Radio waves and our environment

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STUK

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Devices using radio waves are all around us in our present-day environment. We use, for example, mobile phones, wireless internet connections and microwave ovens. Watching TV and listening to radio are also based on receiving radio waves.

The technological development is amazingly fast. You can see base stations mounted on buildings and high masts hoisted in the neighbourhood. People stroll on the street with mobile phones on their ears, and wireless networks are installed at homes, work places and cafes.

Innovations of the latest communications technology are incessantly introduced on the market and wireless data transfer may well be the only alternative to use these gadgets. The fact that these new applications are becoming more common has however raised people's concern about the health effects of radiation produced by these devices.

In wireless data transfer, the antenna sends radio waves into free space towards the receivers. People standing nearby the antenna will inevitably absorb part of the energy transported by the radio waves. The distance between the device and the people affects the exposure most, but the power and frequency of the transmitter, characteristics of the antenna and the rest of the environment also affect it.

Radio waves can warm up tissues

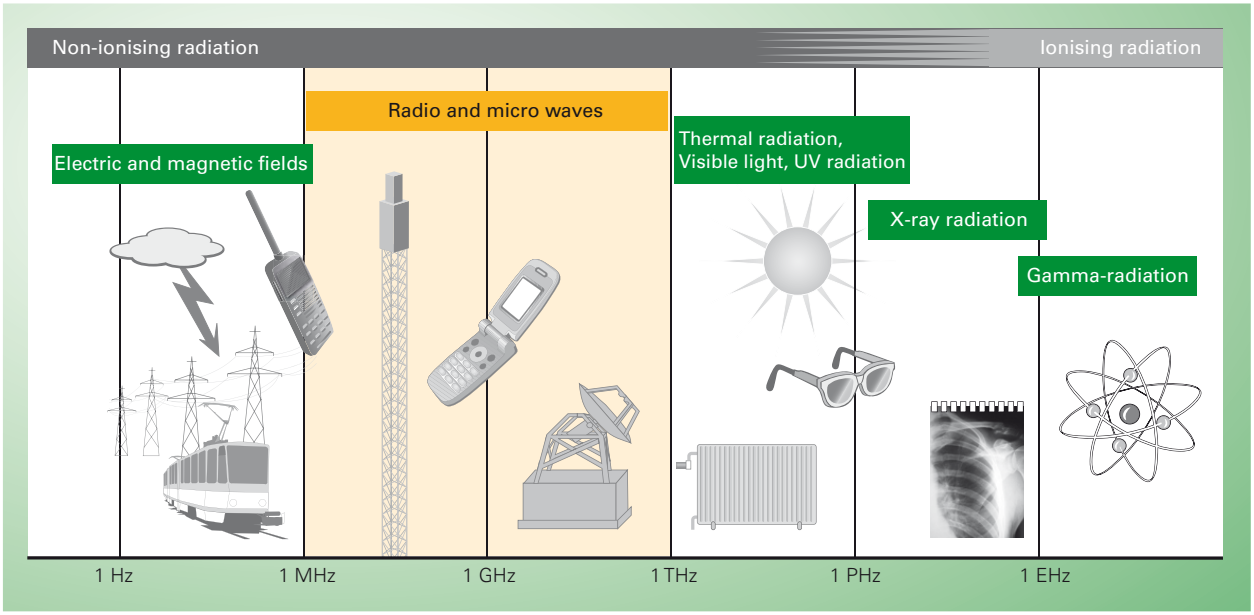
The known direct health effects of radio-frequency (RF) radiation are due to absorption of energy from the radio waves into the body causing warming-up of tissues. Health hazards emerge if the human temperature regulation cannot eliminate the excess heat. The health effects due to increase in temperature appear during the exposure or immediately after it.

These scientifically proved harmful health effects act as a basis for the exposure limits of general public. The same limit values are used, apart from a few exceptions, in all EU countries.

Direct health effects due to RF radiation would presume that the exposure limits of general public are exceeded multi-fold. RF exposures of this magnitude occur only in exceptional working conditions, like in mast operations, radar maintenance and industrial high-frequency heating.

