

Technological Advances and Electromagnetic Pollution

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In recent times, the level of electromagnetic pollution is seen to increase due to technological advances. Radio and TV broadcasting towers, cellular towers, microwave transmission links, bluetooth devices, WiFi routers and electronic devices such as smartphones, tablets, microwave ovens act as electromagnetic pollution sources. Since the usage of electromagnetic pollution sources has increased, health concerns have also been raised. An electromagnetic field above a certain level may cause biological effects on the human body, and may lead to health implications. In response to these concerns, several organizations, including the World Health Organization, (WHO) the International Commission

on Non-Ionizing Radiation Protection (ICNIRP), the British Health Protection Agency, and the International Agency for Research on Cancer have been studying the health effects of electromagnetic pollution over the last two decades. This article investigates how electromagnetic pollution is seen to increase due to technological advances.

Electromagnetic radiation spreads

out the energy as it moves. Electromagnetic pollution level is determined by the frequency and intensity of electromagnetic fields. The electromagnetic spectrum spans over a range of wavelengths and frequencies, and these can be divided into a number of regions: (1) radio waves, (2) microwaves, (3) infrared (IR), visible light, ultraviolet (UV), X-rays and gamma rays as shown in Figure 01.

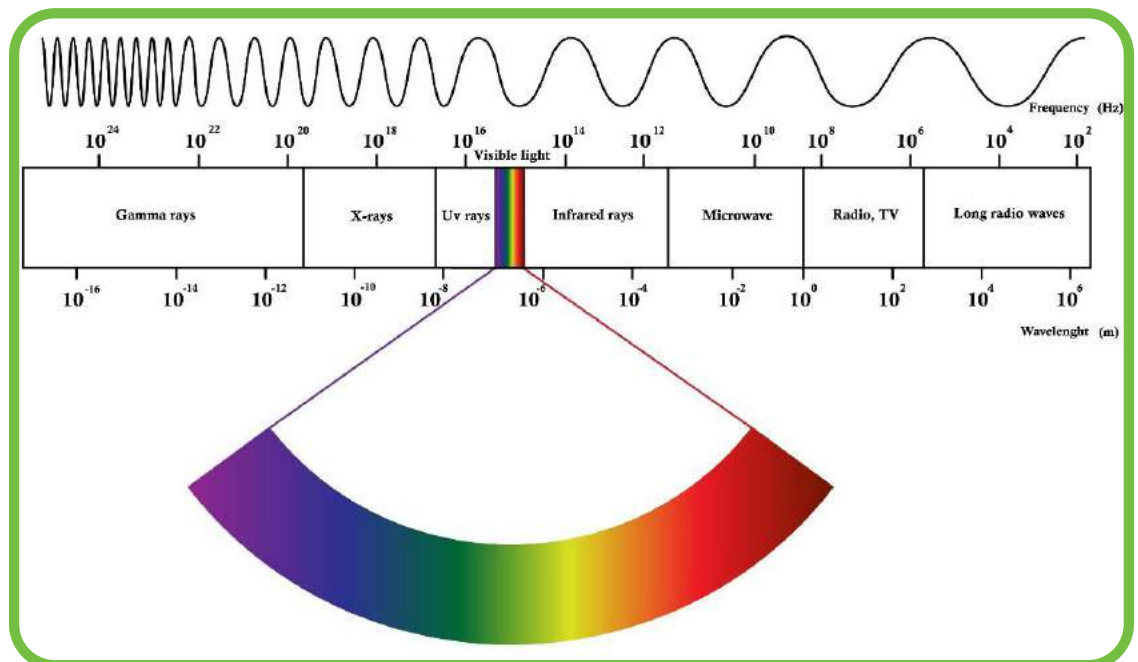
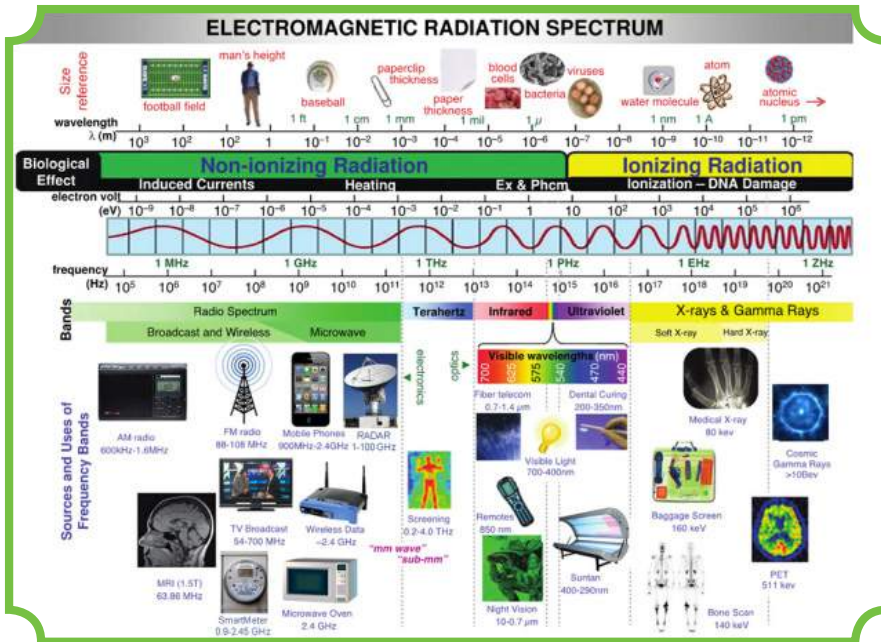
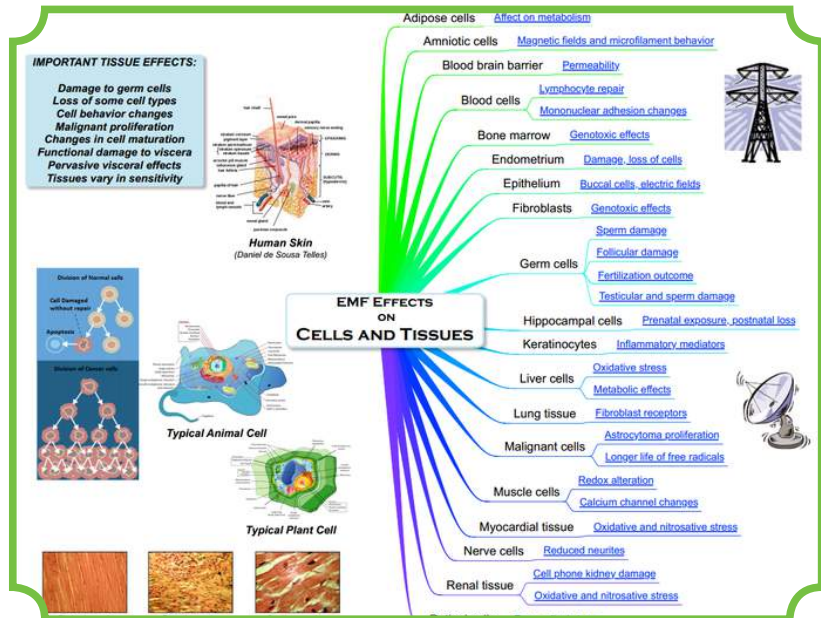


Figure 01: Electromagnetic spectrum

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Radio waves up to 3GHz and radio frequencies, are used in mobile base transceiver stations, wireless LAN, radio and television, mobile phones, tablets and computers. Microwaves have frequencies ranging from 3 GHz to 300 GHz. It is used for high bandwidth point to point transmission, radar communication and 5G. Visible light comes in the range of around 430THz to 770THz, and the frequency ranges of x-rays and gamma rays are very high.

