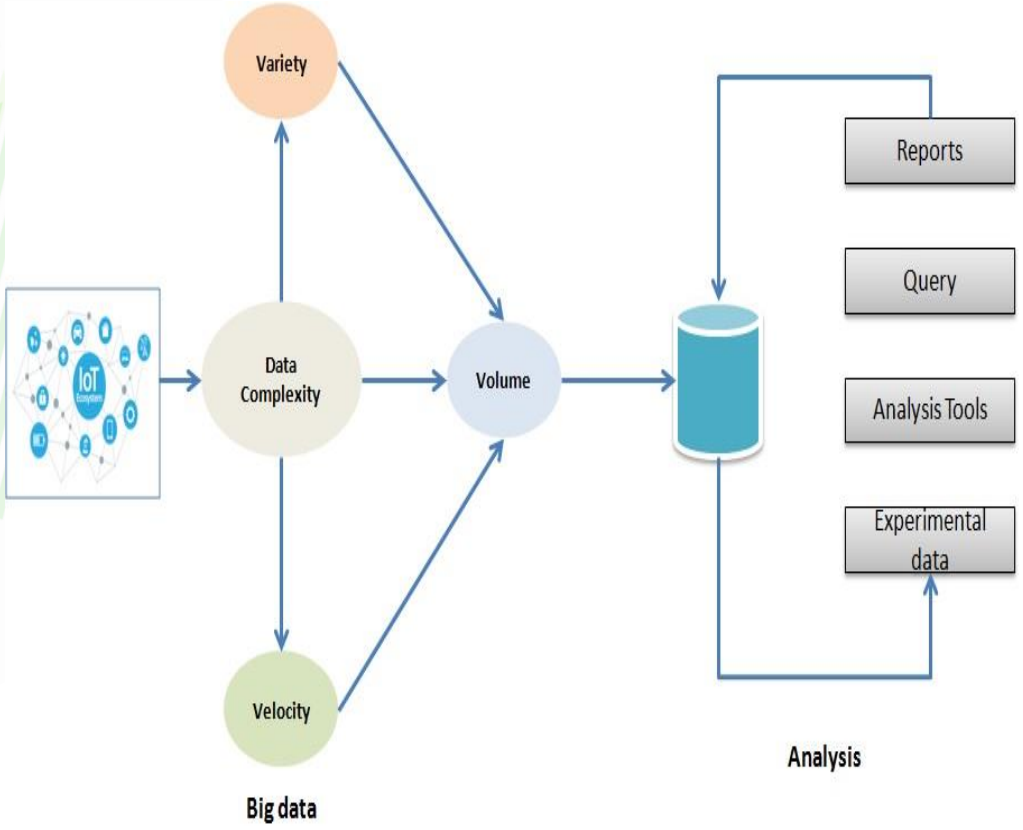
INFO CARD 17

Internet, Internet of Things (IoT) and Big Data Analysis

According to researches, approximately 4,400,000,000,000 GB of data will be generated by the year 2020 via the Internet of Things (IoT). This is undoubtly difficult to understand. Nevertheless, with the growning numer of interconnected devices, it is not surprising that by 2020, more than 10 billion sensors and devices will be connected to the Internet. In addition, all of these devices will collect, analyse, share and transmit data in real time. Therefore, without all these data, devices connected to the Internet would not have the features and capabilities, which have made them so popular and attractive globally.
Big Data Analytics is emerging as the key to analyzing data generated by "connected devices", which contributes to undertaking the initiative to improve decision-making. The role of Data Analytics in the Internet of Things (IoT) is, in essence, the processing of large amounts of data in real time and their storage using different storage technologies.

Since all the above data collected through the Internet needs extremely quick analysis, so that users and devices can obtain information from this data, in order to make quick decisions, the process of analyzing big data, - the fuel of the Internet of Things – is imperative to run and in fact must run fast and reliably. The next picture shows the model of processing the Big Data coming from the Internet of Things.



Source: https://www.whizlabs.com/blog/iot-and-big-data/

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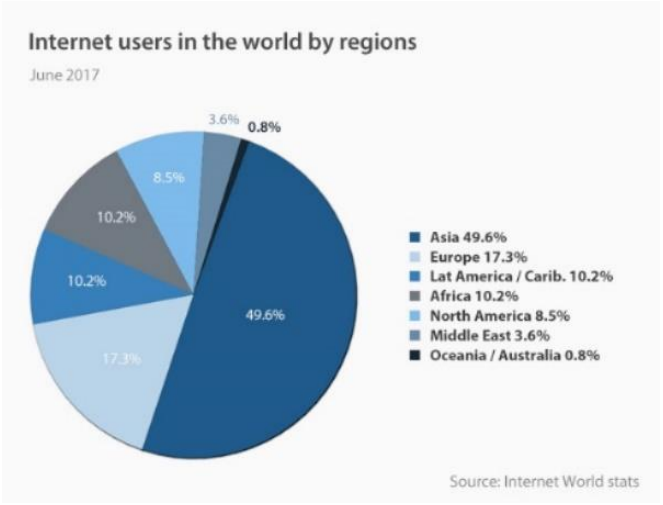
STORY CARD 1

How Internet "was born" 50 years ago

E-mails, face recognition, artificial intelligence and other applications would still be in the realm of fantasy, if two young academics hadn't attempted to transfer data between computers in 1969. On 30.10.2019, Internet celebrated its 50th year anniversary from its birth, when the Americans Charley Kline and Bill Duvall exchanged just two letters on their screens, before the systems collapsed. The data transfer effort marked the establishment of ARPANET, a small network connecting computers to universities and research centers to facilitate academic work. ARPANET was in a way a descendant of the Cold War, as Leonard Kleinrock, a UCLA professor who developed the theoretical part of the operation, commented at Fast Company Magazine. Kleinrock meant that in response to the Soviet satellite-Sputnik-1, which caught the Americans completely off guard, the US Department of Defense needed a network, through which research centers would exchange data remotely. Kleinrock created a new communication system, more efficient than the previous ones.

The development of the network required several million dollars, which came from the Ministry of Defense. From the beginning, the biggest problem was that the computers could not communicate with each other, because they somehow "spoke" different languages. Neither a common Internet language nor a protocol existed, by which computers could exchange data.

A few years later, Kline and Duvall, having utilized the generous funding and hoping to build an extended, professional network, were prepared for the first data exchange attempt. On one screen, there was Charley Kline, an UCLA graduate and member of the Department of Defense's service for ARPA research programms. On the other screen, there was Bill Duvall, a scientist at the Snientific Research Institute (SRI). A failed attempt was marked, which ended with the collapse of the network, and then there was success, that is, the sending of five letters, one word from one computer to another. The word was "LOGIN".



At the time, Klein and Duvall had neither realized the magnitude of the invention nor appreciated its significance. "I don't remember anything remarkable from that night and by no means did I realise that we had achieved something special", Kline told Fast Company Magazine. Moreover, the first Internet connection between two computers remained an obscurity for a long time, as it coincided with the first moon landing, which overshadowed every other evolution in science. Although everything started from that moment, it still took several years to improve the quality of the connections, while 1983 the so-called Transmission Control Protocol/Internet Protocol, known as TCP/IP was introduced, with which the data transfer is done until today. Until the early 1990s, evolutions in Internet area were dictated by the Americans. The next big step, however, was in Europe. In 1989 Tim Berners-Lee set the foundations of World Wide Web at research center "CERN". With the first browser a few years later, the system was simplified and no longer complex commands needed for browsing the Internet. This is how the first two colossuses of the Internet were born, such as Google and Amazon. Since then, developments have been even more radical.

Internet access worldwide (in percentages by population per continent) is presented in the next diagram (https://el.vpnmentor.com/blog/internet-trends-stats-facts-u-s-worldwide/) for the year 2017.

Sources:https://www.kathimerini.gr/1049351/article/oikonomia/die8nhs-oikonomia/me-thn-apostolh-mias-le3hs-gennh8hke-prin-apo-50-xronia-to-internet, https://saferinternet4kids.gr/nea/50-years-internet/

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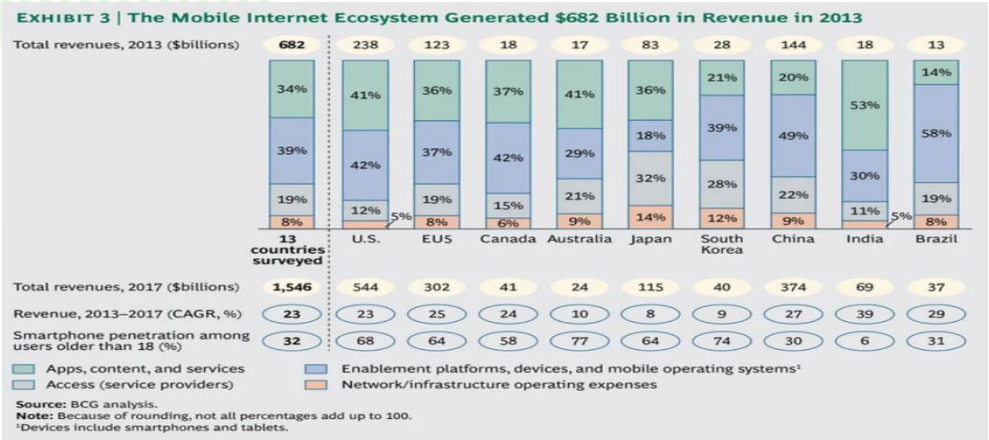
STORY CARD 2

Internet & Economy

The Internet has changed every aspect of our lives. Recent research shows that the online economy is responsible for 20% of Gross Domestic Product (GDP) growth globally over the last five years and that it adds 2.5 new working positions for every working position lost due to process automation. Other benefits include intensity of remote work (46%), productivity (41%) and standardization (35%) as well as new business opportunities (33%) and new markets (32%). All available studies confirm the importance of cloud computing, which is expected to grow radically worldwide. However, according to a new post-hoc analysis published in "Journal of Economic Surveys" Magazine, the Internet has done almost nothing for economic growth. Since the time of Industrial Revolution, innovation and technological changes have led to increased productivity and economic development. It is reasonable to expect that information and communication technologies will follow this model. But there is some evidence suggesting that rather than contributing to economic performance, some parts of ICT may be harmed, as Internet can be a deferral. Cyberslacking can take up to three hours of work a day. Moreover, productivity growth in US manufacturing industry fell from 2% per year between 1992 and 2004 to minus 0.3% per year between 2005 and 2016. Where ICT innovations lead to an increase in productivity, it's often a one-off boost rather than an ongoing increase year after year. Nevertheless, almost all evidence indicates that areas, such as access to running water, electricity and primary education for girls, have greater positive effects due to innovative ICT. Finally, there is a large portion of people who use the so-called "Deep Web". Some of them benefit from its use, since it gives the opportunity for anonymous use and communication – e.g. journalists reporting financial scandals, anti-censorship political activists, or citizen groups against totalitarian, oppressive, political regimes.
On the other hand, the Dark Web (illegal and uncontrolled InternetWeb) favors anonymous bitcoin transactions – e.g. for gambling and other illegal activities. There have, also, buys and sales of uranium ores (which can be used either as a fissile material or to manufacture nuclear weapons).

The next image (https://www.bcg.com/publications/2015/technology-industries-growth-global-mobile-internet-economy.aspx) presents the total global revenues from the Internet from 2013 to 2017.



Source: Doykidis G.I (2013) Internet mainspring of economic evolution, @ Kathimerhnh & Stanley et al. (2018). Does ICT Generate Economic Growth? A Meta-Regression Analysis. Journal of Economic Surveys, 32(3), 705–726. doi:10.1111/joes.12211 Doucouliagos C., Stanley T., (2018) The Internet has done a lot, but so far little for economic growth @ phys.org

Author: Dimitrios I. Sotiropoulos

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STORY CARD 3

The connection between Internet Access and Economic Growth is not as strong as you may think

Mark Zuckerberg recently published (16 February 2017) a manifesto (see: QR code) about the future of Facebook and our world that is saturated with technology. In it, he argued "Connecting everyone to the internet is necessary for building an informed community". For those familiar with Zuckerberg's statements, this is a well-known claim. He argues that not only should we connect everyone in the world to the internet, but that this is a necessary step in solving some of the planet's most serious problems.

Zuckerberg is not alone in this reasoning. Outrageous sums of money have been invested in projects that connect the billions of people who lack an Internet connection – from companies such as e.g. Google or SpaceX. These companies tend to present digital connectivity as a necessary mechanism for achieving key social and economic development goals – targeting Africa in particular, as the part of the world with the lowest incomes and rates of connectivity. Examining these claims, as well as the opposite arguments, we have found that increasing internet access is linked to economic growth and social development. One report for instance, notes that "The internet is a tremendous, undisputable force for economic growth and social change." However, many of these reports tend to either provide no evidence or advocate statements with non-rigorous and non-peer-reviewed studies. Some go further, arguing that not only will lead to growth achieving greater connectivity, but that it may also reduce inequality, although there is little evidence to support this argument. In these reports we read: "Today, armed with more than just a smartphone, anyone - no matter where they were born or how much they earn - can start a business, record a music video, make an invention, take classes with Nobel Prize-winning teachers "or" The impact of ICT on income growth and poverty alleviation is undeniable, and the more ICT applications are used by low-income groups, the faster the income gains at the bottom of the economic pyramid will accelerate".

Twenty years ago, James Ferguson said his view on how targeted programs (using internet connectivity) can help poor people. The concern of many for visions, such as those of Mark Zuckerberg, is not just that the massive resources invested in connecting the world's disconnected will be lost. It is also the fact that by presenting development and inequality as something that can be solved with more connectivity, we are preventing structural economic processes, which can successfully widen inequalities and produce more poverty. We should be concerned when developmental interventions do not work, but we should be even more concerned when we consider that important issues have been dealt effectively while ... they have not.

Source: CFR, (2017), The Link Between Internet Access and Economic Growth Is Not as Strong as You Think.

Author: Dimitrios I. Sotiropoulos

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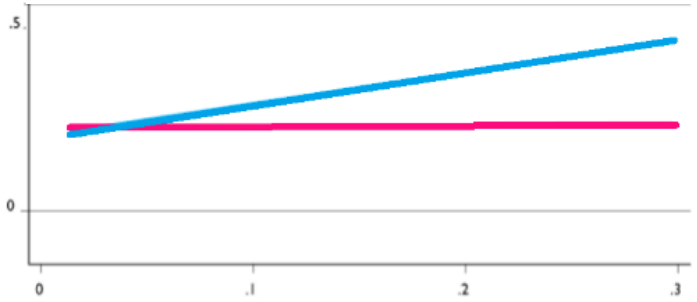
STORY CARD 4

Is technology the answer to widening inequalities?

Of the approximately 3.000 USA counties, only 163 have adopted Business Technologies and Internet Applications, which are (directly) related to salaries and employment growth. These areas had a population of over 150.000 residents and they belonged to the highest economic and educational level before 1995. Between 1995 and 2000, there was an average increase of 28% on salaries compared with a 20% increase in other counties. Greenstein attributes the reason why the Internet has had impact (only) in few areas, to the following claim: these areas already had sophisticated companies and the communications infrastructure they needed to take advantage of Internet opportunities.
The impact could also be due to a well known phenomenon, called ”biased technical change”, which means that new technologies can only thrive in areas with skilled employees, who know how to use them. Lastly, these regions and cities had – in relation to the most remote / isolated regions – the following advantages: denser labor markets, better communication and more intense competition.

Increase on salaries during 1995-2000.
Light blue colour for the countries with high incomes, education level, large population and IT-intensity and red colour for the rest countries, in relation to the percentage of businesses with advanced Internet (horizontal axis).



According to the World Bank, 9 billion electronic devices are currently connected to the Internet. ICT experts and government officials claim that Internet connection is vital for improving millions of people lives. However, Kentaro Toyama (Deputy Professor of Community Information at the University of Michigan School of Information) warns us about whether modern technology is, indeed, the solution to economic growth. Toyama mentions that the world has changed over the past 45 years because of advances in technology. Nevertheless, all these digital innovations haven't bridged the gap between rich and poor people in the United States. "During the same period, this country has experienced increasing inequality. The middle income has decreased". He even adds that, in developing countries, a smartphone alone cannot help people, who are not trained and do not acquire necessary skills. For instance, if farm workers have a mobile phone, it will not make much difference whether or not they can access the latest, updated agricultural research document to improve their crops and cultivation.

Source: UNCTAD, (2017), The Least Developed Countries Report 2017,ISBN 978-92-1-112914-4, eISBN 978-92-1-362256-8, ISSN 0257-7550 & UNESCO, (2017), The State Of Broadband 2017: Broadband Catalyzing Sustainable Development September 2017, ISBN 978-92-61-25411-7 & Kellogg Insight, (2011) What has the Internet Done for the Economy? The puzzling spread of the commercial Internet could explain wage inequalities.

Author: Dimitrios I. Sotiropoulos

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STORY CARD 5

Connecting remote Indigenous communities

Connecting remote indigenous communities is difficult because of the great distances of the areas where these populations live. Recently, a lot of stories came to light about Internet & Telephony service providers and infrastructure providers as well as other organisations helping to connect the indigenous people in some of the most remote parts of Australia.

Since May 2009, **Activ8me**, a satellite broadband provider, has been cooperating with the Australian Government to improve access to telecommunications services in remote indigenous communities. The company has developed and installed innovative, remote telephone points, which use solar energy and are connected via satellite. Phone calls from these community phones (to landlines) are free and over 98% of these phones have also Wi-Fi installed.

Another example is this of **Easyweb Digital** and **NG Media** work, which have connected the entire Wingellina community in remote Western Australia. The company also provides free Wi-Fi in more than 570 locations across all of Australia – many of which are very remote. Continuing at the recent Broadband for the Bush Forum, Anja Tait, Assistant Director Libraries and Learning, Northern Territory Library (NTL) outlined how NTL is collaborating with regional councils and local authorities to provide free public Wi-Fi in 46 remote Aboriginal communities. The initiative is also supported by the Northern Territory Government and is recognised as a fundamental public service.

Over the past two and a half years, ACCAN, member of the Centre for Appropriate Technology (CAT), has been working with various organisations in the Northern Territory, including the NT Government, to improve the connectivity of mobile phone in very remote areas. CAT has designed, built and installed mobile phone hotspots in 22 remote communities, plus a similar number at highway roadside stops and popular tourism locations. The built-in Hotspots are compatible with data, voice, SMS, 3G, 4G and all three mobile network providers. Lastly, Hitnet is an innovative, Australian, 'Communication for Development' company building the smart digital ecosystems needed to reach and attract the most marginalized people. Hitnet's Community Hubs are available in many locations around Australia and provide access to many online services. Hitnet now has over 70 Community Hubs in operation with almost 70,000 purposeful uses a year. Some ACCAN resources about digital education are now also available on Hitnet's Community Hubs.

Source: ACCAN - Australian Communications Consumer Action Network (2017), Connecting remote Indigenous communities @ accan.org.au

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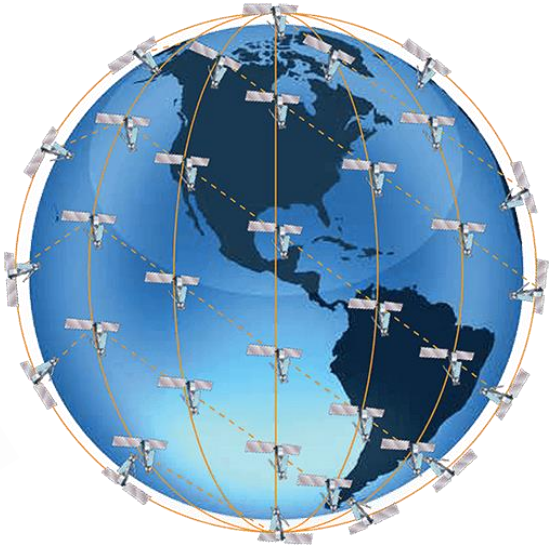
STORY CARD 6

Internet and Space



On the night of May 23, 2019, "SpaceX" company launched its first 60 "Starlink" satellites in low orbit, as it plans to provide 5G services. Satellites will be able to use the same type of antenna as those of the ground systems providing 5G services. This means that they will send focused beams of strong microwave radiation to each specific 5G device located on Earth and vice versa. Thd satellites were launched from the "Kennedy Space Centre" in Florida with the aid of Falcon 9 rockets. SpceX announced its intention to carry out 6 more similar launches this year. When the first 420 satellites are in orbit, they will be activated and will start providing global 5G services to SpaceX's customers. This could happen by the end of 2019. SpaceX intends to carry more satellites and complete its planned fleet of 12,000 satellites within a decade. SpaceX's license from the U.S. Federal Communications Commission permits each of its satellites to transmit power up to 5 million Watts.