In normal conditions the highest exposure is caused by devices kept close to the body such as mobile phones and other wireless terminal equipment. These devices induce at most an exposure of about the same magnitude as the statutory exposure limits.

High-power fixed transmitters, such as mobile phone base stations and TV transmitters, cause a significantly smaller exposure because their antennas are installed on high



By radio waves we mean the area of the electromagnetic spectrum from approximately 3 kHz to 300 GHz. By micro waves we mean radio waves with the frequency over 1 GHz. Below the radio waves in the frequency domain there are low frequency and static electric and magnetic fields, and above the radio waves infrared and visible light. Devices using radio waves are mobile phones, their base stations, WLAN and other wireless data-transfer equipment, micro wave ovens and radars, among others.

masts or roofs where people have no access. The exposures are usually less than one thousandth or some ten thousandth parts, and even at the most, only a few percents of the exposure limits.

Some studies indicate that doses close to the limit values may induce biological reactions in cells that are not explained by the warming-up of tissues. At present we do not know enough to estimate if these reactions have any effect on health and therefore further studies are necessary.

Mobile phones are the major cause for RF radiation

Mobile phones are the most important source of RF fields today in our environment. The highest exposure caused by them can be of the same magnitude as the exposure limits. The exposure to RF radiation caused by a mobile phone is given as a SAR (specific absorption rate) value that is announced model-specifically in the mobile phone's user manual.

Since there is yet no sufficient knowledge on health effects due to RF exposure, STUK states that it is reasonable to restrict children's use of mobile phones. A child's organism is still developing and therefore more sensitive to external detriments than that of an adult. Also the lifetime exposure will be longer for a child than for someone who has started to use mobile phones as a grown-up.

Several factors affect the RF exposure of a mobile phone user. Most important are transmit power of the mobile phone and how much of the emitted energy of the radio waves are absorbed in the phone user's head.

The transmit power depends on the quality of the connection between a mobile phone and a base station; the closer the base station, the lower the transmit power of a mobile phone. The mobile phone always adjusts the power as low as possible so that the connection to the base station is still maintained.

In normal operating environment the typical transmit power and thus also the exposure to RF radiation is about one tenth of the maximum power with GSM phones and one hundredth with 3G phones. In a weak transmitting field, for example, in a basement, inside a moving car or a train, the power is closer to the maximum.

The proportion of the total transmit energy absorbed by the head is defined by the model of the mobile phone and the way of using the phone. When holding the phone against the ear, a significant part of the energy is absorbed in the user's head. The user can decrease the exposure best using a hands-free device and placing the phone e.g. on a table. This way most of the energy emitted by the mobile phone is directed towards the base stations and only a very small part is absorbed by the user.

Biological effects of radio waves with different exposures

Severity of exposure, SAR (local exposure)	Biological effect
<1 W/kg	No detected health effects
2 W/kg	Temperature in tissues increases approximately 0.3 °C at most in long-term exposure. Indications of changes in proteins.
10 W/kg	Temperature in tissues increases to the upper limit of normal range (37 ± 1 °C), slight sense of heat.
50–100 W/kg	Increase in temperature may cause tissue injury (burn, cataract).

SAR value describes the severity of exposure

The measure of exposure is generally given as a SAR value (Specific Absorption Rate) that defines the wattage due to radio waves absorbed into the body or part of it. The unit of the magnitude is W/kg.

When the whole body is exposed to radiation, the excess heat must be removed out of the body by perspiring. In case the exposure is local it is enough that the excess heat spreads to the surrounding tissues. This is why the body endures locally much heavier exposure than if the whole body is exposed to RF radiation.

The measure of a local exposure stands for a SAR value which is averaged over 10 gram cubical tissue mass. The length of a side depends somewhat on the tissue type but the typical length is about 2.2 cm.

The limits for SAR values for the whole body are 0.08 W/kg, locally for the head or body 2 W/kg and for the limbs 4 W/kg, respectively. This means that the SAR limit e.g. for a mobile phone is 2 W/kg.