In Sri Lanka, mobile phone usage is increasing rapidly, and



in some parts of the Sri Lanka, landline connections are not available, and consequently, mobile phones are used for communication. Mobile phones have low-power transmitters. The Telecommunications Regulatory Commission of Sri Lanka (TRCL) grants approval for frequency allocations. In Sri Lanka, 900MHz and 1800MHz are being used for 2G mobile communications, and

2100MHz is used for 3G mobile communication, while 1800MHz and 2300MHz are used for 4G mobile communication. Microwave ovens operate at the frequency of 2.45GHz, and microwave ovens are limited to 5mW/cm² at approximately 2 inches from the oven surface.

The 5G technology has evolved from the previous generation of 3G and 4G technologies. The 5G network frequency band comes

in two sets. Frequency range 1 (or sub-6 GHz) is from 450 MHz to 6 GHz, and frequency range 2 (or mm Wave) is from 24.25 GHz to 52.6 GHz. TRCSL has granted 3.5GHz band for pilot trials of pre-commercial 5G services. TRCSL will be awarding the initial 5G spectrum band slots to mobile service providers by the end of this year.

The microwave link uses up to 80 GHz for point-to-point communications. Service providers are using higher frequency for high capacity links, and such high powers are transmitted in long distance communications, as the power of electromagnetic radiation goes down at an increasing rate with the distance. The point-to-point microwave links produce higher electromagnetic pollution, as high frequencies are used and higher powers are transmitted. The microwave link parabolic antennas are usually placed at the top of the tower. In some places, the microwave link parabolic antennas are fixed at the top of the high-rise building, and it can be very harmful

Table 1 : The reference levels for exposure of the general public for over 30 minutes

Frequency range	Incident power density; S_{inc} (W/m^2)
400 MHz to 2 GHz	$\frac{f}{200} W/m^2$; where f is frequency in MHz
2 GHz to 300 GHz	$10 W/m^2$

to walk across such links. For all radio and microwave frequencies (0 to 300 GHz), maximum power levels are designed to avoid any adverse health effects. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has

exposure to electromagnetic radiation. Telecommunication service providers are expected to make sure that power density of electromagnetic waves are within the limits as defined by ICNIRP guidelines. The frequencies of radio and

standards. It would be prudent to develop innovative solutions to cut down unnecessary exposure, while ensuring technological benefits. Such solutions would be attractive to both Telecommunication service providers and to users.

Table 2 : The electromagnetic radiation limits for the general public, to local exposures for over 6 minutes

Frequency range	Incident power density S_{inc} (W/m^2)
400 MHz -2 GHz	$0.058f^{0.86}$; where f is frequency in MHz
2 GHz – 6 GHz	$40 W/m^2$
6 GHz – 300 GHz	$\frac{55}{f^{0.177}}$; where f is frequency in GHz
300 GHz	$20 W/m^2$

released new guidelines for limiting electromagnetic fields in the range of 100kHz to 300GHz in 2020. These guidelines cover many applications including 5G technologies.

The reference levels for exposure of the general public for over 30 minutes and the whole body, to electromagnetic fields is given in Table 1, which were taken from ICNIRP’s new guidelines.

The Table 2, specifies the electromagnetic radiation limits for the general public, to local exposures for over 6 minutes. These were also taken from ICNIRP’s new guidelines.

In Sri Lanka, TRCSL has adopted the ICNIRP guidelines on limiting

microwave are much lower than ionizing radiations such as x-ray and gamma rays, and the transmitting of power is also limited by regulation bodies. Therefore, they do not have enough energy to break molecular bonds or ionizing of atoms in the human body. There is no conclusive evidence yet to suggest that electromagnetic radiation causes adverse health effects including cancer, electro hypersensitivity, and infertility. However, heating effects occur from 100kHz onwards. Studies on the possible effects of non-ionizing radiation are being conducted, which indicate mixed results, and it may take a while to clearly understand its health consequences, and consequently develop appropriate guidelines and



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