SpaceX's rival, **OneWeb** launched the first 6 of its planned fleets of 4,540 satellites on February 27, 2019. It announced its intention to launch 36 satellites per month and activate them on as soon as 648 satellites are in orbit, which could happen by the end of 2020. The "Wall Street Journal" reports that **Google** also intends to spend more than 1 billion dollars on satellites, which will provide Internet connection, initially with 180 small satellites which will orbit the Earth at low altitudes and later with more equipment. The program is led by Greg Wyler, founder of O3b Networks, in which Google has invested and is experimenting with 680-kilogram satellites. Nevertheless, experts of the program say that Google intends on using satellites weighing less than 115 kilos. Wall Street Journal sources mention that the cost will reach 3 billion dollars for the business, as Google reviews the network and reconsiders the number of satellites it needs, so that it can offer Internet in remote areas of the planet. Lastly, Amazon announced on April 4, 2019 that it is planning to launch its own fleet of more than 3,000 5G satellites.

Source @ prepareforchange.net 2019, Thomas 2019 @technocracy.news, (tweet) & Published by @ insomnia.gr http://bit.ly/2FseN2a, (Photograph from satmodo.com)

Author: Dimitrios I. Sotiropoulos

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STORY CARD 7

Mobility with 5G in Europe and the World as well as economic and geopolitical implications

The development of 5th Generation Networks in Greece has been added to the problems arising from the US-China Trade War. Even though the final outcome of the US-China Telecom War seems to be constantly postponed, pressure on the Greek side is intensifying, with the latter trying to fortify itself behind the statements of the European Commission. One day after the departure of Chinese President Xi Jinping from Athens, representatives of the US Department of Commerce met with Government Officials. The meeting, organized by the Hellenic-American Chamber of Commerce, was attended by both marketing executives and executives of the Ministry of Digital Governance. The purpose of the meeting was to discuss the plans of the Greek Government regarding the development of 5th generation networks. The main goal of the American side was to prevent any impending procurement of new generation mobile telephony network equipment to the Chinese Company Huawei. The American side invokes national safety reasons endangering the Western alliance.

For example, in German, Italy and Great Britain, 5G networks have already been put into commercial operation. Only in France, one of the big countries, 5G networks have not started operating and in a number of other smaller countries such as Portugal, Austria, Greece etc. Thus, most of European telecommunications providers have already decided which equipment manufactures to cooperate with to develop their networks. It is pointed out that nowadays the countries with the highest development / penetration of 5th Generation networks are South Korea on the planet and Switzerland in Europe. In South Korea, it is estimated that there are already 2 million 5th Generation mobile phone users. In China, where 5G networks recently entered the market, it is estimated that by the end of 2020, 5G subscribers will exceed 100 million.

Vodafone association addressed an international Request for Proposal (RFP) for 5G networks equipment supplies, aiming to cover **20 countries**, including Greece too. On the other hand, Cosmote, has already launched 200 million in mammoth-supplies costing euros for the next 7 years. Today, Vodafone and Wind rely exclusively on radio equipment (base stations, antennas, etc.) of Huawei technology. Companies, mainly because of the cost, have chosen in recent years to base their networks on Chinese mobile technology. And unless something shocking and out of the ordinary happens, they will continue to do so. On the other side, Cosmote today relies solely on radio equipment of Nokia (60%) and Ericsson (40%). That is why there is Chinese pressure to break this exclusivity, and the pressure is said to have intensified during the official visit of the Chinese president.

Source: https://www.kathimerini.gr/1053309/article/oikonomia/ellhnikh-oikonomia/pieseis-hpa-pros-a8hna-gia-ta-diktya-pempths-genias

Author: Dimitrios I. Sotiropoulos

The projest has been funded with the support of European Commission within ERASMUS+ program

STORY CARD 8

Smart Cities, 5G and Internet of Things

Oslo at the fight against carbon's emissions

In Oslo, to achieve a 50% reduction in carbon emissions by 2020, they have redesigned the entire public transport network, incorporating an innovative IoT automation system, which ensures that the means communicate with each other and with administration central points. The new system is based on the fast and secure transfer of data through modern telecommunication networks and it covers every need in transportation. Simultaneously, cars in the city will be gradually banned with the sole exception of those being of advanced environmental technology and emit zero pollutants!

Ancient Matera proceeds to 5G speeds

It is estimated that by 2020, 50 billion objects will "talk" to each other while with the transition to 5G networks, which will offer ultra-high speeds, IoT will enable cities to become even more sustainable and functional. Matera in South Italy, for example, does not have to start from scratch to achieve this. This ancient town, built on the edge of a cliff, will be one of the first cities with 5G networks in Europe. Local Government counts on this technology to promote the cultural and artistic inheritage of the town, which was declared European Capital of Culture for 2019.

The most functional city is being built in Finland

The title of the most functional town goes to an unknown, much smaller city, Kalasatama, being currently under construction in Finland. In this new suburb of Helsinki it is estimated that residents will get approximately an hour back of their day. And this will be feasible thanks to its proper manufacture, which ensures easy access to public services, schools, hospitals as well as technological innovations. Fow example, a new system of garbage collection is being designed, according to which citizens will throw their rubbish in a special port absorbing it and transporting it to an underground sorting system. That way, no resident of Kalasatama will waste time stuck behind a garbage truck! Kalasatame relys its development on the Internet of Things, a network of smartly connected devices and machinaries.

But what about Greece?

Greece has been taking its first steps in digital transformation since 2004, focusing on technologies and applications related to both agricultural production and urban needs, noting impressive results, which often exceed many cities abroad. It is no coincidence that even the Guardian in a report praised Trikala as "the most high-tech municipality in Greece" presenting the innovative solutions having been implemented, such as the driverless bus. The "digital" steps of Trikala are followed by other Greek cities too, such as Ioannina, Larisa, Veria and Heraklion utilizing IoT technologies, while Athens has already launched a Smart Garbage Monitoring System in the center and soon it will soon have smart street lighting, saving significant resources, reducing CO2 emissions and light pollution, following the standards of other European cities.

Digital transformation will make our cities more functional, humane, and sustainable and will enable citizens to participate actively in improving services, infrastructures and quality of life in general.

Watch also the relative video: https://www.youtube.com/watch?time_continue=308&v=7bUFZCcAZ6g
Source: iefimerida.gr - https://www.iefimerida.gr/tehnologia/pos-poleis-toy-kosmoy-elladas-ginontai-exypnes

Author: Dimitrios I. Sotiropoulos

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STORY CARD 9

If you've been reading the headlines about the 5G revolution and imagining smart home installations free of connected cables, think again.

5G promises that mobile networks can accommodate the widespread implementation of the Internet og Things (IoT). Verizon (mobile phone company) has said that their 5G network will be 200 times faster than their current 4G LTE (long-term evolution) network. This speed could compete with wired broadband, but there are many reasons why 5G will not completely replace fiber optics and copper cables anytime soon. Device compatibility, service flexibility, security, and service coverage are factors that will slow the so-called 5G revolution. Timing is an issue as well.

Device compatibility: There are billions of Wi-Fi devices in use today: PCs, tablets, TVs, printers, sound systems, smart home devices and more. Even smartphones designed to use mobile data have a built-in Wi-Fi preference derived from wired Internet installations. Switching to mobile network will take time.
Service flexibility: Providing Wi-Fi to wired networks is flexible. Customers can purchase it as a service delivered to homes and offices via fiber optics and coaxial cable. They can also get it for free in hotels or restaurants. They can even buy Wi-Fi time when traveling. With mobile networks, subscription models are the only option.

Security: Broadband is considered more secure for direct file sharing and communication between devices (peer-to-peer). Businesses have established secure Wi-Fi network for local area network (LAN) integration. Convincing these users to switch to a mobile network (replacing the existing wired network) could be a real challenge.

Coverage: A well-designed facility with Internet access will ensure that there is Wi-Fi coverage everywhere in the home or office - even below ground level. Mobile networks can offer this level of service only by adding small cells or distributed antenna systems (DAS). A small cell is a low-power access node that covers from 30 to several hundred square feet (unit of length). The small cells enhance the coverage of the larger mobile network effectively bringing it closer to the user. A DAS antenna can work with multiple service providers and is designed to provide services to up to 1,800 users within of few miles. DAS would be a good solution for a soccer field (where a relatively large number of people with mobile phones are gathered in a relatively small place).

Timing: Small cell and DAS could solve the coverage problem, but installing these services will take a long time. As 5G won't be fully functional by the end of 2020, when the standard is expected to be completed, the installation of small cells and DAS will be far behind the adoption rate of the wired broadband network. And while mobile providers are busy increasing their coverage and implementing 5G, Internet Service Providers (ISPs) will provide faster and more reliable cable networks. Another consideration is that the reports on speeds that can be achieved with 5G may not be reliable as some tests are done indoors without considering many of the inevitable problems existing outdoors, such as channel noise and transmission issues.

Source: https://primex.com/5g-wont-replace-fiber-cable-broadband/

Author: Dimitrios I. Sotiropoulos

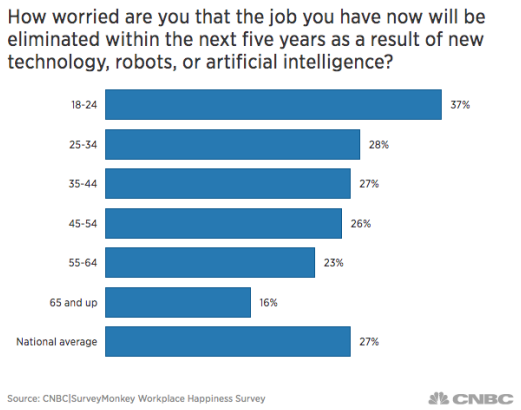
The project has been funded with the support of European Commission within ERASMUS+ program

STORY CARD 10

Employees are afraid that robots will steal their jobs

1. What do employees believe about the evolution of Artificial Intelligence and Machine Learning in their work places? The impact of the growing flood of technology in work places has been one of the most researched issues in the field of Human Resource Management for years, but several recent studies are full of contradictions.
Take, for example, the recent opinion poll of Blumberg Capital, in which 1.000 American Adualts participated. About half of them are ready to adopt new technologies, whereas the other half are afraid that these will steal their jobs. Here is an amazing finding: Most people (72%) realise that artificial intelligence aims to relieve them of boring, repetitive parts of their job, allowing them to focus on more complex and interesting tasks. Even so, still, 81% are very afraid of being replaced, because they are reluctant to hand over the most boring parts of their job to an algorithm. “Our employees have expressed concerns. They are asking me: What part of my job will be automatized?” Joe Atkinson says, who is in charge of digital politicy at PwC (Pricewaterhouse Coopers), advisory Taxing and Accounting. “Change creates a lot of stress and anxiety, not only for the future of people but also for their ability to keep up with the demands of the jobs they now have.”

2. The new movie “The Terminator” is back, and the idea that robots and artificial intelligence are coming for us - specifically for our jobs – is a big part of the movie. However, the majority of the working population remains fearless of a T-800 stealing their jobs. Just over a quarter (27%) reacts. All employees claim that they are worried about losing the job they now have within the next 5 years due to new technology, robots or artificial intelligence, according to the three-month survey for happiness in CNBC workplace. Nevertheless, survey shows that it can only be a matter of time: fears for automatization and employment are higher among younger employees. The survey found that 37% of employees between 18 and 24 years old are worried about the new technology, which is eliminating their jobs. Dan Schawbel, director of research for future workplaces and author of “Back to Human,” said one reason for the age gap in fear is because technology, like AI, is normalizing. “They are beginning to recognise the value of Artificial Intelligence and the way it affects their personal and professional lives”, Schawbel says. “We use AI without even thinking about it. It’s a part of our lives. If you are talking to Siri or Alexa, this is AI.”



Sources: 1. Anne Fisher, https://www.fortunegreece.com/article/i-ergazomeni-fovounte-oti-ta-rompot-tha-klepsoun-tis-doulies-tous/ και
2. Jacob Douglas, https://www.cnbc.com/2019/11/07/these-american-workers-are-the-most-afraid-of-ai-taking-their-jobs.html

Author: Dimitrios I. Sotiropoulos

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STORY CARD 11

Internet Addiction and what to do about It

Internet addiction is a behavioral addiction, a non-adaptive way of coping with the pressures of life. In other words, a person is addicted to using the Internet or other internet devices. Internet addiction in some countries affects a large number of people. In South Korea, for example, it is recognized as a national health problem. It is also a source of growing concern in developed countries, in North America and Europe. As Internet addiction is not officially recognized as an addictive disorder, it can be difficult to diagnose. However, many experts have helped to identify the symptoms of cyber addiction. All types of Internet addiction contain the following four elements:

- Excessive use of the Internet
- Withdrawal symptoms (when Internet access is not available)
- Strong mood for more internet access
- Negative effects in various areas of life

Internet addiction especially affects children and adolescents, as they do not have the knowledge and awareness of computer management and have no idea about the possible harms that excessive exposure to the Internet can cause. Most children have access to a computer, and it is common for children and teens to carry cell phones. While this can be reassuring for parents, as they can communicate with their child in an emergency, there are real risks due to constant internet access. In addition, children who play online games are often pressured by friends, classmates, etc. to play for extended periods of time in order to support their team or maintain their skills.

This lack of boundaries can make children vulnerable to developing video game addiction. This can also make it difficult to develop healthy social relationships, leading to isolation and victimization. Here are some evaluation questions that will help you evaluate if you are addicted to the internet.

How often:

- Do you stay online longer than you intend?
- Do you hear other people in your life complaining about how much time you spend online?
- Do you say or think, "A few more minutes" when you are logged in?
- Do you try and fail to reduce the amount of time you spend online?
- Do you try to hide how long you have been online?

If any of these situations occur daily, you may be addicted. What to do if you are addicted to the Internet? Talk to your doctor about getting help. Internet addiction can also overlap with other behavioral addictions, such as work addiction, television addiction, and smartphone addiction.

Source: Elizabeth Hartney, BSc., MSc., MA, PhD.The article may be retrieved in the following link: https://www.verywellmind.com/internet-addiction-4157289 Photo source: https://choice.npr.org/index.html?origin=https://www.npr.org/sections/health-shots/2017/05/18/527799301/is-internet-addiction-real

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STORY CARD 12

How the Internet has affected knowledge

It is a given that the Internet has brought a more equal access to knowledge. We are living in a wave of democratization of knowledge. In the past, to see the Cambridge Library, one had to travel thousands of miles. Today, we can find its books from our office. In the past, one had to have money to attend MIT classes. Today, they come to our house online.

Three objections are raised to this existing democratization of knowledge:

• The first one is the denial of technology, because of the potential dangers of its development. Paul Virillo, for example, wrote **The Information Bomb**. He is sure that the knowledge society poses risks, but unknowns ones. He does not know them, but ... they exist.

• The second objection has to do with the "children of Africa". We hear about every new technology: "What can I do about the Alzheimer's vaccine, when African children do not even have aspirin for the fever?" The argument makes sense in part. Really "what to do about the Alzheimer's vaccine, if you do not have Alzheimer's?". But if you get it, the first thing you forget is the "kids of Africa".

• The third objection has to do with the infamous "digital divide". Of course, no technology, no scientific revolution spreads immediately all over the world. Gutenberg printed the first Bible in 1455. However, printing in Greece came at the beginning of the 19th century. As for the printed book, we are still striving to make it the property of the Greek people. The important thing, however, is that the revolution took place and is still going on. After all, those who talk about the digital divide in Africa need to consider what the typographical gap between the western world and Africa is.

Many more people can participate equally in the knowledge society and now not only as readers but also as writers. In cyberspace, economically and technologically, everyone is at the same starting point. On the Internet, a journalist's article is just as accessible as a kid's article.

That is, communication networks flatten old hierarchies of industrial society and it remains to be seen whether they will compose new ones. In cyberspace, everyone works according to their needs and capabilities. But this creates a fragmentation of experience that scares many. The community needs shared experience to be a community. On the other hand, all this abundance of available information turns into stress. Some psychologists call it "information anxiety": "to be able to see one article, to read the other, not to miss the third, so that I am not out of topic and out of the community where I live and work". This stress makes sense to exist and increase as the amount of information we all have available grows.

All this is true, but the same would be said by a medieval monk watching the flood of heretical texts that began to come out of the printing presses. We must not forget that the information revolution is in transition and every revolution in transition is confusing. The old is not dead and the new is not born.

Source: Subject of national exams 2011 in the course Modern Greek Language of general education. Paschos Mandravelis. From the daily press (adaptation).
Photo: https://www.wikihow.com/Expand-Your-Knowledge-Using-the-Internet

Author: Dimitrios I. Sotiropoulos

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STORY CARD 13

Internet is knowledge and knowledge is power

Adisa Bolutife, 22 yeas old, from Nigeria, is a proponent of open Internet access. He is a graduate of the University of Lagos in electronics engineering. He is passionate about internet access, technology, integration and Internet Governance. In 2016, he founded **Open Switch Africa**, to support open access to research, education and data in Nigeria. He is also the co-founder and director of **Digital Grassroots**, a global initiative working to improve digital literacy in local communities. He is a graduate of the **UNESCO Youth Leadership Laboratory for Global Citizen Education**, **Mozilla Open Leaders** and **OpenCon 2017**. As it happens with many other people in the world, the Internet has greatly shaped who we are today - building our knowledge by accessing a wealth of information. Without the Internet, many things would not be as easy as they are now, he notes.

As a graduate, I can say that the Internet has improved my learning and research capabilities, as I have been able to discover academic resources and attend world-class lectures from the comfort of my own room. I am a fervent supporter of open access to research, education and data. The Internet has been a powerful factor in bridging the gap between privileged and disadvantaged communities. I hope the Internet serves as a platform for disseminating information to everyone, regardless of race, gender or nationality. In 2016, I founded **Open Switch Africa**. I support an accessible and inclusive Internet, where information is not blocked due to costs (paywalls), regulations or lack of connectivity. Without connectivity we can not have the huge interface that the Internet creates between billions of computers and devices, thus achieving the interconnection of people and information.

Information brings knowledge and knowledge, as they say, is power. It is clear that Internet is at the core of almost everything we do. With automation and machine learning at the forefront of the transformation of future jobs, open education and open data, leading the field of education and research, as well as social media and blogs, disrupting the status quo in communication, very soon a much larger percentage of the world will depend on the internet for a living. That is why it is so important, as we prepare for the future, to ensure that all voices are heard when it comes to critical decisions about the future of the Internet. The Internet is diverse in nature and the participation of young people is vital to its formation. Young people are already shaping online culture in many ways. They are building the Internet of their dreams. However, when it comes to policy discussions, they are not on the table. We need policies that protect us and prepare us for the future of the Internet, while ensuring that no one is left behind.

Source: Internet Governance. https://www.internetsociety.org/blog/2019/01/the-internet-is-knowledge-and-knowledge-is-power/

Author: Dimitrios I. Sotiropoulos

The projest has been funded with the support of European Commission within ERASMUS+ program

QUESTION CARD 1	QUESTION CARD 2	QUESTION CARD 3	QUESTION CARD 4
When was Internet created? How many people have access to it and its services?	With which ways can Internet access be possible?	Which are the advantages and disadvantages of wired Internet Access?	Which are the main advantages and disadvantages of wireless Internet Access?

QUESTION CARD 5	QUESTION CARD 6	QUESTION CARD 7	QUESTION CARD 8
Which are the advantages and disadvantages of satellite Internet Access?	Who determines the "safe limits" for exposure to electromagnetic radiation? Are there "normal values" for the limits?	Can the "safety limits" for exposure to electromagnetic radiation, suggested by scientific organisations, be exceeded?	Do electromagnetic fields, which are created by wireless networks, have biological impacts for humans?

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QUESTION CARD 9	QUESTION CARD 10	QUESTION CARD 11	QUESTION CARD 12
Which applications are those being in evolution and needing fast and broadband Internet?	**Is IoT possible to be developed without wireless connection?**	**Is there unpreventable Internet access (infrastructure and services) for the global population?**	**What is satellite Internet?**

QUESTION CARD 13	QUESTION CARD 14
Will a global low orbit's satellite network mitigate social inequalities?	Will wireless network contribute more to economic growth than wired? What is your opinion?

Author: Dimitrios I. Sotiropoulos

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Worksheet No 2

Based on the materials provided by the teacher, prepare arguments for discussion. One group of students prepares arguments supporting the resolution, the other one - opposing arguments. Use the proposed template.