Easy-to-measure reference values have been derived from the SAR limits for electric fields (V/m), magnetic fields (A/m) and power density calculated from these (W/m2). If the field strength is not higher than the reference value at most, a person subjected to this would not be exposed, even in the worst case, for radiation exceeding the SAR limit. When defining the worst case, the differences in people's size and weight and their different positions have been taken into account, so in most cases a field that exceeds the reference values slightly will not cause a SAR value exceeding the limit values.

When using both normal and wireless hands-free devices, one should remember that the phone in the pocket (against the body) emits about as much RF radiation to the nearby tissues as it would emit to the head when the phone is held against the ear. Even a small distance between the body and the phone however decreases the exposure substantially. Therefore it is sensible to carry the mobile phone rather e.g. in a belt case than in the pocket. The recommended minimum distance between the body and the mobile phone is given in the user's manual and should be followed.

Mobile phone systems also have various data transfer characteristics (GPRS, EDGE, 3G) that allow the user to surf the internet and connect a PC to a network. The mobile phone may use higher power in data transfer than when the user is speaking on the phone. This is why it is better to keep the mobile phone e.g. on a table than in the pocket when transferring data.

Dense base station network reduces mobile phone radiation

The GSM base station network covers almost the whole of Finland. In addition, the 3G i.e. the UMTS network operates especially in populous areas. The mobile phone network consists of three types of base stations; macro-, micro- and picocells.

The range of macrocell base stations is from a few kilometres to twenty kilometres. Macrocell base stations manage the telecommunications in a few hundred metres' range, for example, on one street or square. Picocell base stations are used to increase e.g. the capacity of individual conference facilities or local shadow zones.

Picocell base stations may locate in the immediate vicinity of people but their transmit power is approximately the same as that of a single mobile phone. Respectively, the macrocell base stations use higher transmit power but their transmitting antennas are placed high on masts or roofs so people have no access to their main lobe. Therefore, the radiation exposure caused by the base stations is usually minor. Measurements of power density have been performed in apartments nearby a base station and the results have been 0.01–0.5 percent of the maximum limit values for exposure.

A nearby base station usually even decreases the radiation exposure to people because mobile phones transmit with considerably lower power in a strong field than far away from the base stations.

The situation may be different in places with no access for the

Surveillance of mobile phones

In the EU, the exposure to mobile phone radiation is restricted by the EU directive (1999/5/EC) concerning telecommunication terminal equipment, the Council Recommendation (1999/519/EC) and national regulations. Controlling mobile phone radiation is based on self-diagnosis principle so that the manufacturer of the devices, the EU-importer and ultimately the retailer is responsible for the devices' compliance with the requirements. In practice, the manufacturers measure the SAR value of all their mobile phone models and ascertain that the limit value is not exceeded.

As an authority, STUK supervises the radiation safety of mobile phones on the market by making random tests for various phone models. The measured SAR values of the mobile phones so far have ranged between 0.2 and 1.4 W/kg, being thus below the limit value 2 W/kg. In almost all cases, the measured values have been, within the limits of uncertainties of measurement, equal to the SAR values reported by the manufacturers. The up-to-date measurement results are available on STUK's web pages (www.stuk.fi).

The basic rule in SAR testing is that the measured SAR value should be at least as high as the value in a real mobile phone operating situation causing the highest exposure, i.e. when the mobile phone is used in a weak field and the user speaks on the phone continuously. The technique of the mobile phone, various using positions and the anatomic characteristics of the user are taken into account. The phones operate at non-stop full power in the test.

In a normal operating situation the exposure is usually lesser because the transmit power of the mobile phone adjusts at lower level according to the signal strength of the base station in order to save the battery. In addition, on the mobile phone you generally listen part of the time, in which case the phone adjusts the transmission less frequent and the SAR value typically decreases about 30%.

In Finland we use mobile phones that operate on GSM 900 and GSM 1800 frequencies and on the 3G, i.e. the UMTS frequencies. All present GSM phones operate on both 900 MHz and 1800 MHz frequencies. 3G phones operate in the 3G network if there is one available, otherwise they use GSM networks.