ARGUMENT n° 1

Argument with reasoning	Foreseen rebuttals from the other team	Answers to rebuttals

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ARGUMENT n° 2

Argument with reasoning	Foreseen rebuttals from the other team	Answers to rebuttals

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ARGUMENT n° 3

Argument with reasoning	Foreseen rebuttals from the other team	Answers to rebuttals

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Odyssey
Oxford Debates for Youths in Science Education

Erasmus+

Access to the Internet and Development

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Physician, M.Ed. In Didactics of Natural Science

Ph.D. in Natural Sciences and in Digital Educational Technology

Web Seminar

Institute of Geophysics
Polish Academy of Sciences

CENTER FOR THE PROMOTION OF SCIENCE

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ENERGIA
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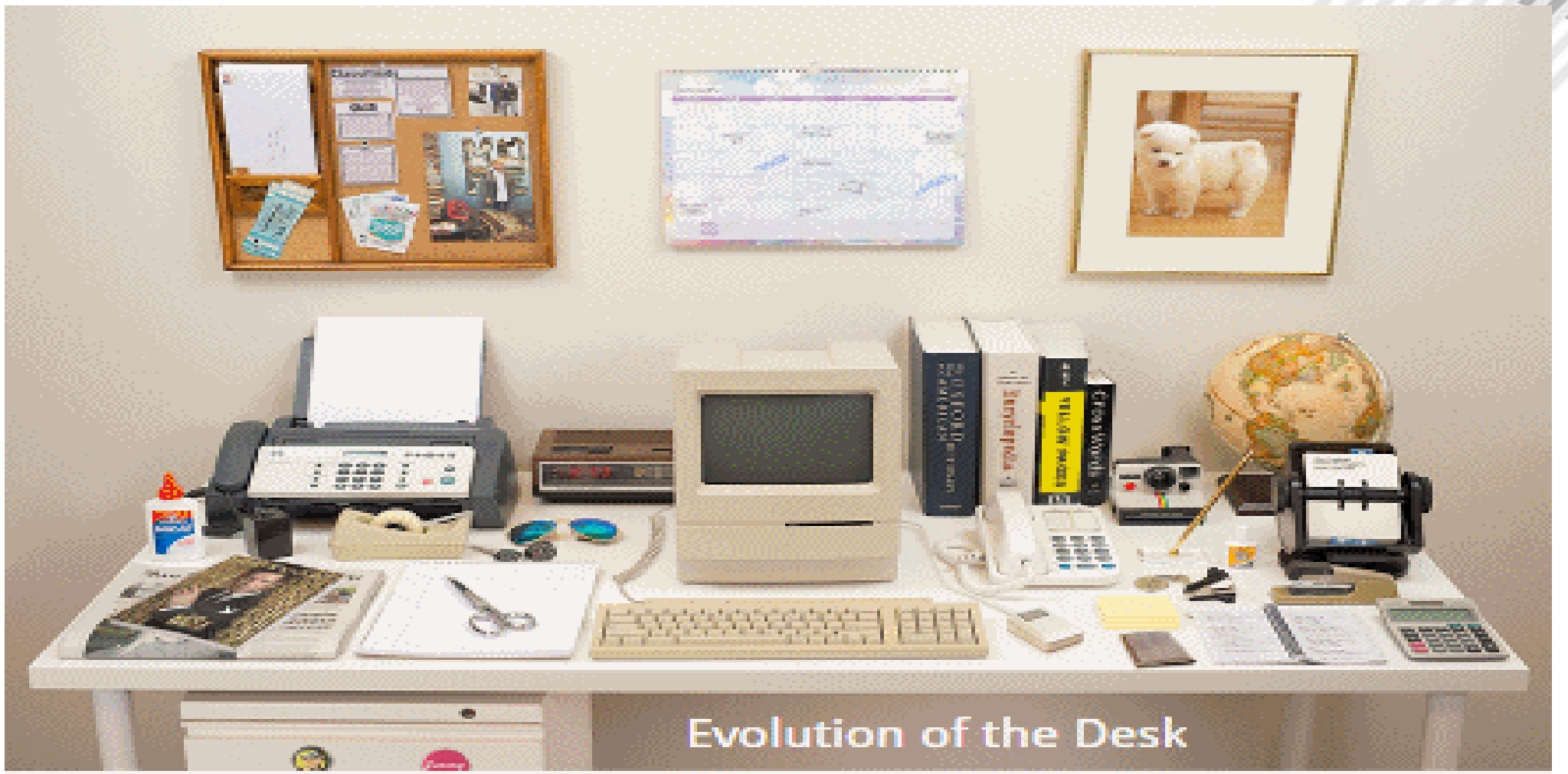
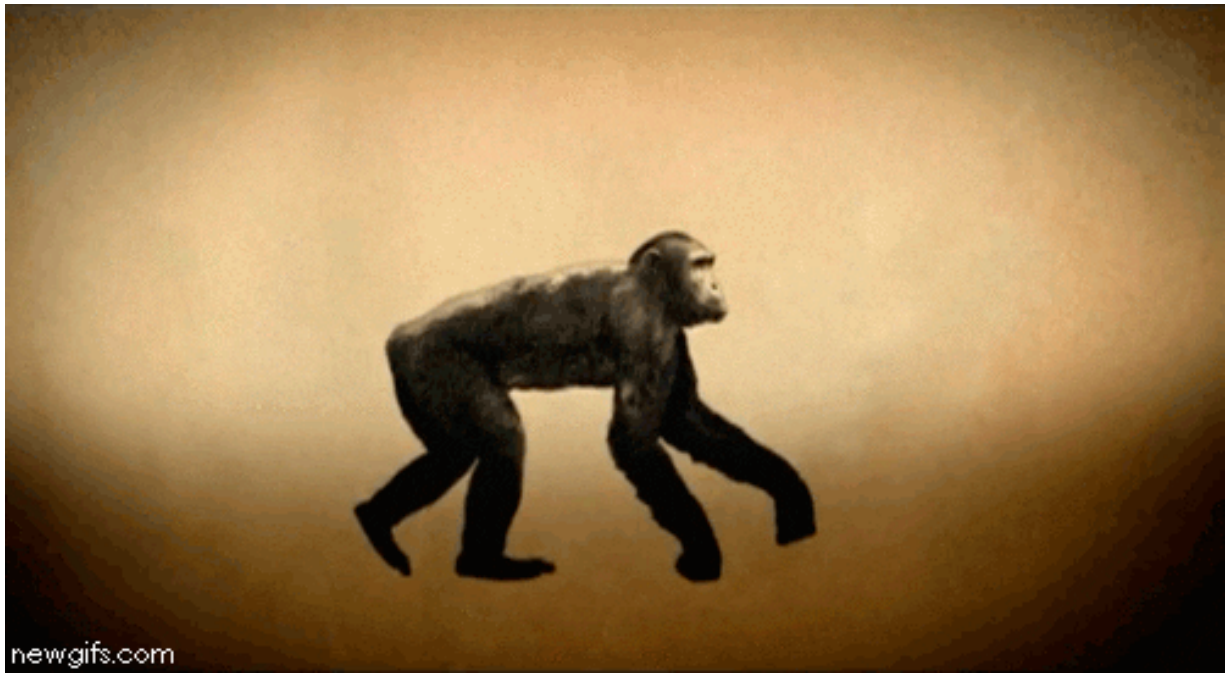
ENERGY DISCOVERY CENTRE


Evolution of the Desk
1980

Food for thought…



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Theoretical Introduction

for global networking

Institute of Geophysics
Polish Academy of Sciences

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4th Industrial Revolution

The 21st century is described by a reflux of technological applications and evolutions in various fields (Computer Science, Artificial Intelligence, Photonics, Nanotechnology, Biotechnology, Robotics etc.), which is called the 4th Industrial Revolution.

Technological applications, related to Computer Science and Internet play a fundamental role. It can be supported, with safety, that catalyst of this revolution is the Internet and that that the width of social changes depends on the range of its permeation through the societies.

4th Industrial Revolution

In this so called "4th Industrial Revolution", what we need is for it to be universal. That means, that the countries which at the moment are known as 'developing countries' and are left behind (in relation to other countries) need to participate in it actively as far as the field of use and utilization of Internet's technology is concerned.

Photo: https://economictranscript.wordpress.com/2019/09/01/the-fourth-industrial-revolution-the-paradigm-shift-in-economy/

Internet Use

This increment on Internet's worldwide use (participation of more users, use of new application for information, communication and entertainment), results to a geometrical increase on the needs for a wider and faster Internet.

Big Data Analytics, Artificial Intelligence and Internet's of Things technologies require wide, unpreventable and fast access to the Internet.

Photo: https://www.educba.com/what-is-big-data-analytics/

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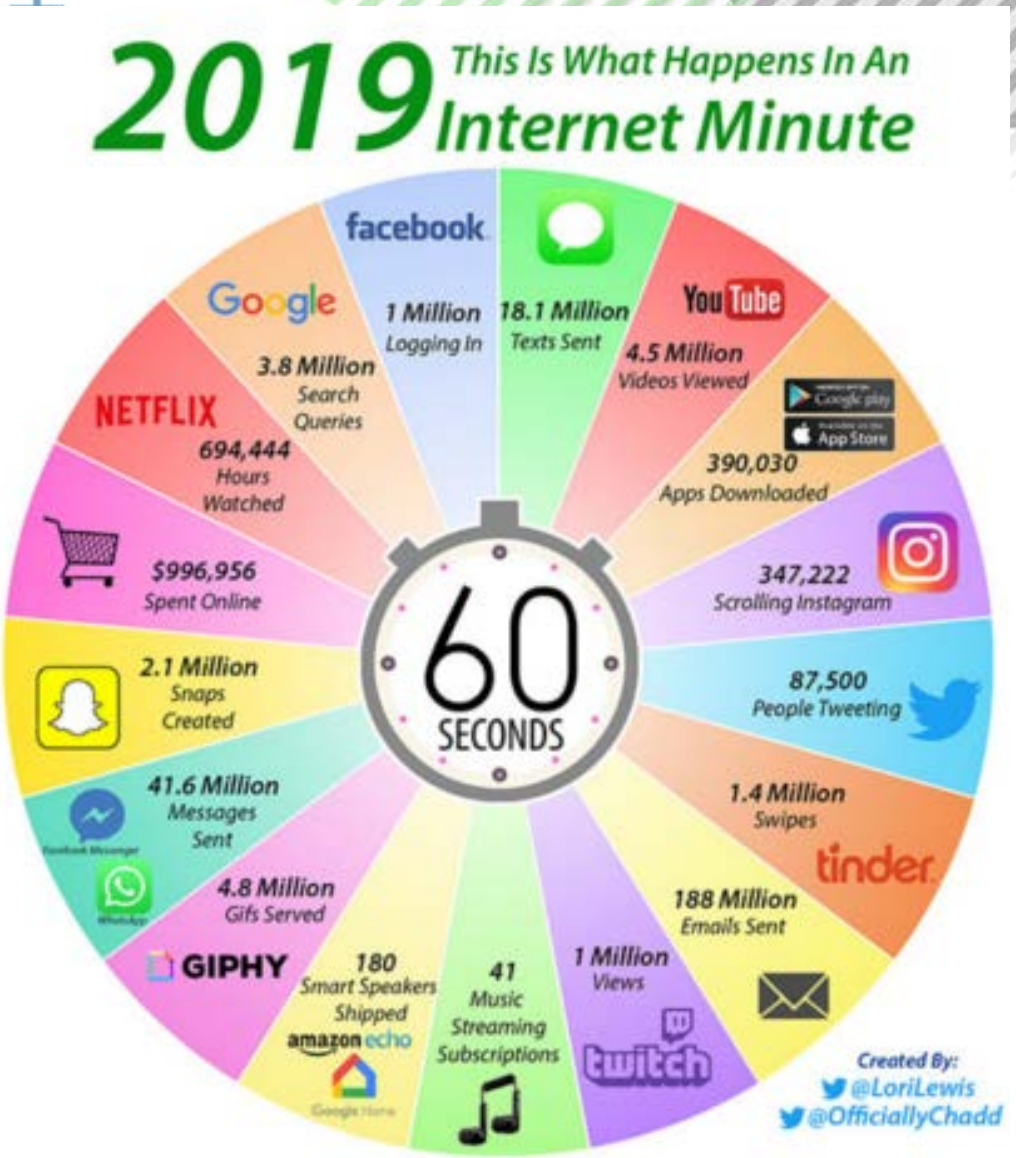

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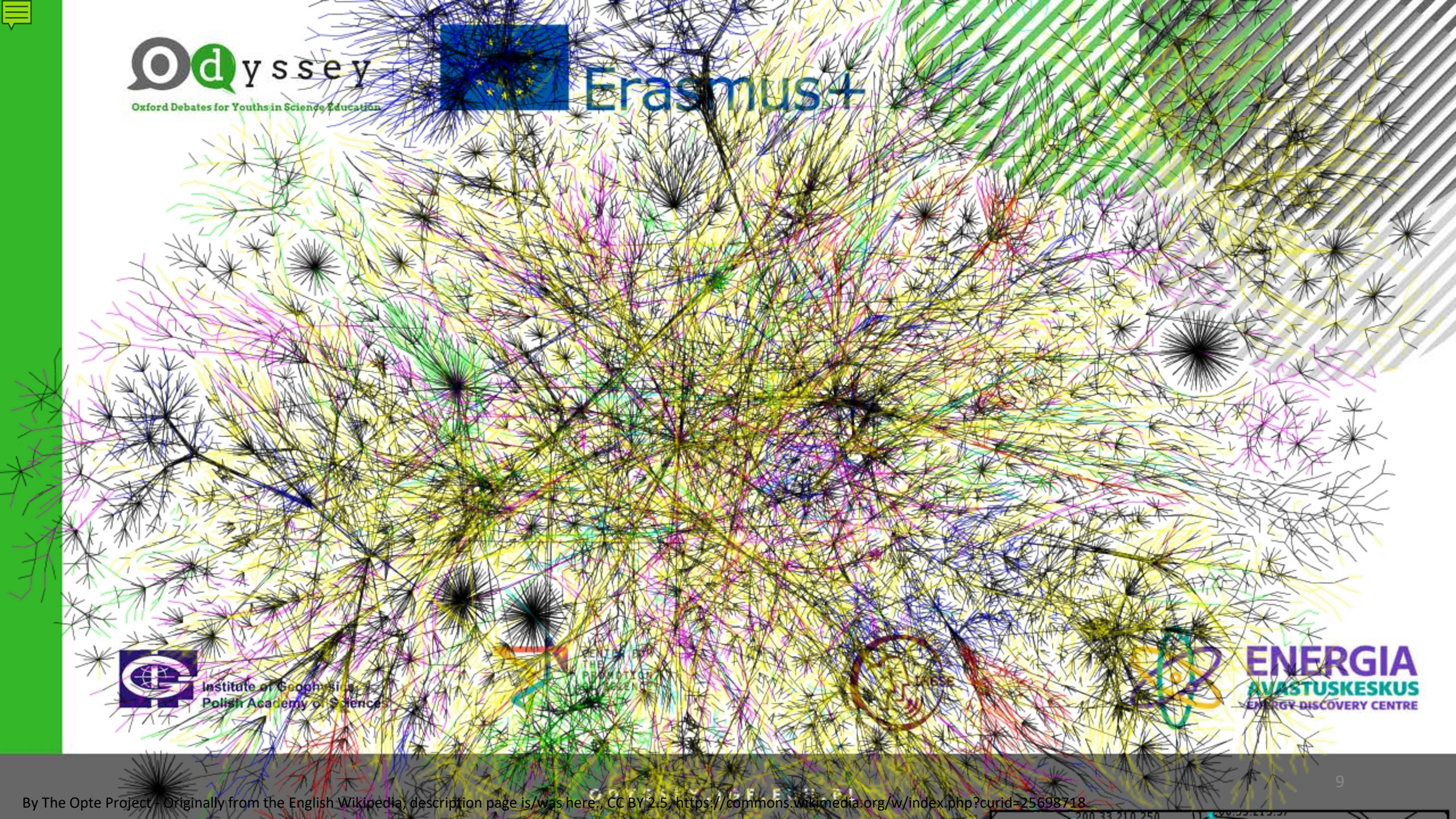

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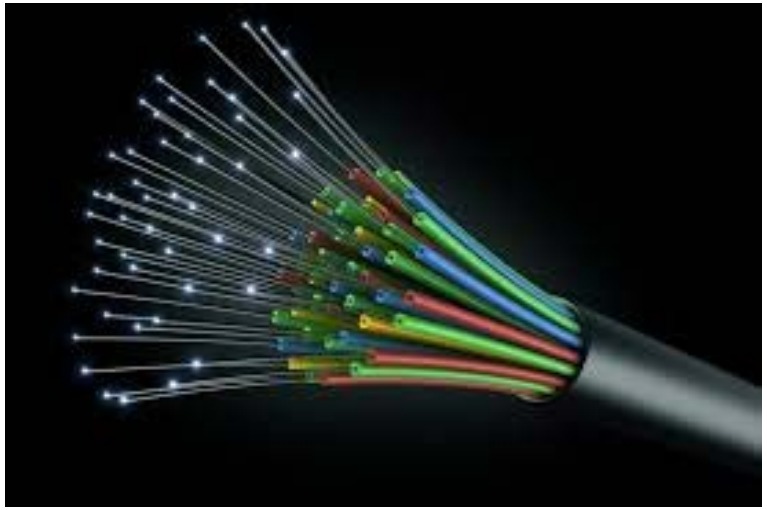
Until now, wired devices are used more than the wireless ones for Internet Access. Furthermore, it seems that there is no infrastructure for wired access in the developing countries.

Wired Means for Internet Access

Wired means: telephone cables and fiber optics

Fiber Optics refer to a medium for wired networking, offering capabilities of high speeds, greater data security, with almost zero impact on health issues while preventing data interception. However, there is difficulty in expanding the existing network (either due to geographical reasons or increased, economic resources needed for its expansion).



Physical Side of the Internet and wired ways for Internet Access…

- Discover the physical side of the Internet (video)

Wireless means for Internet Access

Cellular Mobile Antennas (3G,4G και 5G) and broadband WiFi networks (**WiMAX)**

2G,3G,4G,…5G

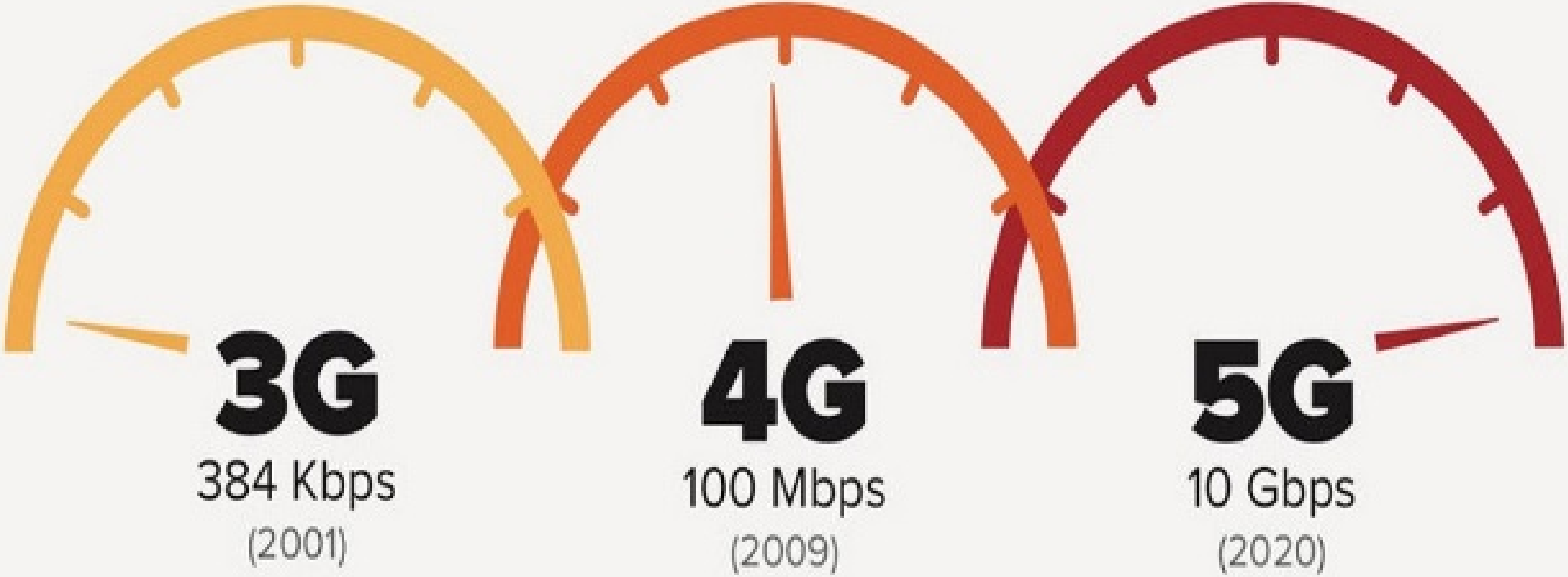
2G Mobile telephony transmitted only voice.