Exposure to mobile phone radiation can be significantly reduced

- Avoid mobile phone calls in a weak transmitting field, like in a basement, in a moving car or a train.
- Use a hands-free (wireless or by wire) and during the call place the mobile phone e.g. on a table.
- Choose a mobile phone model with a low SAR value. The information can be found in the operating manual of the mobile phone or on a special info sheet inside the sales package.

Antennas of large transmitters are installed on high masts in order to improve the range and the antenna beams are designed to achieve as evenly distributed transmission to various distances as possible. This is why the power density at the ground level is low even near the mast.

public, like on the roofs of high-rise buildings. If a person stands in front of a high-powered base station antenna, the exposure will clearly exceed the limit values. This is why it is not recommended to stay near base station antenna panels.

Your neighbour's WLAN causes no radiation hazard

WLAN, i.e. Wireless Local Area Network, allows us to connect the computer for example to internet wirelessly using microwaves to transmit data. The service area of a single base station is quite small, and therefore WLAN is typically used as an extension to other types of internet connections, e.g. ADSL. Internet connections at cafes, hotels and conference rooms, among others, are often provided with WLAN.

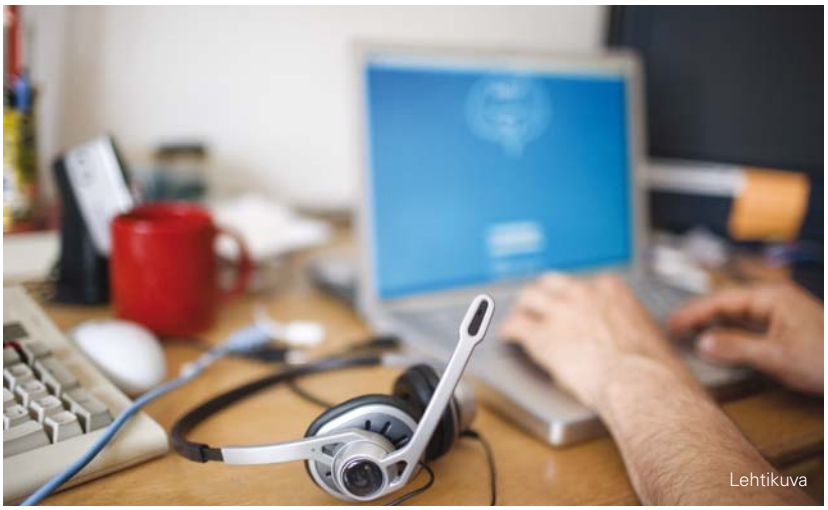
WLAN base stations connected to broadband are also very popular among home users because a wireless network adapter comes as a standard accessory in almost every modern laptop.

The exposure caused by a WLAN device is approximately 1 W/kg at highest, in case the antenna of the device comes into contact with the body. This exposure is easy to decrease significantly by leaving at least a few centimetres in between the WLAN card and the user's body. This concerns also other wireless network terminal devices such as 3G broadband adapters.

Many laptops have internal antennas. The location of the antenna is easiest found out by asking the retailer. A typical place for an internal antenna is on the top of the screen.

When surfing the internet, most of the data transmission is directed from the base station to the ter-

It is not recommended to go to the immediate vicinity of base station antennas.



A PC equipped with a WLAN is best kept on the table rather than in the lap.

minal device, i.e. you download data. Therefore the terminal device transmits and emits radiation only periodically. Switching off the WLAN when it is not needed prevents the radiation completely.

A WLAN base station has a similar transmitter as a laptop. A base station can however be located so that it causes only a minor exposure. For example, a transmitter located at a distance of more than one metre from the subject causes a field strength that is only one thousandth of the limit values. Consequently, your neighbour's WLAN base station does not cause any radiation hazard.

Wireless internet connections that are based on larger service areas can be implemented using, for example, @450, WiMAX and 3G techniques. @450 and WiMAX base stations are installed on high masts which is why their power density on the ground is low everywhere. Then again 3G connections use mobile phone base stations. They either have low-power or they are located in places where people have no access. Thus, @450, WiMAX and 3G base stations do not pose a significant exposure to radiation.

Most bluetooths have very low power

Bluetooth technique is used to connect a mobile phone and a hands-free or a PC and its accessories, among others. There are three different types of transmitters. Their ranges are approximately one metre, ten metres or one hundred metres, the last of which are mainly found in laptops. The SAR values of the longest range devices are approximately 0.5 W/kg at most, when the antenna comes into contact with the body.

The wireless mobile phone hands-frees have transmitters with a very short range and the exposure caused by these is parts of per cent of the limit values at the maximum. This concerns also wireless PC mice.

TV picture is also sent via radio waves

The sound radio is one of the oldest applications of radio waves. The radio broadcasts of the Finnish Broadcasting Company started in 1926 and TV broadcasts in 1955.

The powers of TV transmitters are high since the range of a single broadcast station may be over one hundred kilometres. The antennas are installed on high masts in order to improve the range and the antenna lobes are designed to achieve as evenly distributed transmission to various distances as possible. This is also why the power density is low at the ground level near the masts and the exposure is usually 0.001–0.1 per cent of the limit values. Radio and TV receivers do not send radio waves.

Food heated in a microwave oven does not radiate

You can find a microwave oven almost in every kitchen. After the mobile phone, it is possibly the most common application in Finland using microwaves.

The microwave power of such an oven is high but microwaves are damped immediately when the oven is switched off. No radiation remains in the oven or the heated food.

The microwaves cause no hazard if the oven is undamaged. Microwaves do not penetrate the door's metal wire net or the walls of the oven. The inner frame of the door is sealed with a so-called wave trap. All microwave ovens must have two separate safety switches, independent of each other, that prevent from switching on the oven when the door is open.

However, it is good to remember that a minor amount of microwaves always leaks through the wave trap. Therefore, it is not recommended to watch the heating of food with one's face too close to the oven door, but already at a distance of half a metre from the oven the radiation is decreased to a few per cents of the limit values.

If the oven door or its frame is visibly twisted, cracked or dented, the wave trap may let out more microwaves than usual and the damaged oven should not be used.

If you suspect the condition of the microwave oven is not faultless, you may inquire about radiation leakage tests from any domestic appliance after-sales service. The tightness of an oven cannot be tested with a mobile phone. The oven door's wave trap functions only in the operation frequency of the oven, and therefore a mobile phone placed into the microwave oven maintains the connection to the base station.