3G introduced us to Internet World, but not Video World.

With 4G we are sending Videos, downloading movies, watching livestream etc.

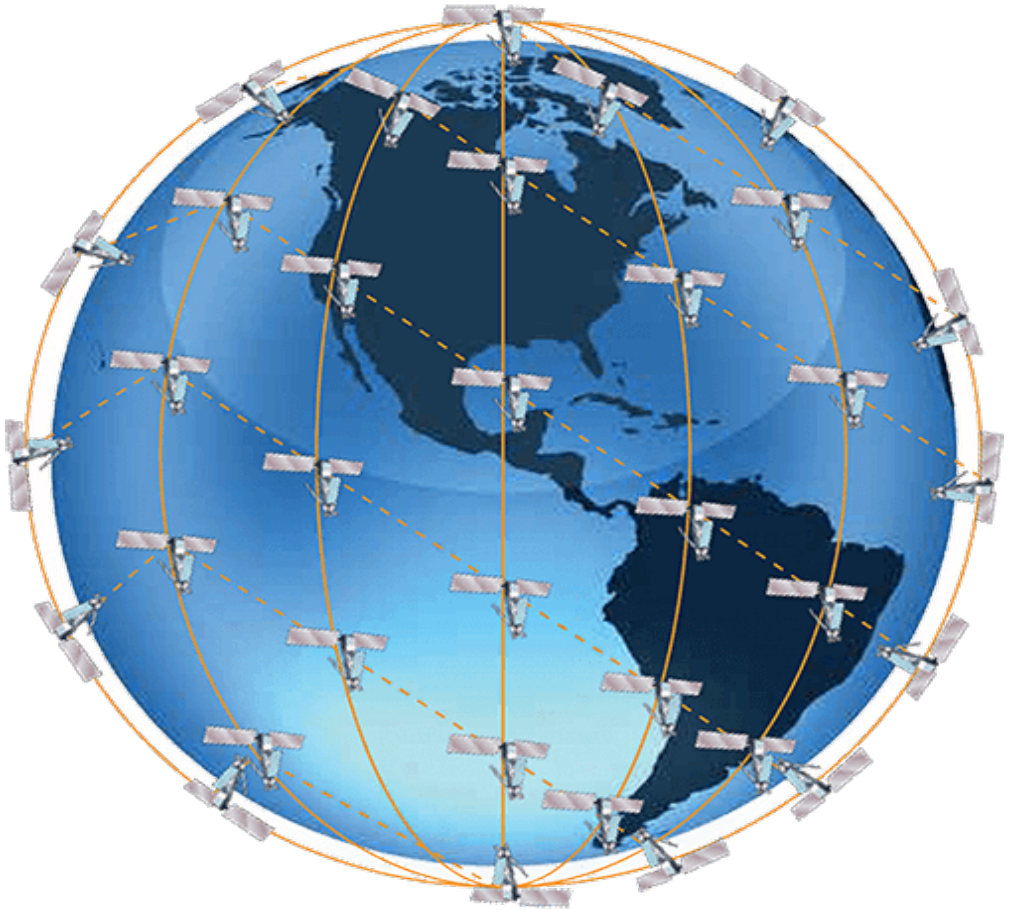
At 5G, the greatest advantage are the enormous data amount, being transmitted at the unit of time (high data speed) and the very low device delay to answer to one other's signal, when it is called (minimum time delay). There is a new world ahead, where the user will enjoy real time services (artificial intelligence applications, data analytics, mixed/virtual reality, Internet of Things (IoT) etc.).

Ασύρματη σύνδεση τηλεφωνίας http://artinews.gr/%CE%BA%CE%B9%CE%BD%CE%B7%CF%84%CE%AE-%CF%84%CE%B7%CE%BB%CE%B5%CF%86%CF%89%CE%BD%CE%AF%CE%B1-5g-%CE%BA%CE%B1%CE%B9-%CF%80%CF%81%CE%BF%CF%83%CF%84%CE%B1%CF%83%CE%AF%CE%B1-%CF%84%CE%B7%CF%82-%CF%85%CE%B3%CE%B5%CE%AF%CE%B1%CF%82?fbclid=IwAR00PRXhwEO1g7XYMcfy_QiQ5kMEzHA7uyb2flOocdL1uel9EMIBaKYEVFo


3G
384 Kbps
(2001)
4G
100 Mbps
(2009)
5G
10 Gbps
(2020)

Wireless ways of Internet Access

Satellites, which have very little wideband and data speed for the time being, are included in wireless ways of Internet connection. Nevertheless, according to the latest information, this changes and it seems to be converted to an enormous, extensive, worldwide network, consisting of micro-satellites in low orbit. However, it is not sure yet which technology will be chosen for their function.

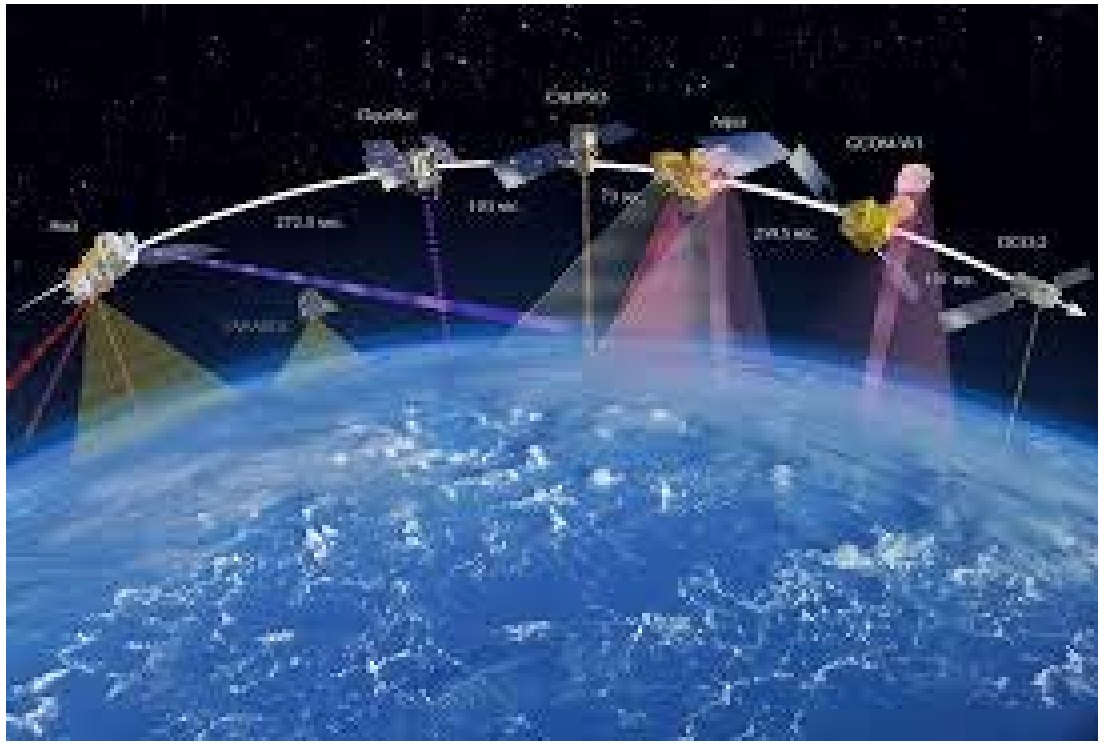


Satellite Internet of today

- Satellite Internet or in other words satellite broadband Internet, is a high speed Internet connection, which is done through communications satellites and not through telephony lines or other earthly ways. It provides double direction connection. That is to say that it gives the possibility for data downloading and uploading between the Internet and your computer.
- Satellite Internet is now available in whole Europe. It is the only broadband solution for those residing in areas with no or slow earthly broadband connection or in areas with slow wireless broadband connection or mobile telephony connection.
- It constitutes a direct way of filling gaps, while it is possible to expect for some other solution (such as ADSL, fiber optics, etc.).

Satellite Internet of today

- The solutions, which satellite Internet is offering, are not complicated.
- They require an antenna (a white satellite plate, that it seems as a television satellite plate, only that it is a little larger than 70 centimeters in diameter). This device is connected with a modem inside the house (as far as traditional solutions are concerned).
- This replaces the connection to the copper network through telephone lines or fiber optics. There is no need for any specialized software application at Personal Computer.



Satellite Internet of Tomorrow (Satellite Internet) and its advertisement…

- How will Satellite Internet work?
- https://www.youtube.com/watch?v=REzA_SYInvc

- ONEweb Advertisement
- https://www.youtube.com/watch?v=UmTDcil97XQ

The “train” of SpaceX Starlink Satellites are passing over Netherlands

- https://www.youtube.com/watch?v=ytUygPqjXEc

IOT. Internet of Things

- The abbreviation IoT describes the coordination among many machines, devices and electronic materials connected to the Internet through multiple wired and wireless connections. Such devices are or will be mobile phones, tablets, other electronic devices, cars supplied with IoT connection (so that they can receive and send signals to “smart” traffic lights, parking, Internet).
- IoT multiplies the use of radio waves sources to the environment, having the difference that we are referring to extremely low power sources (~0,15 mW) and for very little broadcasting time.

Machine-to-machine (M2M)

The term machine-to-machine (M2M) refers to services, which involve two or more machines, devices and electronic devices, which are communicating wirelessly with each other, with no significant human interference. A wide variety of sensors, surveillance tools etc., could be equipped with this new 5G technology, offering precious services on health, agriculture, water supply, meteorology, electricity and elsewhere.

Big Data Analytics

- “Big Data” Analytics means processing and analysis of elements, deriving from devices and Internet services.

- It helps at the development and companies’ economy.

Artificial Intelligence

- The term **Artificial Intelligence** refers to the field of computer science, which deals with design and implementation of computer systems, imitating elements of human behavior, which imply even essential intelligence: learning, adjustment, making inferences, context comprehension, problem solving etc.
- It needs resources and systems, which can also have through Internet.

Από HAL9000.svg: Cryteriaderivative work: MorningLemon - This file was derived from: HAL9000.svg:, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=20000732

- **The internet of things | Jordan Duffy | TEDxSouthBank**
- **https://www.youtube.com/watch?v=mzy84Vb_Gxk**

Electric Fields

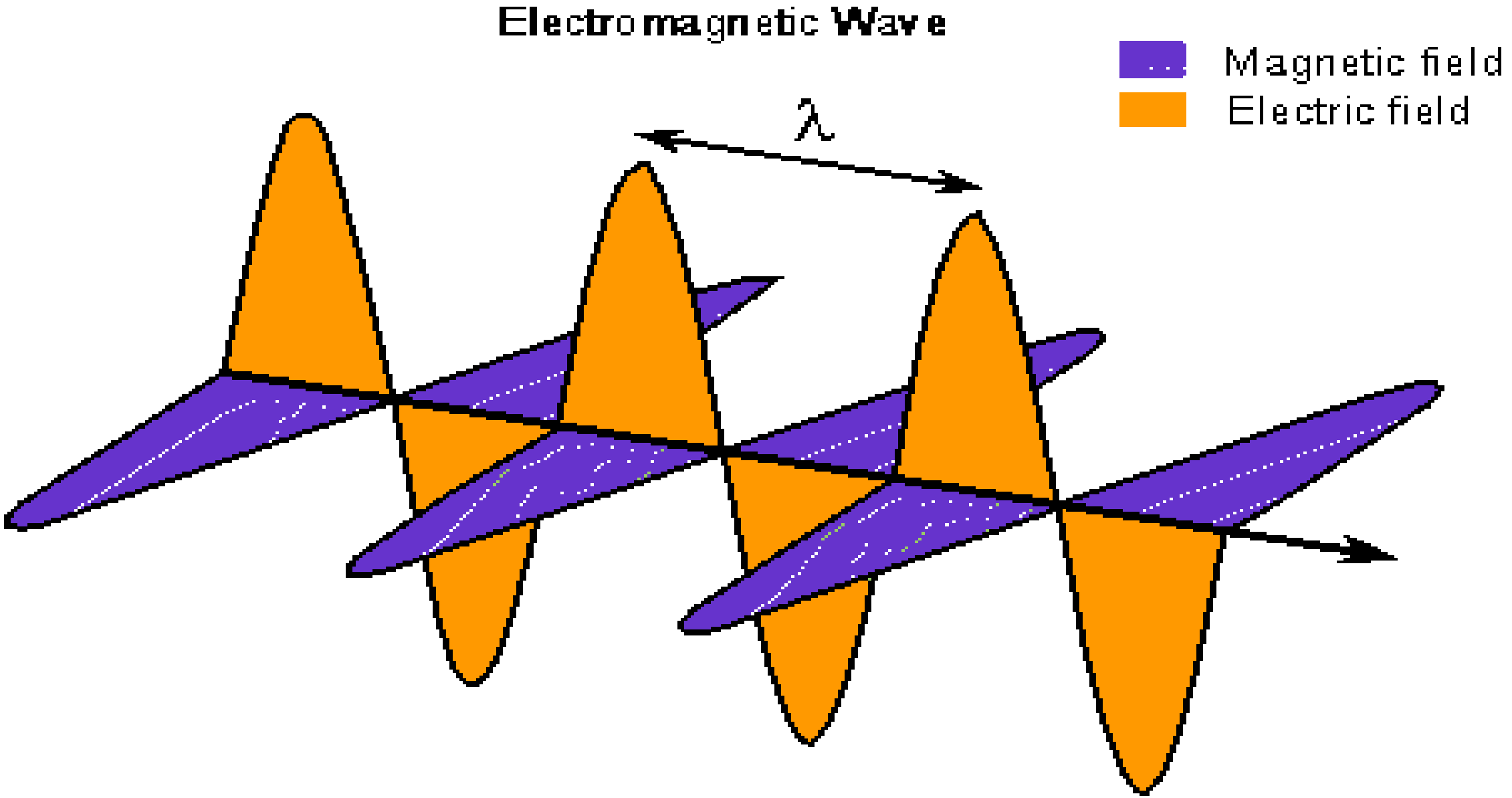
- Electric fields generated from electrical energy transmission layouts are related to the value of voltage at electricity conductors, as well as to the design of the layout. The voltage at the conductors can be considered the reason which causes the transmission of the electrical energy, as it happens with the alteration of water pressure in a water supply network, which causes the movement of water. Generally, the higher the voltage is, the stronger the electric fields are. The standard metric unit of electric field strength is Volt per Meter (V/m). Often, the multiple kV/m (1 kV/m = 1000 V/m) is used.
- Electric fields found in nature are created because of the electric charges which are gathered in the atmosphere. The electric charges create close to the surface of the atmosphere electric fields at the ranking of 100V/m, in good weather conditions. The values of these fields usually range from 500V/m to 1000V/m during thunderstorms. Electric fields are shielded from constructional materials, trees, tall fences etc. In other words, such materials do not let electric fields penetrate them (in contrast to the magnetic fields). For this reason, electric fields in a house close to an electric power line (for electric energy transmission) cannot enter the house. Generally, humans, plants, houses are non-transparent to the electric field. Beyond this, electric fields, generated by any source, are weakened as the distance from the source increases.

Magnetic Fields

- Magnetic fields created from electric energy transmission layouts depend on the magnitude of the transmitted electric energy (current) at the conductors, as well as on the design of the layout. For given value of voltage, the magnitude of the current at the conductors defines the amount of energy, transmitted by the layout. An analogy can be drawn between the electrical current flow in a conductor and the water flow in a pipe. Generally, the stronger the current is, the stronger the magnetic fields are. The standard measurement unit for magnetic fields is microtesla (μT – Europe). The metric unit miliGauass (mG - America) (10mG = 1μT) is used too.
- The Earth's magnetic field is approximately 45μT in Greece. Magnetic fields are barely affected from the presence of trees, fences and constructional materials in their majority in contrast to the electric fields. That way, magnetic fields generated from electric power lines at the outside of our houses can penetrate the walls and the roofs (only ferromagnetic materials do not allow that). Magnetic fields -like electric fields to - are weakened as the distance from the source increases.

Electromagnetic Radiation

- The term refers to oscillations of electric and magnetic fields, which propagate through space perpendicular with each other and perpendicular to the direction of their propagation in space. These oscillations have the form of electromagnetic waves and they carry electromagnetic radiant energy (Poynting vector). The different kinds of electromagnetic radiation are distinguished with each other depending on the frequency of the oscillation or the length of the wave, which is propagated.
- **Frequency** is measured in Hz (Hertz) (oscillations or cycles per second), kHz (thousands of Hz), MHz (millions of Hz) και GHz (billions of Hz).
- The wavelength is measured in distance metric units (e.g. meters).
- Electromagnetic waves are found in different forms (that means different frequency, different wavelength). For example, radio waves, micro waves and visible light are all forms of electromagnetic waves.



http://users.sch.gr/xtsamis/OkosmosMas/Aktinovolies/Aktinovolies.htm

Non-Ionizing Radiation

In the non-ionizing radiations are included:

- static electric and magnetic fields, which are not altered and, as a result, they do not generate electromagnetic waves. Example: the physical, magnetic field of the Earth.
- Electric and magnetic fields of low frequency (50 Hz), generated by electronic devices, substations and electricity transmission power lines.
- Radio waves and micro waves, being broadcasted by telecommunication antennas, radio and television antennas, microwave ovens, infrared radiation, visible radiation (light) and part of ultra violet radiation (not the part that causes problems).

Ionizing Radiation

- Radiation from the environment (ground, air, water, food), cosmic radiation, radiation generated by medical devices (X-rays devices, scintigraphs, Gamma Rays devices, radio isotopes applications etc.), nuclear reactors, nuclear waste, nuclear weapons tests and many other construction materials belong to ionizing radiation.

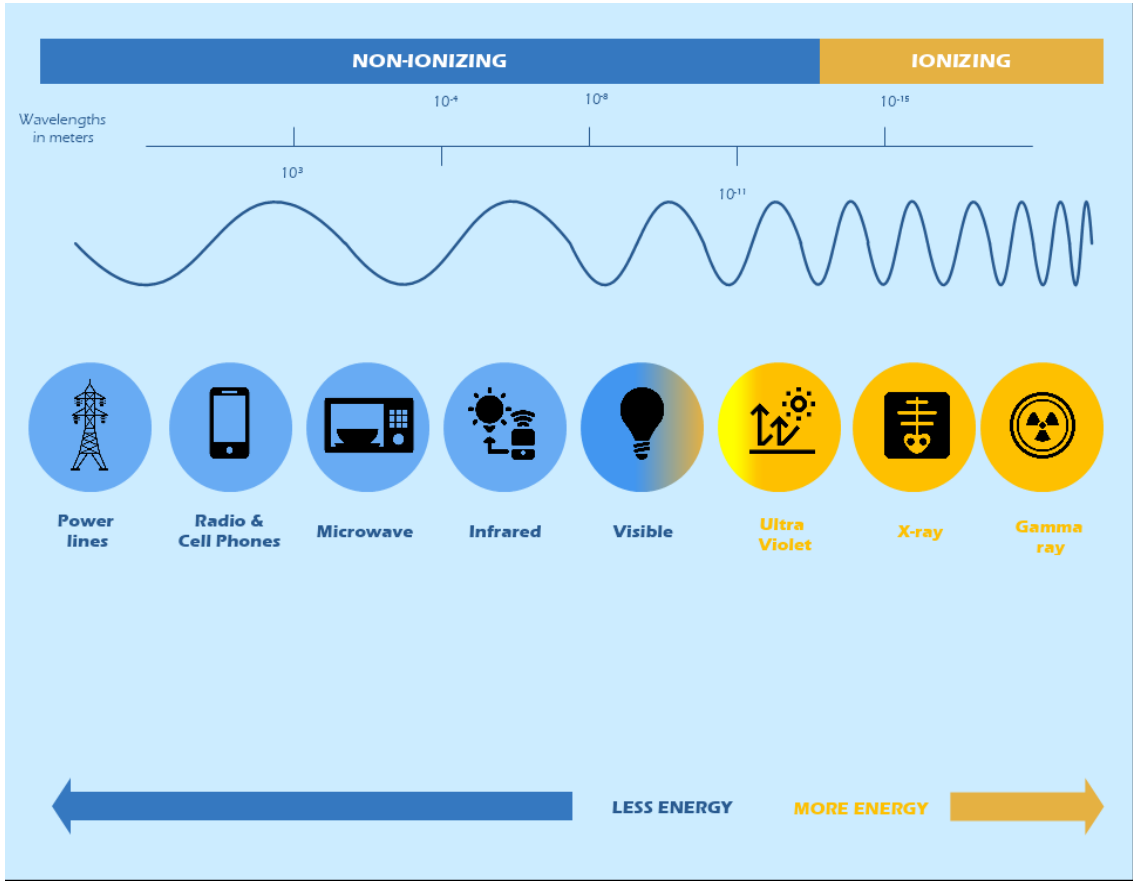
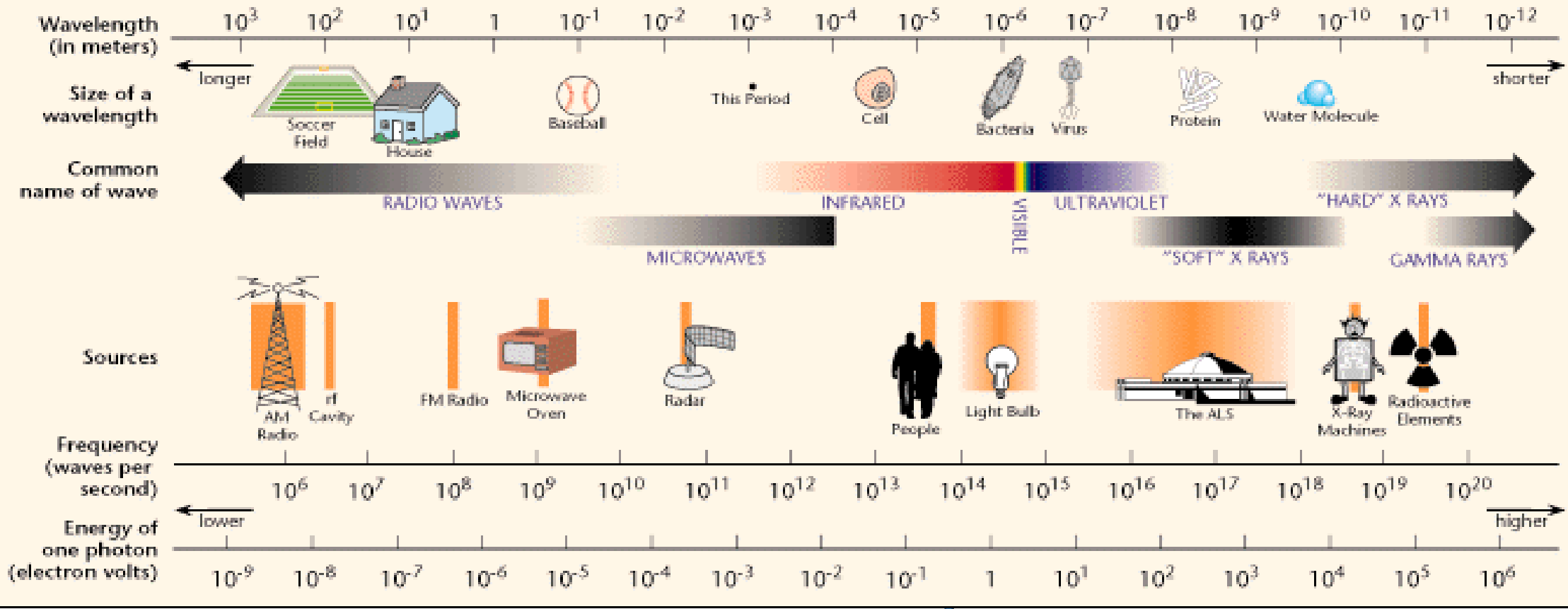


Photo: https://www.mydraw.com/templates-scientifics-ionizing-vs-non-ionizing-radiation

THE ELECTROMAGNETIC SPECTRUM



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Wireless Ways of Internet Access and Health Issues

Because of the use of wireless networking, issues concerning public health are arising. For this reason, the action of non-ionizing (electromagnetic) radiation, which wireless technologies use, is under investigation.

Even though the increase of warmth in the cells due to the intensive use of mobile phones (3G, 4G), is, maybe, the only proof related to human health issues, nobody can claim with certainty if that is going to change in the future.

International and National exposure and absorption limits have been established by ICNIRP

- According to the Law 3431/2006, around any antenna construction that emits electromagnetic radiation there should be no areas accessible to the general population, where exposure levels exceed 70% of the ICNIRP limits. In addition, in the case of an antenna installation found in a distance shorter than 300 meters from the perimeter of nursery school, school, nursing home and hospital premises, public exposure levels may not exceed 60% of the ICNIRP limits. That is, even stricter limits apply than those set by ICNIRP, as shown in the next Table.

Application	Electric Field Intensity (V/m)	Magnetic Field Intensity (A/m)	Power Density of Electromagnetic Wave (W/m^2)
Mobile Telephony 900 MHz (GSM)	28.7 (24.6)	0.08 (0.066)	3.15 (2.7)
Mobile Telephony 1800 MHz (DCS)	40.6 (34.8)	0.11 (0.096)	6.3 (5.4)
Mobile Telephony 2100 MHz (UMTS)	42.7 (36.6)	0.11 (0.096)	7 (6)
Wireless Networks 2.4 GHz (WiFi)	42.7 (36.6)	0.11 (0.096)	7 (6)
Wireless Networks 3.5 GHz (WiMax)	42.7 (36.6)	0.11 (0.096)	7 (6)

Absorption Limits

The next table presents the absorption limits from various body parts, which have been established by Greece related to SAR.

Once more, these limits are 70% or 60% of the limits, suggested by ICNIRP.

Application	Specific Absorption Rate – SAR (W/Kg) (mean value for the whole body)	Specific Absorption Rate – SAR (W/Kg) (mean value for 10g of the tissue of the head or the torso)	Specific Absorption Rate – SAR (W/Kg) (mean value for 10g of the limbs' tissue)
Mobile Telephony 900 MHz (GSM)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Mobile Telephony 1800 MHz (DCS)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Mobile Telephony 2100 MHz (UMTS)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Wireless Networks 2.4 GHz (WiFi)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)
Wireless Networks 3.5 GHz (WiMax)	0.056 (0.048)	1.4 (1.2)	2.8 (2.4)

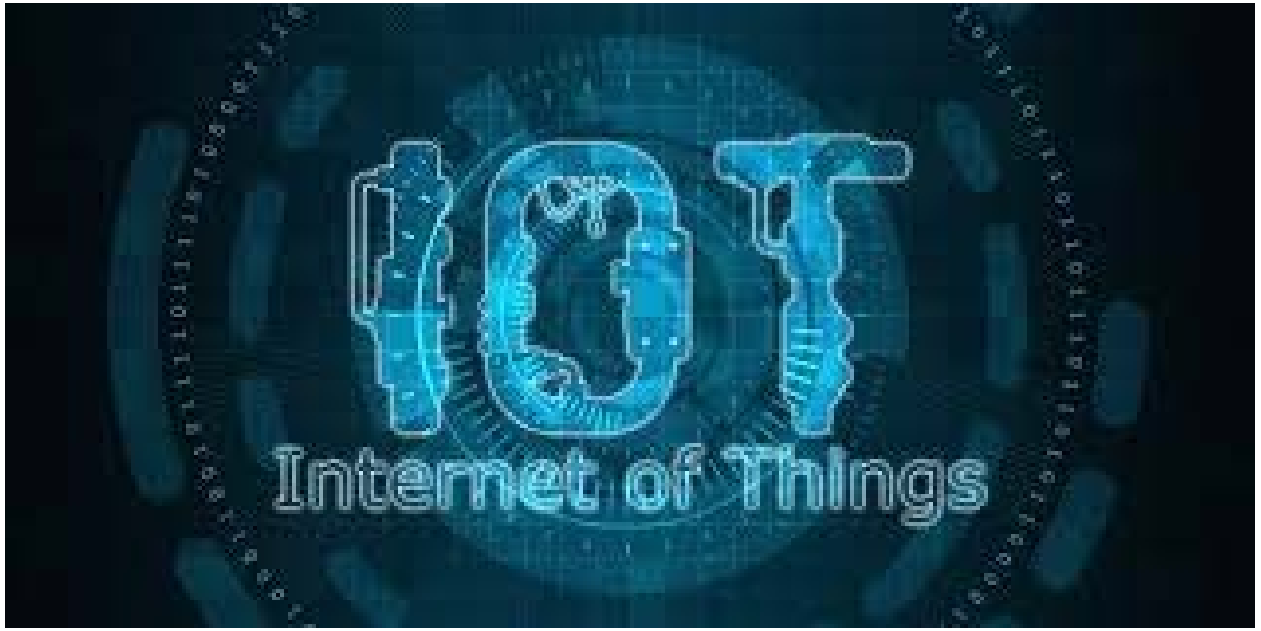
Relation between electromagnetic Radiation and health

- Could Your Phone Hurt You? Electromagnetic Pollution

- https://www.youtube.com/watch?v=FfgT6zx4k3Q

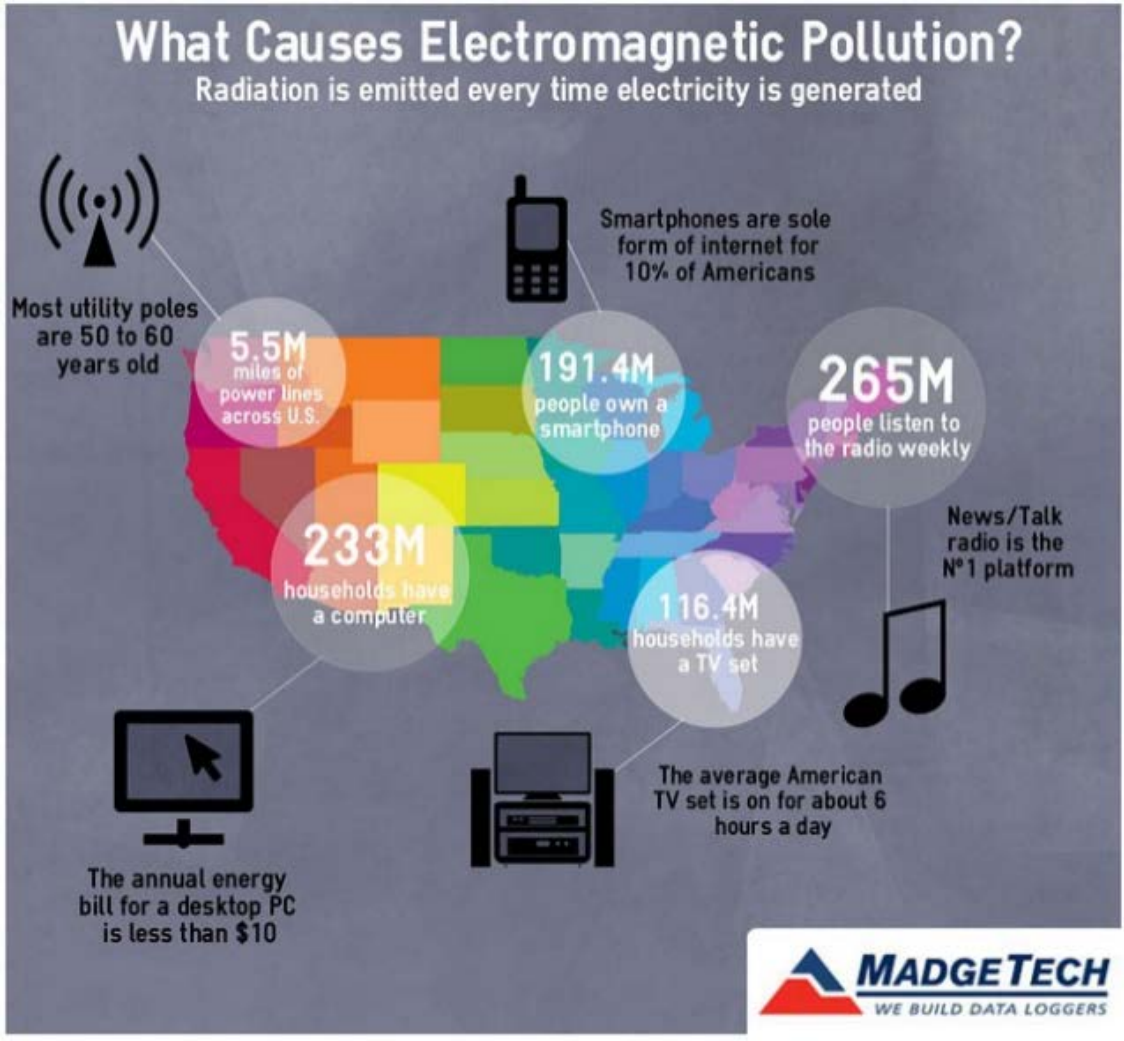
Are IOT devices dangerous?

- How dangerous are IOT devices? | Yuval Elovici | TEDxBGU
- https://www.youtube.com/watch?v=vgoX_m6Mkko



A Wireless “Wake-Up” Call

- Wireless wake-up call | Jeromy Johnson | TEDxBerkeley
- https://www.youtube.com/watch?v=F0NEaPTu9oI



How do cell phones work and… what is their impact to our health?

- Do Cell Phones Damage Your Brain? - The Elevator Situation
- https://www.youtube.com/watch?v=CdDNQJhjBDU

5G Technology and Health

5G is the new expanding technology, which raises discussions about issues concerning human health along with potential impacts on health, which the radiation from 3G and 4G wireless networking has.

This topic is correlated to the 5G technology, which supports the increased needs for speed and data bandwidth, operating at different frequencies (from 3G and 4G). That's the reason why more antennas are needed.

Photo: https://www.dr-hempel-network.com/digital-health-technolgy/5g-transforming-digital-healthcare/

How dangerous is the use of mobile devices (wearable devices) at 5G technology?

- Mobile devices, especially those of lifestyle, such as smart watches, trackers of natural functions and/or athletic activities, have become part of our lives. Their purchase has been expanded in health, constructions, household equipment and elsewhere. They consist of electronics, software, sensors and connectivity accessories, which usually use wireless technology.

Photo: https://www.bbc.com/news/business-44871448

How dangerous is the use of mobile devices (wearable devices) at 5G technology?

The international and national safety limits for the above technology have taken into account even the 24 hour / 365 days of continuous operation. In general, these devices transmit signal at intervals and over short distances, e.g. on a nearby mobile phone, table or laptop. Transmission sources are generally very low frequency and range. Typically, when watching a video, the device mainly receives information, while transmitting a signal for very short periods. The same goes for activity loggers.

Photo: https://www.wired.co.uk/article/ericsson-5g-gaming

How dangerous is the use of mobile devices (wearable devices) at 5G technology?

- IoT devices and wearable devices, which are functioning at frequencies between 30 MHz and 6 GHz are already covered by the existing, international technical standards. Devices, which will function at **higher frequencies**, will be covered by timely, international, technical standards, which are being formed.

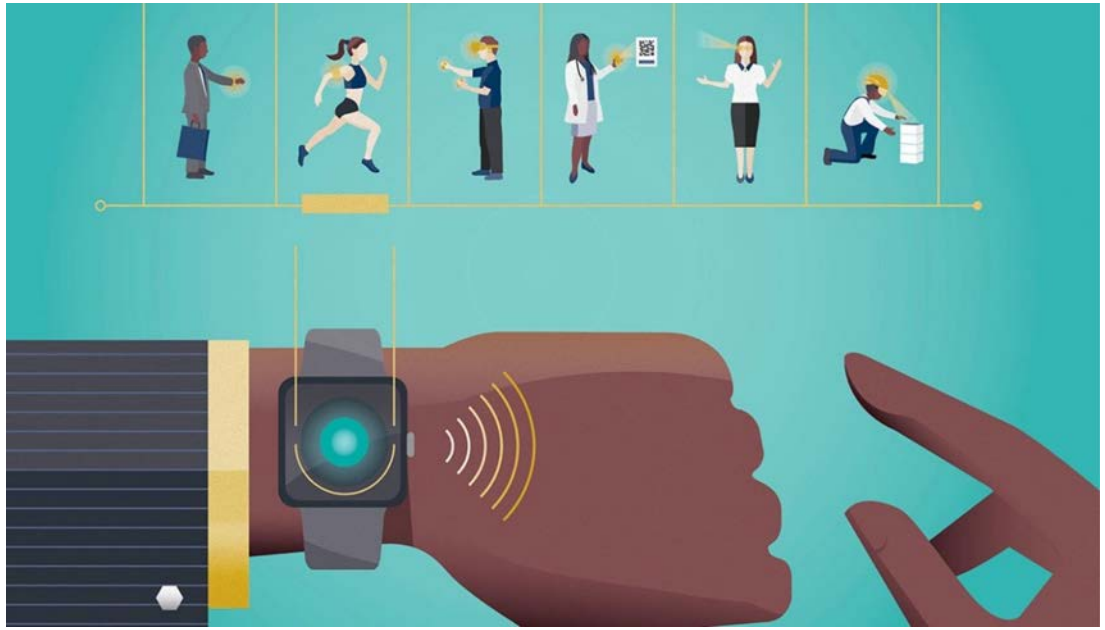


Photo: https://www.wareable.com/wearable-tech/how-5g-is-going-to-change-wearables-5445

The more the frequency increases, the more humans' exposure increases?

- *There is confusion among citizens between the terms "high frequency" and "high exposure".*
- High frequency doesn't mean high exposure. The more the radiation frequency increases, the more the exposed body "resists", the more the radiation weakens and the more the median range decreases. In practice, with 5G high frequencies technology, the amount of radiation which is not reflected, it is superficially absorbed by the skin and it is not coming in deeply.

International Organizations for 5G impacts on Health

- World Health Organization (WHO), Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) and International Commission on Non-Ionizing Radiation Protection (ICNIRP) have reached the following conclusion:
- *“Exposure to electromagnetic radiation, which is owed to wireless networks and to their use, doesn’t lead to harmful, biological impacts for human health, as long as it remains in levels lower than the limits suggested by ICNIRP” [WHO 1993, SCENIHR 2015, ICNIRP Guide lines 2009, ICNIRP Guide lines 2018].*

Which physical quantities describe the intensity of radiation emitted by a mobile base transceiver station?

- There are 3 physical quantities which describe the intensity of electromagnetic radiation:
- the intensity of the electric field (V/m)
- the intensity of the magnetic field (A/m) and
- power density (W/m^2).
- When we have flat waves, namely when the distance from the antenna is quite greater than the antenna's physical dimensions, these three physical quantities are connected to each other by simple mathematical relationships and the knowledge of one can be used for the estimation of the other two.

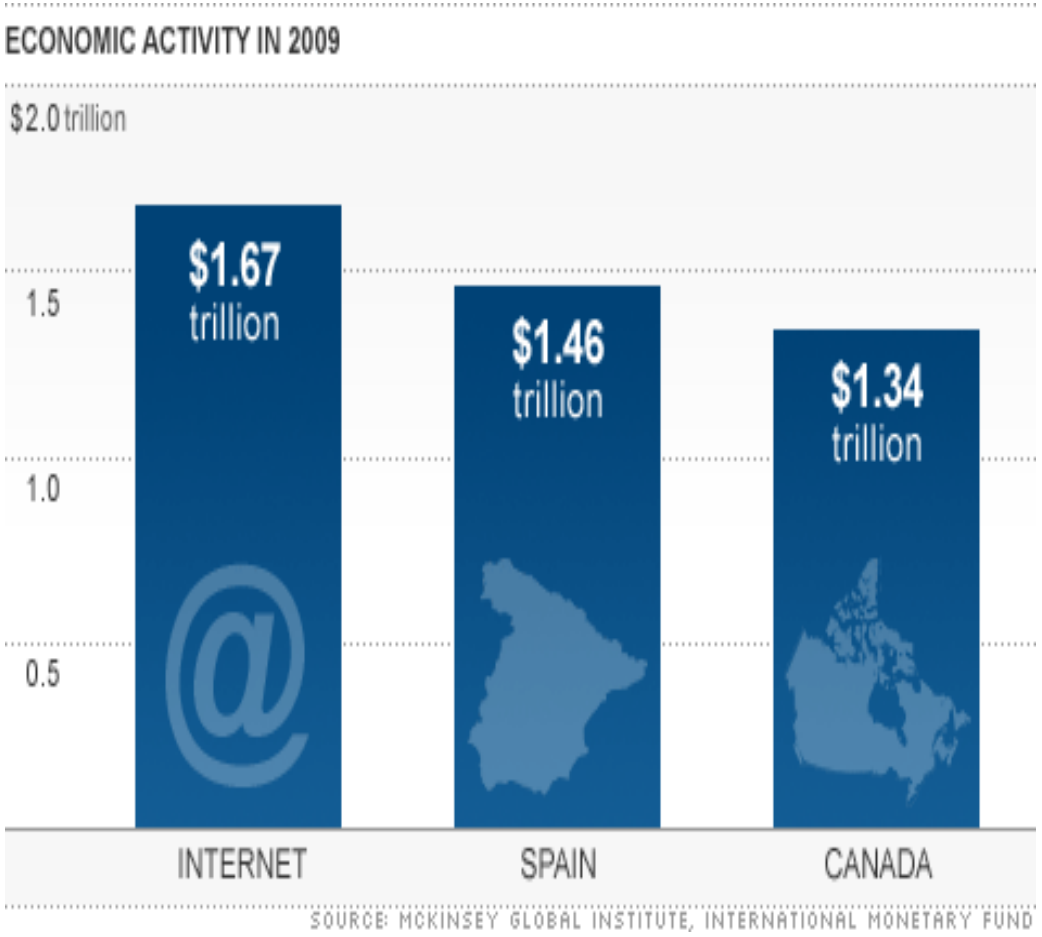
Important features for biological impacts

- …is exposure time.
- the distance between the biological parts and the radiation source.

- We have to follow the well known Greek quote “All in good measure”.
- Self Protection Principle (handsfree, no practical uses indoors or when being in motion).

Photo: https://es-ireland.com/5g-5th-generation-greater-dangers/

Economy of the Internet, its contribution to GDP of some countries (2009)



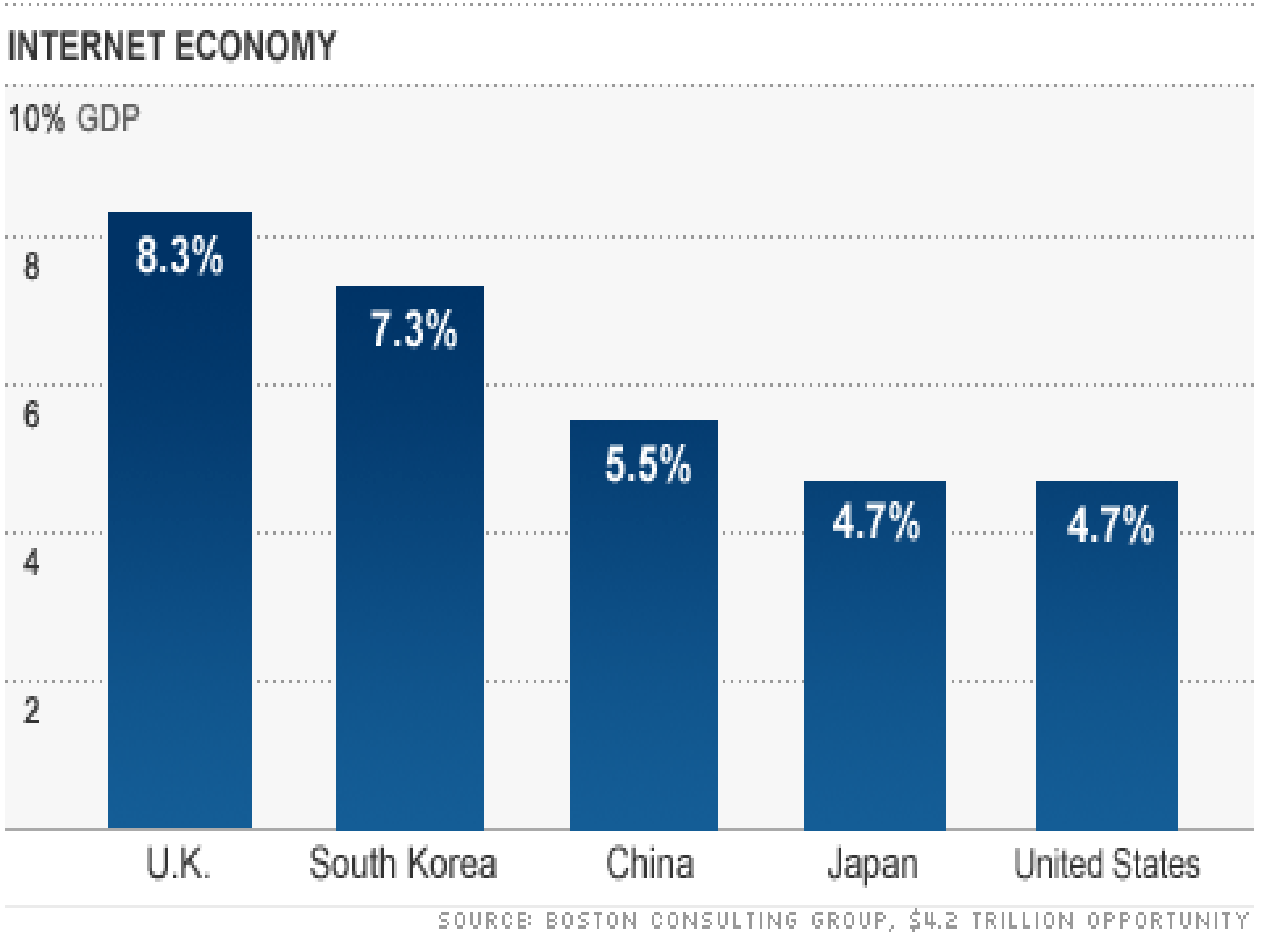
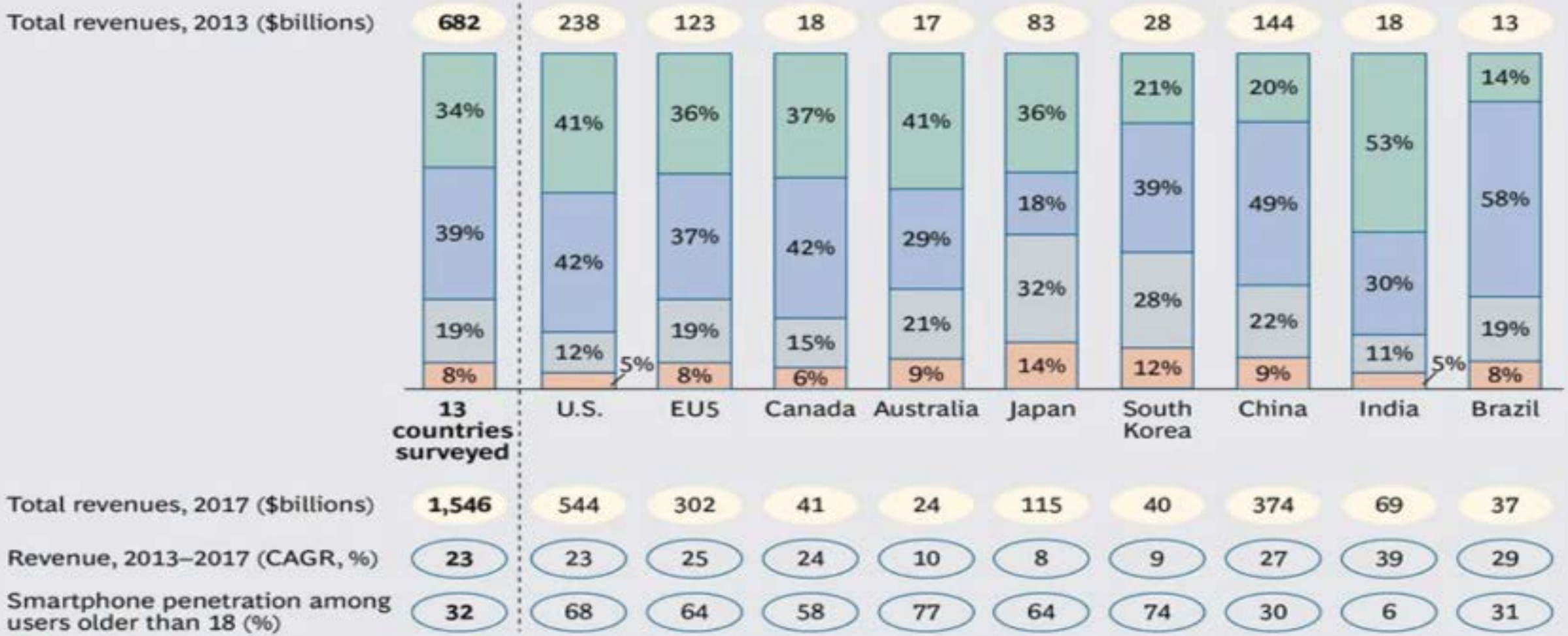


EXHIBIT 3 | The Mobile Internet Ecosystem Generated $682 Billion in Revenue in 2013



Source: BCG analysis.
Note: Because of rounding, not all percentages add up to 100.
[1]Devices include smartphones and tablets.

India is the second country globally, adopting Internet access (2019)

Exhibit E1

India is among the top two countries globally on many key dimensions of digital adoption.

India no. 1 globally

1.2b
people enrolled in the world's largest unique digital identity program

India no. 2 globally, behind China

12.3b
app downloads in 2018

1.17b
wireless phone subscribers

560m
internet subscribers

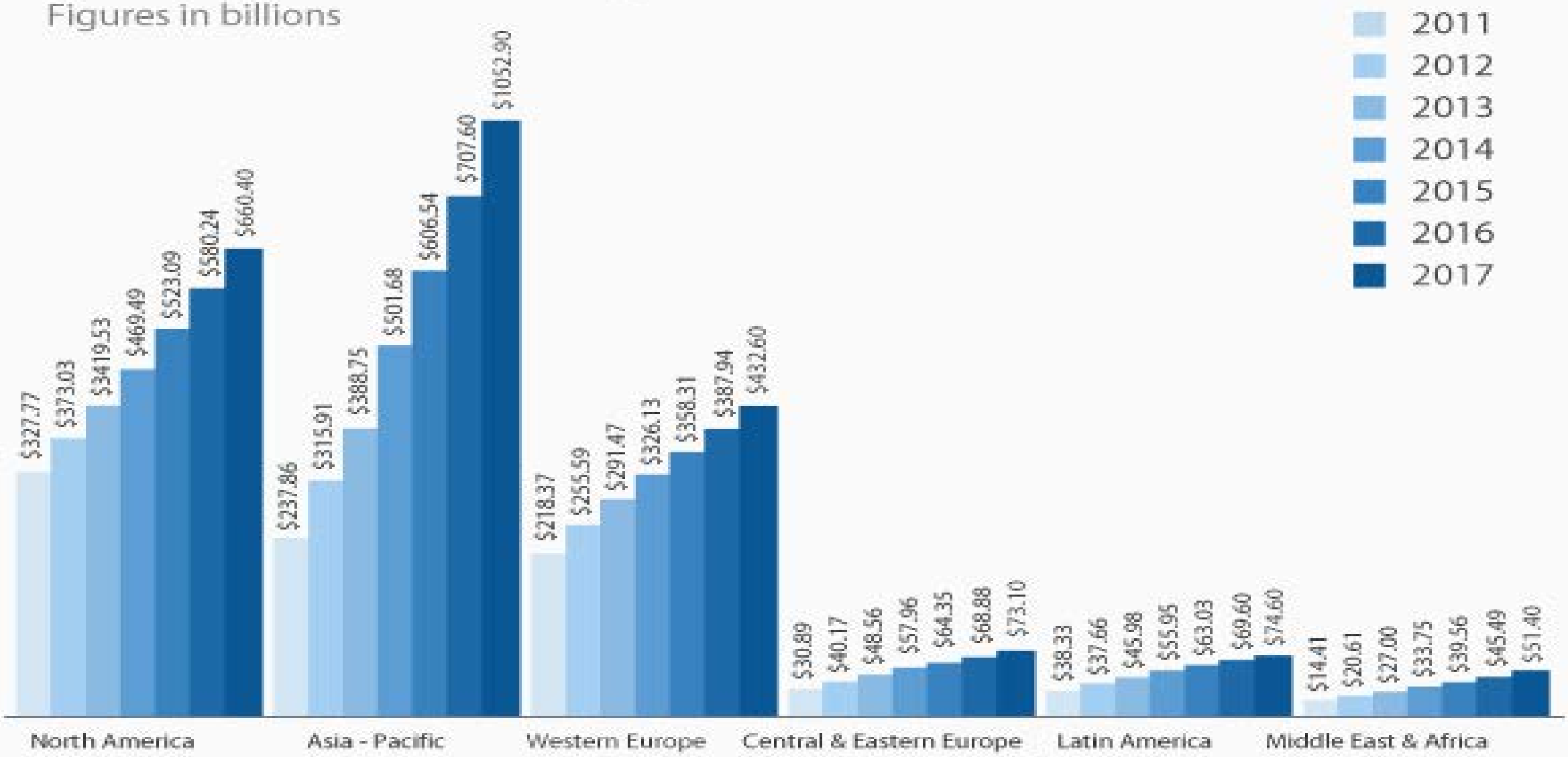
354m
smartphone devices

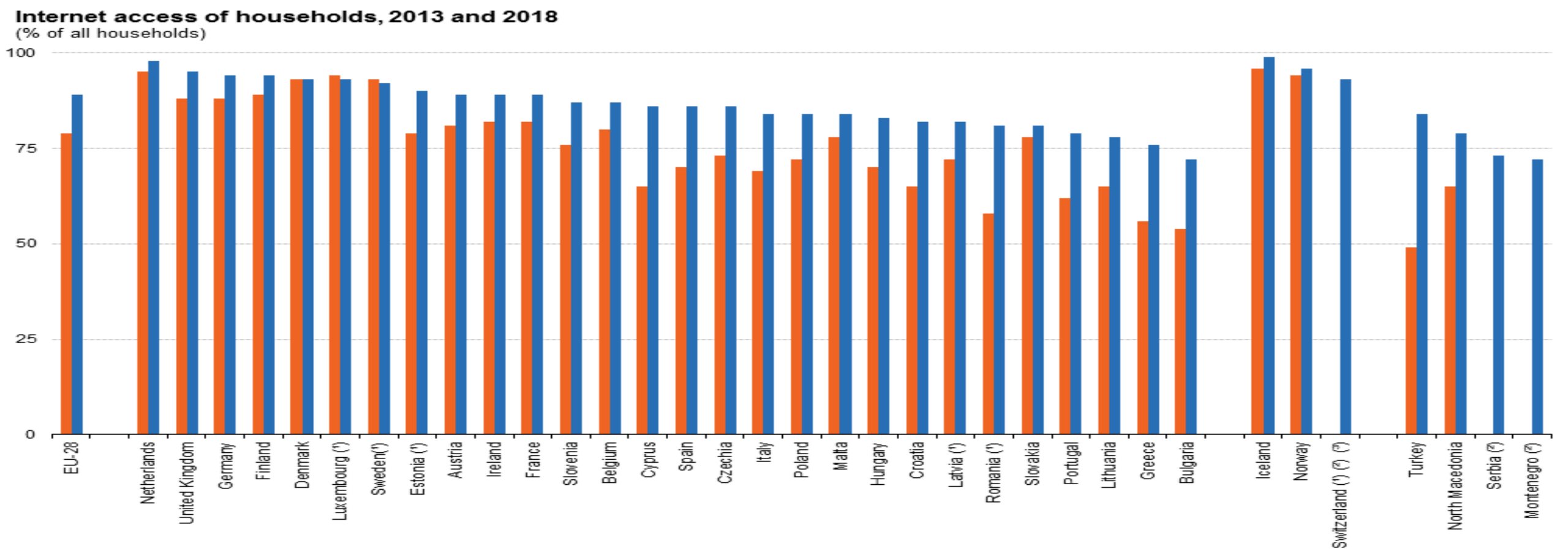
294m
users engaged in social media

SOURCE: Priori Data, January 2019; Strategy Analytics, 2018; TRAI, September 30, 2018; UIDAI, April 2018; We Are Social, January 2019; McKinsey Global Institute analysis

B2C Ecommerce sales growth, worldwide

Figures in billions



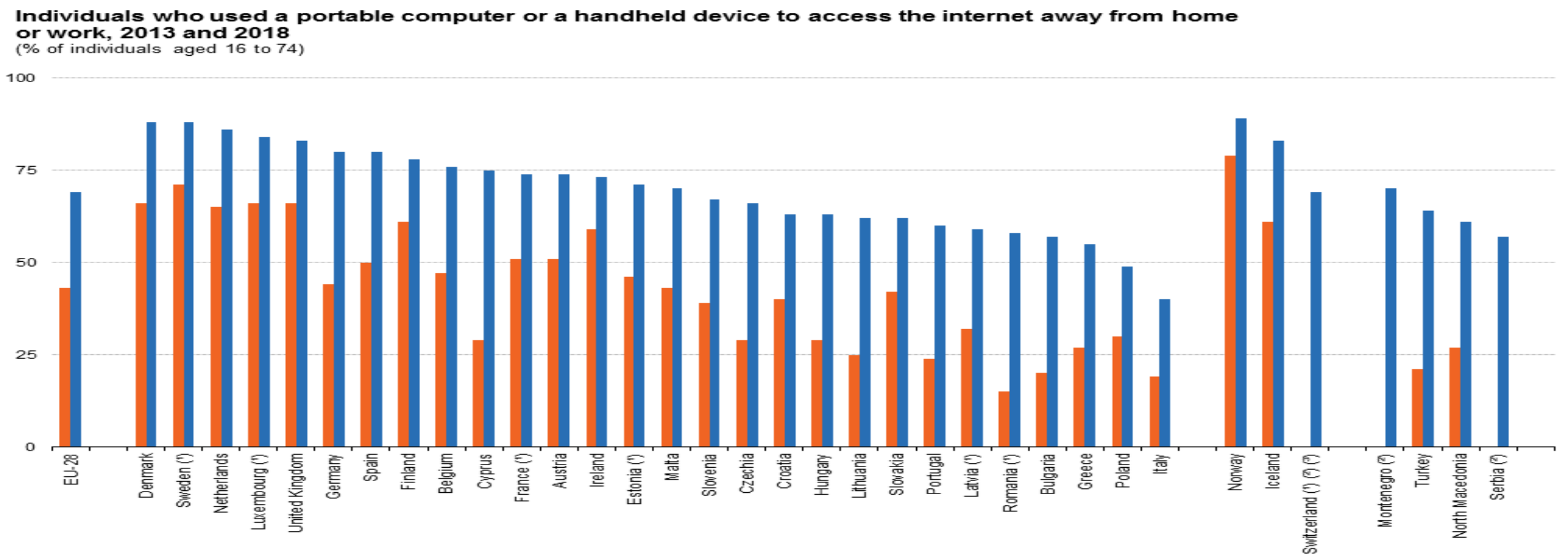


Households' Internet Access in 2013 and in 2018 in Europe

(*) Break in series.
(2) 2013: not available.
(3) 2017 instead of 2018.
Source: Eurostat (online data code: isoc_ci_in_h)

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Digital_economy_and_society_statistics_-_households_and_individuals#Internet_access

eurostat



Internet Access when being in motion (from mobile phones and public hotspots) in 2013 and in 2018 in Europe

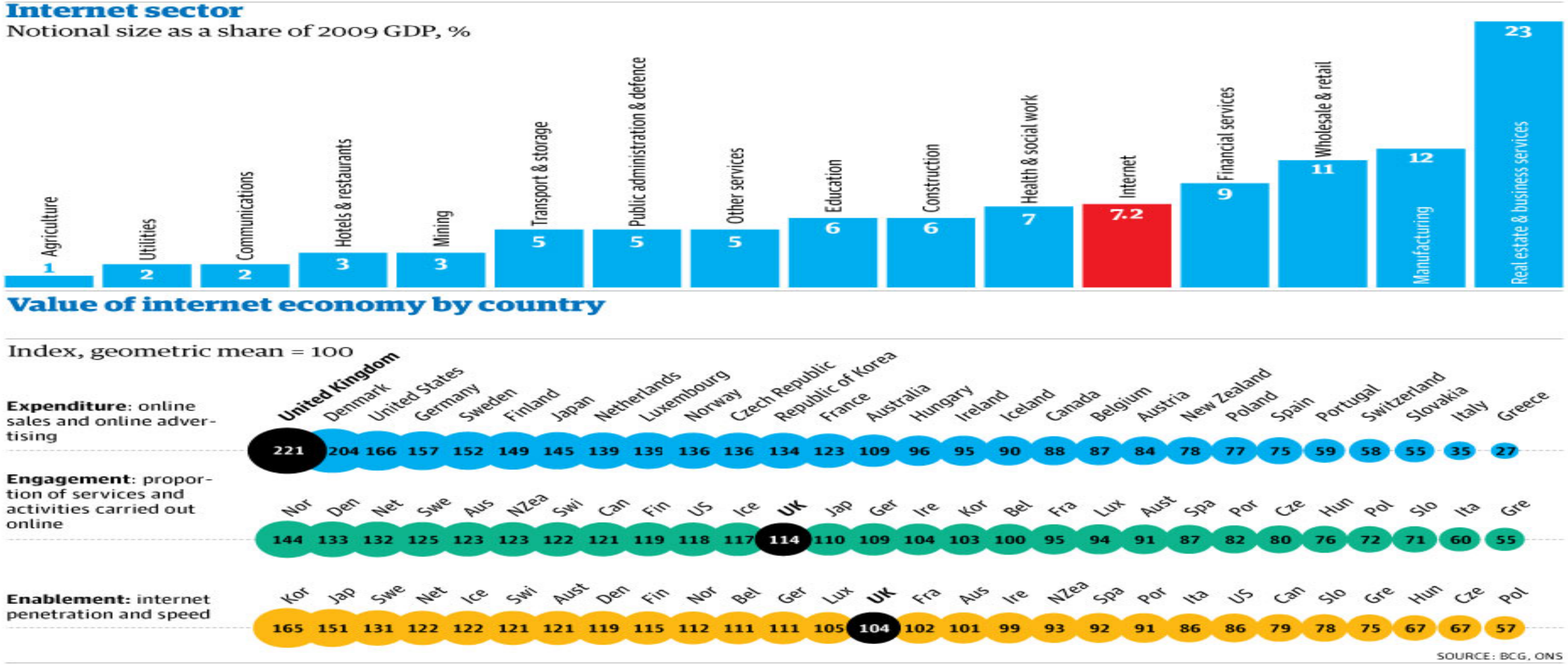
2013 2018

Note: defined as using the internet away from home or work on portable computers or handheld devices via mobile phone networks or wireless connections.
(1) Break in series.
(2) 2013: not available.
(3) 2017 instead of 2018.
Source: Eurostat (online data code: isoc_ci_im_i)

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Digital_economy_and_society_statistics_-_households_and_individuals#Internet_access

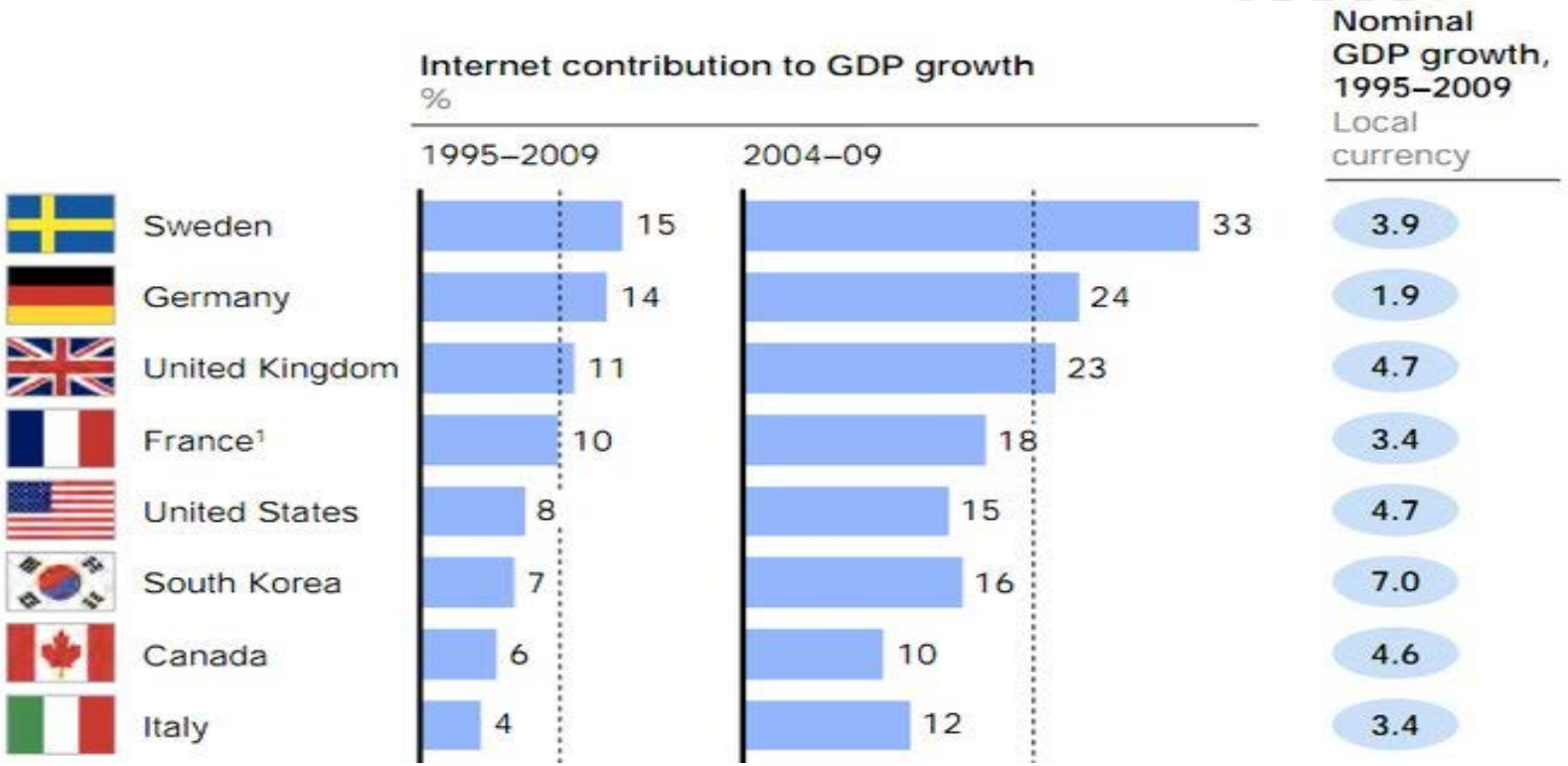
eurostat

Contribution Rate of the (field) Internet to the GDP



Contribution of Internet to GDP

Internet Access is related with the development of a country and generally it contributes to that development.

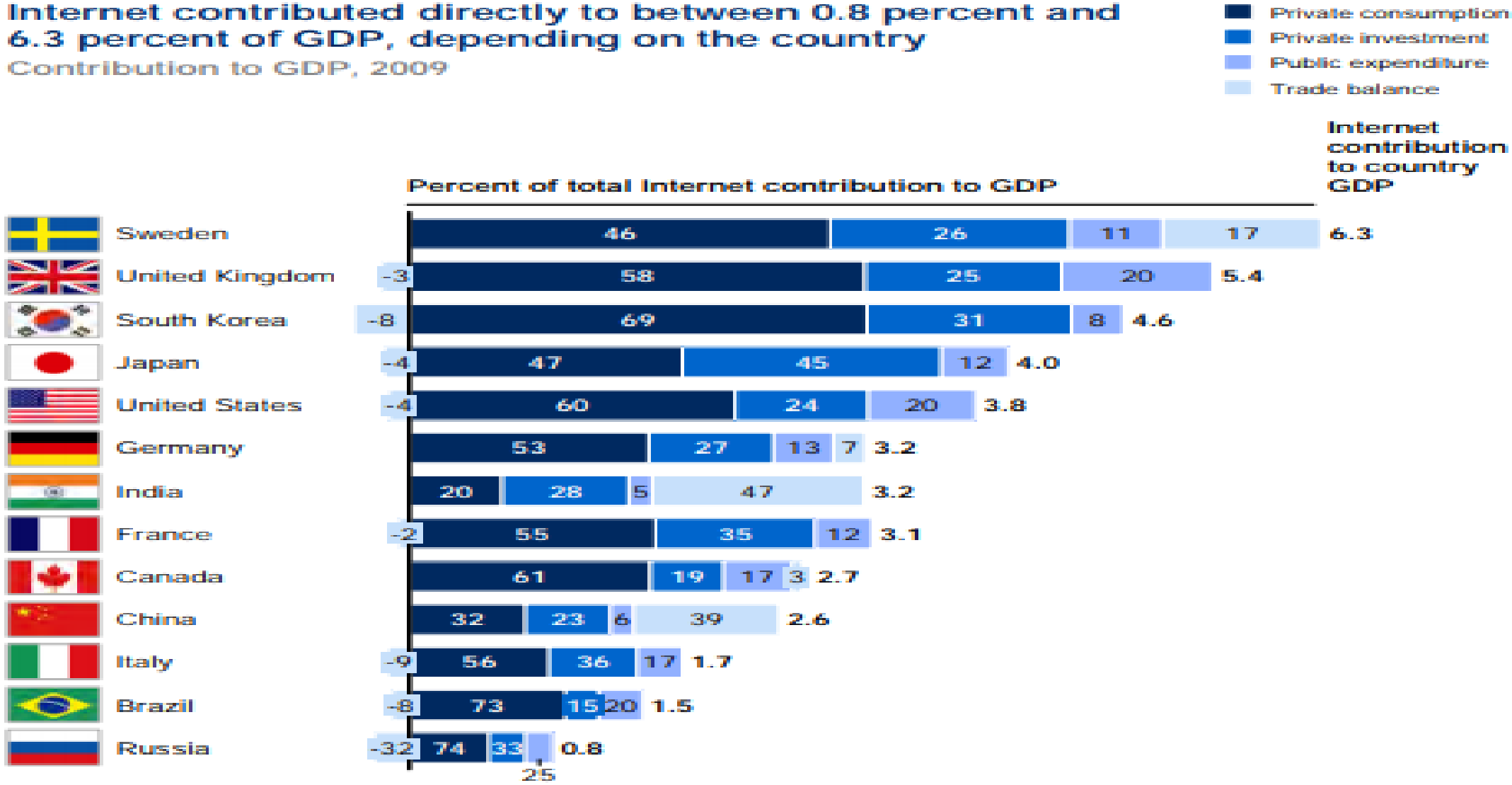


Countries with little or restrictive Internet Access have less potential of growth. So it is important to find massive and economic ways of access to the Internet for these countries.

Exhibit 4

Internet contributed directly to between 0.8 percent and 6.3 percent of GDP, depending on the country

Contribution to GDP, 2009



SOURCE: McKinsey analysis

Universality and Equality I

In 2016, UN (United Nations) declared the promotion, protection and delight of human rights for Internet users. The declaration among others:

1. confirms that users' rights must be protected when being both offline and online,
2. recognizes the worldwide and open nature of Internet as a motivational tool for development and progress in Europe,
3. invites all nations to promote and make the international cooperation easier, which aims to the development of information and communication means and
4. invites all nations to promote digital learning and make Internet Access easier.

http://www.justina.gr/%CE%BC%CE%B5%CE%BB%CE%AD%CF%84%CE%B5%CF%82-%CE%BA%CE%B1%CE%B9-%CF%83%CF%87%CF%8C%CE%BB%CE%B9%CE%B1/%CE%B1%CE%BD%CE%B8%CF%81%CF%8E%CF%80%CE%B9%CE%BD%CE%B1-%CE%B4%CE%B9%CE%BA%CE%B1%CE%B9%CF%8E%CE%BC%CE%B1%CF%84%CE%B1/h-prosvash-sto-diadiktyo-ws-themeliwdes-anthrwpino-dikaiwma/

Universality and Equality II

In 2016, UN (United Nations) declared the promotion, protection and delight of human rights of Internet users. The declaration among others:
5. invites all nations to bridge the digital gap between the two sexes and give a boost to women to use Internet more,

6. encourages all nations to take the necessary measures in order to promote Internet Access for persons with disabilities,

7. invites all nations to deal with issues concerning Internet safety,

8. condemns every human's right violation on the Internet and suggests to take measures for their prevention and confrontation and

9. convicts all measures leading to the disturbance of Internet access or preventing the transmission of information through the Internet, while it invites all nations to keep a distance and ban such measures.

http://www.justina.gr/%CE%BC%CE%B5%CE%BB%CE%AD%CF%84%CE%B5%CF%82-%CE%BA%CE%B1%CE%B9-%CF%83%CF%87%CF%8C%CE%BB%CE%B9%CE%B1/%CE%B1%CE%BD%CE%B8%CF%81%CF%8E%CF%80%CE%B9%CE%BD%CE%B1-%CE%B4%CE%B9%CE%BA%CE%B1%CE%B9%CF%8E%CE%BC%CE%B1%CF%84%CE%B1/h-prosvash-sto-diadiktyo-ws-themeliwdes-anthrwpino-dikaiwma/

Issues to be investigated…

- Research is conducted concerning the biologically safest, most affordable and socially fair way for global Internet Access…but issues are arising such as:
- Is the impact of wireless access on public health important or not?
- Should wired connection be preferred?
- Is it possible everywhere?
- Which are the difficulties concerning the expansion of Internet Access both for the developed and the “developing” countries…?

Debatable topic

The question that arises is: “Which is the most affordable and safest way of networking: the wired or the wireless Internet Access?”

Students with the aid of the appropriate informative material (structured according to the educational approach, which has been developed within the context of the European Program *Odyssey*) and in cooperation with their educators, will form, in groups, arguments in favor or against each opinion. So, the topic of the classroom debate is:

Worldwide Internet Access should be done only through <u>wireless</u> networking

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Worldwide Internet Access should be done only through wireless networking

Seminar through Internet (Web)

WEBinar

Institute of Geophysics
Polish Academy of Sciences

CENTER FOR THE PROMOTION OF SCIENCE

IRESE

ENERGIA
AVASTUSKESKUS
ENERGY DISCOVERY CENTRE

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Thank you very much…
Dimitrios I. Sotiropoulos

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Notes for the teacher from now on…

Relative Subjects

- **Physics:** 1st, 3rd Grade of Junior High School, 2nd Grade of High School
- **ICT:** 1st, 3rd Grade of Junior High School
- **Introduction to Computer Science Principles:** 2nd Grade of High School
- **Chemistry:** 3rd Grade of Junior High School
- **Biology:** 1st, 3rd Grade of Junior High School, 2nd Grade of High School
- **Geography:** 1st Grade of Junior High School,
- **Science Technology:** 2nd Grade of High School
- **Modern World-Citizen and Democracy:** 2nd Grade of High School

Relative Subjects per Class

1st Grade of Junior High School

- **Physics** (Work Paper 8)
- **ICT** (1.4, 4.12, 4.13, 4.14, 5.15)
- **Biology** (1.2)
- **Geography** (В.2.1, Г.1.6, Г.2.1, Г.2.2, Г.2.3)

3rd Grade of Junior High School

- **Physics** (6.1, 6.2, 10.1, 10.2, 10.3)
- **ICT** (3)
- **Chemistry** (Module 2, Sub-modules 5.1, 5.4, 5.5.)
- **Biology** (4.1)

Relative Subjects per Class

2nd Grade of High School

- **Physics** General Education (1.3, 4.4)
- **Introduction to Computer Science Principles** (3.3, 3.4),
- **Biology** (2.3, 4.4)
- **Science Technology (Technological Specialization:** Module 1 (pp. 6-39), 2 (pp. 22-39), 3 (pp. 40-56), 6 (pp. 121-126)
- **Modern World-Citizen and Democracy** (Modules 4 & 6)

For Instance at 2nd Grade of High School

Through **Physics** subject, students are expected:

- to describe the way of data transfer due to the use of electromagnetic radiation.

Specifically, at Analytic Studies Program (p. 19645) is referred that students should have the ability :

- to describe characteristics and qualities of photon,
- to formulate and apply the relation, which describes the energy of photon in relation with the frequency of photon or not,
- to describe the form and qualities of electromagnetic waves, formulate and apply the universal wave equation and,
- to refer to relative concepts, being essential to wired and wireless networking.

For Instance at 2nd Grade of High School

Through the **Introduction to Computer Science Principles** subject, students will become familiar with aspects, related to network technology (ASP, p. 17).

Specifically, students are expected to:

- organize in a conceptual model basic topics concerning communication and artificial intelligence networks and realize the dimensions of the 4th industrial revolution.

For Instance at 2nd Grade of High School

In the subject of Biology, students will come to know about the function of the cell.

More specifically, they are expected:

- to formulate, briefly, the cell theory and further,
- to refer to the impacts that radiation has on cells and correlate it with mutations.

Moreover, they are expected:

- to name factors, which can cause mutations, and to discern the impact that radiation has on cells.

For Instance at 2nd Grade of High School

Through **Modern World-Citizen and Democracy** in Modules 4 & 6 students are expected:

- to explain the phenomenon of population's diversity,
- to correlate various characteristics of population with each other,
- to be concerned about inequalities, which directly or indirectly arise and
- to find the reasons and consequences of globalization in its economic, political, social and cultural dimension (Book pg 125).

Finally, the modern world and the social institutions have to be examined. So, students are expected to refer to the correlation between the society and its institutions and to describe the function of democracy when important issues arise, such as that of the Internet's global expansion, considering that Internet is mainly a democratic communication means.

The issue of wired or wireless networking…

is related to aspects, phenomena, relations and mechanisms, included in school objects' modules, which have been referred above.

Therefore, they are included in the cognitive goals of the analytical studies program and the instructions, being additionally announced every year at schools.

At the same time, the educational material…

… which will be given to teachers and students, will expand their cognitive field in relation to the existing goals of the analytic studies program, while it will add new knowledge, relative to the cognitive sub-categories of the lesson, which refers to the issue of worldwide networking.

For example, students should…

- realize potential impacts on health and environment in each case of networking, especially, due to the new data transferring technologies (5G).
- Correlate the universal economic and social development to the worldwide expansion of the Internet and
- to be concerned about the growth of the fleets of low orbit-satellites and about the dimensions of the 4th Industrial Revolution, which are relative to Internet's technology.

The Educational Guide…

…being integrated in formal education, suggests a scientific approach to the cognitive object of Networking Access.

Through the theme activities which are suggested and the educational material which will be given, students will get to know the main dimensions of the issue, the potential impacts on the natural environment and on human health arising from the different ways of accessing the Internet. They will also get to know probable social and economic effects with developing potential which will be achieved by the universal access to the Internet through wired or/and wireless networking.

Through the procedure that includes the debate…

… students will develop skills such as:

- Communication skills (speaking, listening, reading, writing, debating, dialogue etc.),
- Cooperation skills in team projects.

As it has already been pointed out, the given material will include for the 3 hours lesson…

- Lesson Plan
- Work Papers for Students
- Work Papers for the teacher (same as those of the students but they will be indicatively filled in)
- Presentation / Multimedia and lessons organization
- More reference material.

With the given material and the teachers' guidance…

- Students, being in groups, will form arguments in favor or against one or the other point of view (after their 3-hour examination of the topic).
- Then, they will have a "debate" with their classmates at the last hour supporting their arguments and trying to refute the arguments of the opposite team.

Additional Remarks

- It should be clear that the units which are suggested include meanings, phenomena and relations or mechanisms which potentially could be related to the present educational material. This correlation will be achieved by the teachers. In this way, the necessary connection with the existing goals of the Curriculum concerning these subjects will be realized even indirectly. In some (extremely few) cases, the suggested units are not part of the Curriculum (for this year). Despite it, these units are appropriate for the needs of the specific educational guide.
- For the students of the 3rd Grade of Junior High School and the 2nd Grade of High School, the educational Guide could be implemented during the hours of school activities or the hours of innovative, creative projects. It could be implemented as well within students' clubs and, undoubtedly, it can enrich and expand the teaching of the pre-mentioned subjects.
- Finally, at the platform "Digital School", the subject of 'Communication Technology' can support the existing package explaining technical terms, related to "networking" (e.g. communication systems, Internet, Internet access etc.).

Sources from the Web

- *Existing Analytic Studies Programs-Uniform Theme Studies Programs Plan. General Part per Subject http://ebooks.edu.gr/new/ps.php*
- *Instructions for ICT for Junior High School https://www.alfavita.gr/sites/default/files/2019-09/6.pdf*
- *Instructions for Natural Sciences For Junior High School https://www.alfavita.gr/sites/default/files/2019 09/7.pdf*
- *Instructions for ICT for High School https://www.esos.gr/sites/default/files/articles-legacy/-_143633_-_2019_-_odigies_pliroforiki_a_v_gel_2019_20_v_v_130254.pdf*
- *Instructions for Natural Sciences For High School https://www.esos.gr/sites/default/files/articles-legacy/exe-143685-2019-odigies-fysikes-epist-a_v-gel-viii_130254.pdf*
- *Modern World-Citizen %Democracy http://2lyk-kerats.att.sch.gr/Ylh_2019/Politis_Dimokratia_B.pdf*

„ Internet Access and Development”

Teacher’s Material

With methodological guidelines, a lesson plan and an answer key to worksheets

The educational package: "Internet Access and Development" was developed within "Oxford Debates for Youths in Science education" project.

It is a key material, facilitating the achievement of primary project's goals, including developing reasoning skills and interest in STEM education. Such a turn is important for students, as it can lead them to a successful scientific career in the future.

When preparing students for the debate, one should not neglect the development of such skills as: communication excellence, argumentation or public speaking. Students should improve their ability to persuade effectively, argue properly, reason accordingly and speak out correctly. Composition of texts, using rhetorical means in oral statements, speaking in accordance with the rules of language culture, text interpretation, public speaking and presentation of texts, discussions and negotiations are of equally high importance.

In order to achieve the abovementioned goals, the implementation of thematic educational packages should be preceded by classes dedicated to preparation for debating as such. This can be accomplished in consultation with teachers of other subjects and the class teacher. The development of basic communication skills can be included in the class teacher's work plan, and the prepared lesson plans can be used during regular classes. Auxiliary materials can be found in the following documents:

1. **Warm up practice** – Annex No 2 to:
   National Frameworks for implementation of Oxford debates in STEM in school practice. This document includes the following exercises: active listening, public speaking and debating skills.

2. **Lesson plans aimed at general development of debating skills** – Annex No 2 to:
   National Frameworks for implemantation of Oxford debates in STEM in school practice. This material consists of 7 lesson plans prepared by Dr. Foteini Englezou, president of the Hellenic Institute for Rhetorical and Communication Research. Scenarios are a guide to work. It is not necessary to follow all the lessons. The teacher can decide which scenarios (or their selected fragments) are most useful for working with a specific group of students. The document offers the following lesson plans:

   1. Communication skills
   2. Express your scientific argument, not your opinion
   3. Build a valid scientific argument
   4. Searching for evidence
   5. Enhancing students’ linguistic skills
   6. Rebuttal and refutation
   7. Fallacies

3. Methodological Guide for Teachers. ODYSSEY: Oxford Debates for Youths in Science Education
   The final stage of preparation for debates based on specific packages is to familiarize students with the principles of debating, described in detail in the abovementioned document.

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Internet Access and Development

The "Internet Access and Development" educational package consists of the following elements:

- Multimedia presentation;
- Video- recording based on the presentation;

https://www.youtube.com/watch?v=mld5cn4wFtw&feature=youtu.be

- Educational package "Internet Access and Development" - material for students;
- Worksheets (the same for all packages);
- "Internet Access and Development" - material for the teacher (with answer key)

It is recommended to implement the package during a minimum of three lesson units.

At the dawn of the 21st century, a wave of technological applications and developments in various fields (Informatics, Artificial Intelligence, Photonics, Nanotechnology, Biotechnology, Robotics, etc.) is observed, which is described by many as the 4th Industrial Revolution. The Internet and technological applications related to Informatics dominate in this wave. One could say, for sure, that the catalyst for this revolution is the internet and that, depending on the extent of its penetration into societies, the extent of change in societies around the world also arises. In this so-called 4th Industrial Revolution, the aim is to be universal, that is, to involve actively countries that are currently characterized as "developing countries" and, in general, we could claim that they are behind (in relation to many others) in the field of use and utilization of Internet technology. This increase in the global use of the internet (participation of more users, use of new applications for information, communication and entertainment), increases geometrically the needs for a wider and faster internet, as well. So the question arises as to what the most convenient and safest way for networking is; wireless or wired access is the answer?
Having a vision for the future and aiming to the active participation of all European countries in the global educational process, it is recommended that students be aware and able to deal effectively with the issue of Internet development, which is one of the most important dimensions of the 4th Industrial Revolution. This educational guide "Internet Access and Development" includes a series of activities, which provide the opportunity to enrich the knowledge of students on how to access the Internet. It also allows students to formulate arguments for the safest way to access the Internet.

The debate concerning the following topic: "Global Internet access should be done only through wireless networking" can take place during thematic activities related to the courses of Physics and Biology Informatics but also to the elective course: Modern World - Citizen and Democracy. The level of material provided is aimed mainly to high school students.

Lesson 1: Internet Access and Development. What is the most convenient and safest way for networking? Implementations of wireless or wired Internet access?

With the help of the supervisory material (as the case may be) of the educational guide **"Internet Access and Development"**, students are expected to:

- focus on the rapid global development of networks (wireless and wired), the needs for the expansion of these networks and the difficulties in their global expansion,
- understand the potential impact on health and the environment in each case of networking, especially when it comes to the new data transmission (5G) technologies,
- relate the universal, economic and social development to the global expansion of the Internet,
- concern about the development of the low-orbit satellite fleets and the dimensions of the 4th Industrial Revolution, related to the Internet information technology.

Lesson 2: „Global Internet Access should be done only through wireless networking" - constructing arguments for and against the resolution

The aim of the second lesson is to formulate as many arguments as possible (both for and against the resolution) that will be used by students during the debate, summarizing the work with the educational package.

Lesson Plan

1. Organizational issues, checking the attendance list, familiarizing with the topic and objectives of the lesson **[5 minutes]**.
2. Preparation of arguments: The teacher divides the class into teams of two. Each team receives **18 question cards** available in the educational package (materials for the student) and 2 copies of worksheet No. 1 (one for each student individually). Based on the questions, students formulate arguments for the presented thesis, against the thesis and those that are debatable and can be used in the discussion by both parties. Students work together, but each student individually completes his/her worksheet. There are examples of selected arguments for worksheet 1 are in the answer key **[25 minutes].**
3. Teams: proposition and opposition are formed **[10 minutes]**.

   Team selection may be executed in 2 forms, each of them having both advantages and disadvantages.

   a) Students declare which arguments are closer to their beliefs. The teacher divides the class into teams (each with a similar number of students) in the manner reflecting their convictions.

   b) The second method assumes a division similar to the one above, with the difference that ultimately the team consisting of the supporters of a given resolution becomes the "opposition" team, while the opponents of the thesis become “proposition” team. The supporters of such a division assume that it teaches the participants of the debate to a greater extent to use arguments supported by facts, and is less based on emotions. Alternatively, division into teams can also be done randomly.

   Finally, team selection can also be made by the teacher in a subjective way, ensuring that each team has both leaders and students who require more help, so that both teams have similar “winning potential”. In order to save time for division, the teacher can do it at the beginning of the lesson, for example by distributing worksheets number 1 to the students, printed on sheets of different colour or marked in some other manner.
4. The teacher distributes worksheets number 2 to the students (one for each student) and explains the homework. An example of a filled out worksheet is available in the answer key.
5. Students in each team read prepared arguments in accordance with the assignment to a given group. Each student receives 1 argument, which he/she will develop (as homework) according to the guidelines in worksheet No.2.
6. Each team also appoints 3 people who will present the arguments prepared by the entire group. Students decide the order of their speeches. During the debate, other team members who are not directly involved in the debate fill out worksheet.
7. Summary of the lesson, evaluation of students' work **[5 minutes]**.

During the final lesson, the teams conduct a debate according to the guidelines contained in the "Methodological Guide for Teachers. ODYSSEY: Oxford Debates for Youths in Science Education". (https://odyssey.igf.edu.pl/wp-content/uploads/2019/11/%CE%9F4-IN-ENGLISH.pdf). It takes 45 minutes in total to conduct a full debate. During the debate, the teacher does not comment on the arguments or indicate the fallacies made by the students on an ongoing basis.

An exercise-based debate should be structured as follows:

1. Opening of the debate by the moderator/chairperson [3 minutes].
2. Initial vote by the audience [2 minutes].
3. 1st Researcher-Debater of the A research-team: Constructive Speech [4 minutes].
4. 1st Researcher-Debater of the B research-team: Constructive Speech [4 minutes].
5. Cross-fire between the researchers-debaters (1) of both research teams [3 minutes].
6. 2nd Researcher-Debater of the A research-team: Rebuttal Speech [4 minutes].
7. 2nd Researcher-Debater of the B research-team: Rebuttal Speech [4 minutes]
8. Cross-fire between the researchers-debaters (2) of both research teams [3 minutes].
9. Preparation time for the Summary and Final Rebuttal by both research teams [2 minutes].
10. 3rd Researcher-Debater of the A research-team: Summary Rebuttal [2 minutes].
11. 3rd Researcher-Debater of the B research-team: Summary Rebuttal [2 minutes].
12. Grand Cross-fire between the researchers-debaters (1 & 2) of both research-teams [3 minutes].
13. 3rd Researcher-Debater of the A research-team: Final Focus Rebuttal [2 minutes].
14. 3rd Researcher-Debater of the B research-team: Final Focus Rebuttal [2 minutes].
15. Final vote by the audience / Short written feedback [3 minutes].
16. Presentation of the results by the moderator [2 minutes].

If the debate takes place during extra-curricular activities, then it is recommended to devote, for example, 90 minutes for this part. This will allow you to prepare the room for the debate, recall the rules, conduct the debate and discuss its course and finally evaluate the work of students.

In terms of classroom conditions, it would be ideal to allocate two adjoining lesson units to the debate. Taking into account the school circumstances, organizational difficulties and the inability to devote too many lessons to content extending the core curriculum, the debate can be conducted in one lesson, while maintaining high discipline in time. In this case, it is recommended that during the next lesson with the class additional 10 minutes are spent discussing the debate, pointing to strengths and mistakes made by the participants of the debate.

In this format, 6 students (3 from each team) actively participate in the debate. The teacher may also appoint a moderator from among the students and a time keeper.

The rest of the students will receive worksheet number 3. Their task will be to listen carefully to the debate and to note the opposing team's strengths and areas for improvement, and to justify their choice. Completed worksheet no. 3 may be the basis for issuing a grade for activity in the lesson for students who did not take part in the debate directly, but participated in its preparation and were active observers of its course.

Worksheet No 1

The educational package contains a set of questions to help prepare arguments for discussion on the resolution. On their basis, prepare a set of arguments and group them into those that are clearly in favor of the resolution, against the thesis, and those arguments that can be used by both teams. Write them down in the appropriate parts of the table.

FOR	"GREY AREA"	AGAINST
What are the main advantages of wireless Internet access? The fast speed and significant data range, the contribution to economic growth through its easier spread (installation of the components necessary for the interconnection), and the support of new technologies (IoT, Big Data Analytics, A.I). **(IC: 3,4,6,7,8,10,11,12,14,15,17 – SC: 4,6,7,8,9)** **What are the disadvantages of wired Internet access?** The main disadvantages are (as the case may be) the high cost for extending and installing new cables (e.g. fiber optics to the house), the damage due to humidity and engineering strains and the fact that it cannot cover the emerging need for new features that are constantly evolving, such as the Internet of Things (IoT). **(IC: 2,5,16,17 – SC: 8,9)** **What are the advantages of satellite Internet access?** Main advantages are low charges, as the cost of communication is independent of the distance to the endpoints and easy access to communication from remote areas or areas that have experienced an emergency. **(IC: 7 – SC: 4,6)**	**When was the internet created? Since its inception, how many people have access to it and its services?** The technology of the Internet was created in 1985, whereas what we call the World Wide Web (WWW) in 1993. Despite the technological advancement, access has less than 50% of the world's population. However, this access is constantly increasing. Of course, as everything related with economic development differs from continent to continent. **(IC: 1 – SC: 1)** **How can Internet access be achieved?** Wired (cables, fiber optics) and/or wireless (WLAN, with satellite). Each way finds application depending on the requirements of the user. **(IC: 2,3,4,5,6,7,16 – SC: 5,6)** **Is there unobstructed Internet access (infrastructure and services) for the global population?** Despite technological advances, access to internet services has about 50% of the world's population. There is no infrastructure (neither wired nor wireless), so that in the	**What are the main disadvantages of wireless Internet access?** Possible Radio Signals interferences (from other radio signals), some potential issues concerning the protection of users' health and network security. **(IC: 3,4,6,7,8,10,11,12,14,15,17 – SC: 4,6,7,8,9)** **What are the benefits of wired Internet access?** The main advantages are the simple construction, the possibility of cable shielding - both from strains and other electromagnetic fields – and its minimal effects on human health. **(IC: 2,5,16,17 – SC: 8,9)** **What are the disadvantages of satellite Internet access?** The main disadvantages are the long delay

Who sets the "safe limits" for exposure to electromagnetic radiation? Are there "normal values" for the limits?

In Greece, EETT is responsible for the values, internationally ICNIRP is responsible. Levels in nature are less than 0.000001 mW / m^2. Also, other parameters play a big role in the overall radiation being absorbed and therefore in the final exposure limits. In fact, in Greece limits have been adopted that correspond to 60% to 70% of the limits set by ICNIRP. **(IC: 8,9,10,11,13,14,15 - SC: 1)**

Which applications are in progress and need fast and wide internet?

The Internet of Things, artificial intelligence (A.I.), and big data analytics (Bdata A) technologies that will improve the lives of citizens and help global economic growth. **(IC: 14,17 – SC: 8)**

Can IoT be developed without wireless Internet access?

No, it is impossible by nature, since it presupposes the wireless connection of the devices to the internet. **(IC: 17 – SC: 8)**

What is satellite Internet?

It is accessible via low-orbit satellites. It differs from the existing satellite Internet which relies on higher orbit satellites. It is under development and aims to provide Internet everywhere on Earth. **(IC: 7 – SC: 4,6)**

short term a significantly larger percentage of the population has access to Internet services.
(IC: 1 – SC: 1,4,5,6)

Will wireless Internet contribute to economic growth more than wired?

The contribution of the Internet to the global economy is significant. In fact, there are indications that societies with already developed economies will benefit from strengthening / expanding the use of the Internet in various sectors. Based on that, applications using the Internet will boost the economy. Whether wireless or wired access modes are selected for the connection, varies depending on the application being used. The applications of companies (with a large financial footprint in the economy), for example, will probably continue for a long time to use wired networking as a way to access the Internet. In fact, perhaps due to the development of artificial intelligence and IoT technology, jobs performed by humans today will be lost and they will be performed by robots in the future. On the other hand, everyday applications will be enhanced through wireless access and the new technologies (IoT, BDA) will strengthen the economy by offering new employment opportunities. Therefore, the answer to this question depends on many factors and therefore it is difficult to answer having a one-track mind. **(IC: 4,5,6,16,17 – SC: 4,7,8,9,10)**

Will a global Internet through low-orbit satellites alleviate social inequalities?

Like any new technological approach to Internet access, initially, it needs a period of normalization and economic adjustment. Potentially supporting users in even the most remote areas can alleviate social inequalities, since broad access to the internet and its services can help people in many different ways to live better and more creatively. Of

of signal propagation (as there is simultaneous transmission at multiple points) and the fact that the signal can be affected by the state of the earth's atmosphere. **(IC: 7 – SC: 4,6)**

Can the "safe limits" of exposure to electromagnetic radiation, proposed by scientific organizations, finally be exceeded?

There are some factors that can cause 'excessive' exposure. Multiple wireless Internet hotspots and mobile antennas are two of them. At this point special attention should be paid to the exposure of children to electromagnetic radiation. So, it is good that they are not exceeded and that relevant measures are taken towards it. **(IC: 8,9,10,11,13,14,15 – SC: 1)**

Do the electromagnetic fields of wireless information transmission networks ultimately have (have been recorded and scientifically proven) biological effects on humans?

Until now, scientists have only confirmed thermal effects but at the same time research are being conducted to generalize the results (in vivo) of experiments.
(IC: 8,9,10,11,13,14,15 – SC: 1)

	course this is under investigation and depends on the case and region. **(IC: 1,7 – SC: 4,6)**	

Worksheet No 2

Based on the materials provided by the teacher, prepare arguments for discussion. One group of students prepares arguments supporting the resolution, the other one - opposing arguments. Use the proposed template.

ARGUMENT No 1:

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
Internet connections must be wireless everywhere. **Fears – or better myths – about the harm of non-ionizing radiation** are deprived of scientific base, since only biological, thermal impacts have been proved for human organizations, which don't have any meaningful health problem. **(IC 10,11,12)**	We disagree, networking and connections must be wired, since **the permitted limits can be overlooked**, if for instance there is simultaneous exposure to multiple radiation sources. Furthermore, the different radiation absorption rate from adults and children is not taken into account during researches. **(IC 12,15)** We disagree, networking and connections must be wired, since there are studies going on, which have discovered a lot of new findings, except for the thermal impacts of the non-ionising radiation. Maybe it is important that they are taken into consideration for the protection of public health. **(IC 10,16)** Especially for 5G technology, all data haven't been studied yet and perhaps most antennas generate problems concerning the total radiation at which people are exposed. **(IC 13)**	If there is correct adjustment of the **antennas**, not only will not there be danger exceeding the limits (even the Greek strict limits) but also the supply of a quality signal won't lead to bad functioning of the device. Moreover, we remind the "Inverse Square Law" of distance, where for example in a 100m distance from the radiation source, the power weakens by 10.000 times in relation to the power generating in 1m distance from the source. **(IC 12,15)** Science is something "living" and it is fed by long-term experimental studies and researches. At each case, for those worrying, the limits are in compliance with the **Protection Principle.** According to this, it is suggested for example to avoid Internet's use in indoor places (elevators, underground etc.), to use hands free accessories when they talk on the phone and to discourage children to use mobile phones. **(IC 10,11)** Especially, 5G technology can potentially help decrease the radiation finally absorbed by a user. This is possible thanks to better management of the radiation emitted and the frequency, which 5G technology uses. (**IC 12,14,15)** **Also: (See Presentation Material - IC 8,9,13 – SC 1)**

ARGUMENT No 2:

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
Wireless connection can offer on the whole wider Internet Access and of course higher speeds, giving the opportunity of accessing information everywhere, even when in motion (in public means of transportation). The above have increase in work efficiency and generally increase in economic growth as a result. **(IC 17, - SC 2)**	On the contrary, cables offer better quality in connections than wireless ways, because they are stable and they are not affected by weather conditions and the geography of the area. The development of wired fiber optics networks offering high speeds for accessing the Internet is not significantly expensive. There is really sufficient, simple, low-priced and for various applications technical knowledge for the development of wired networks. **(IC 5, 16 - SC 9)** Especially, fiber to the home (FTTH) for accessing the Internet can give the chance for higher speeds and data broadbands to be developed than wireless networking. (**IC 16)**	However, many companies **have old, wired Internet connections, which entail low speeds,** due to the oldness of the wired network (**decrease in effectiveness**). **Updating a wired network and its devices is always more difficult and costly**. And that's because other costs are included to an update (streets, services to others etc). Upgrading a wireless network has small cost for the consumer (modem + software). **(IC 2,4,5,6)** Installing wired networking connections from the beginning is more expensive and time-consuming for remote and developing areas and for this reason these regions can decelerate the social and economic growth, if there is delay in mass Internet access. Satellite connection can constitute a solution to this problem. **(SC 5, 6)**

ARGUMENT No 3:

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
There will be better life, socially fairer, with equal chances for more people in the world through the support of the technologies being in evolution, such as Internet of Things, Big Data Analytics, Artificial Intelligence and through satellite connection. **(SC 2)**	Wired Access can support the new, coming technologies with safety, contributing to economic development. Wireless networking is not necessary. **(SC 9)** **Wireless networks have significant disadvantages** (such as difficulty in connection) in contrast to wired networks, while in satellite applications, problems can arise due to weather phenomena. **(IC 15, 16)** Living is not more socially fair, only because there is access to the Internet and its services. **(SC 3,4)** The development of Artificial Intelligence will be boost by wireless Access to the Internet, will bring at the forefront robots which may steal jobs from employees. **(SC 10)**	Internet of Things, Big Data Analytics and other technologies, which will help the economic and social –for the majority- growth, can be served only by wireless Internet connections. **(IC 4,17)** We disagree, since wireless applications of transferring data are technologically mature to offer both "Earth" and "Space" applications **covering the total population and having very good signal quality**. **(IC 7)** Satellite Internet (way of wireless networking as well) can make Access to the Internet a reality internationally, covering areas which are impossible to cover today. **(IC 7 - SC 5,.6)** Access to the Internet could pull 7% of the global population off the levels of absolute poverty and according to Organization of United Nations (UN), access to it can be mainspring for development and progress. Organization of United Nations invites all nations to promote and make easier the international collaboration, aiming to the development of information means and to communication through Internet. **(IC 1 - SC 1,2,5,6)** Artificial Intelligence will finally support employees and will create new work positions. **(SC 8)**

Worksheet No 3

Name and surname:..... **Class**..... **Team: Proposition/Opposition**

During the debate, hear and observe carefully the speeches of the debates from the other team. Then, evaluate which speech convinced you the most and which areas of your opponents' speech should be improved.

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1. In terms of **argumentation (**e.g. the quality of the arguments presented, credibility of the data and scientific evidence) in the rival team I was most convinced by the speaker No. .....

Reason:

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2. In terms of **the style of presentation and communication with the audience** (e.g. confident, persuasive, authentic and dynamic posture, moderate gestures, assertive voice variety, good eye contact with the audience, use of moderate humor, friendly and professional approach to all participants, effective use of body language) in the rival team I was most convinced by the speaker No. .....

Reason:

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Indicate the element of the rival team's performance that requires improvement. Justify your answer.

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Reason:

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