Baby monitors best kept out of reach of babies

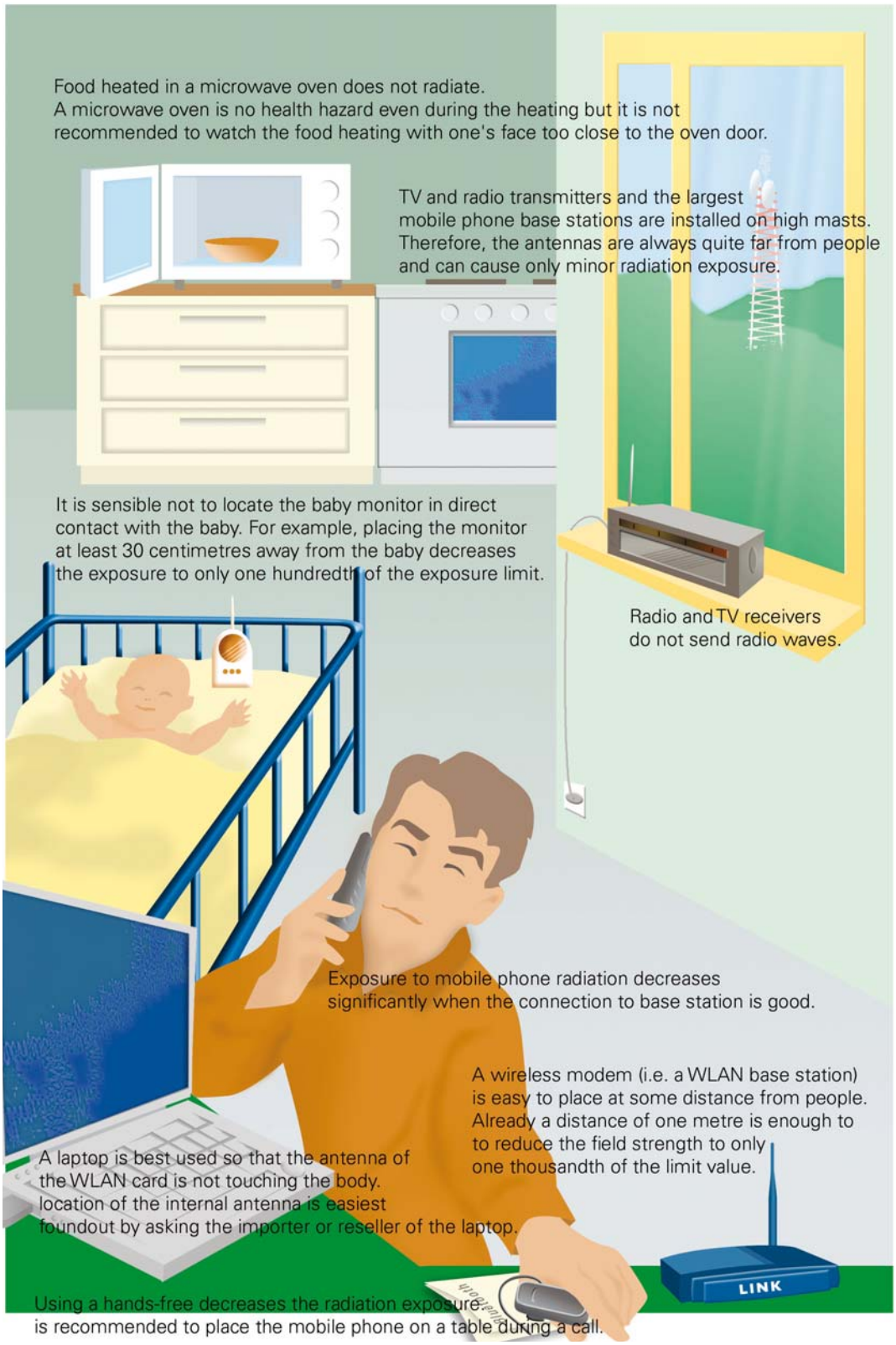
A baby monitor, i.e. a certain type of digital cordless telephone, transmits the voice of a waking-up baby via a radio signal from the transmitting baby unit to the receiving parent unit. The transmitter placed near the baby causes exposure to radio waves, the intensity of which depends on the technology of the appliance.

Nevertheless, the exposure is typically of short-term. Baby monitors send radio waves only when they are activated by voice (when the baby cries), so the exposure occurs only for a very short while when the baby wakes up.

Most of these appliances use a very low power and their range is approximately 100–300 metres. The exposure due to such baby monitors is minor.

Certain monitors, however, use higher power that enables a service range of even three kilometres. If such a device comes into contact with the body, it can cause at most a SAR value of about 20 per cent of the limit values. Therefore it is sensible not to place the baby monitor into direct contact with the baby. If the monitor is at least 30 centimetres away from the baby, the exposure is only one hundredth of the exposure limits in all cases.

Domestic appliances do not cause any RF radiation that would exceed the limit values. You can however decrease unnecessary exposure with a few simple methods.



Examples of exposure to RF radiation in various everyday situations

Situation	Exposure to RF radiation (compared to the limit values)	Note
A mobile phone call in a weak field, in a car or a train	10–60 %	There are differences between the phone models. The model-specific SAR value describes the exposure in a very weak field.
A laptop held in the lap, the antenna of a WLAN card or a 3G modem touching the body.	50 %	The antenna or the modem is usually easy to move farther away from the body. Even a short distance decreases the exposure significantly.
A longer-range PMR baby monitor in direct contact with the baby	20 %	Baby monitors of other types cause only a minor exposure.
Cordless telephone (DECT)	5 %	The power of the dock of a cordless telephone and the cordless telephone itself is the same, but the distance between the dock and the user is longer.
A microwave oven, heating on, distance 50 centimetres.	5 %	When the leakage radiation is at the permissible limit. In reality the microwave ovens leak clearly less. Heated food does not radiate
A mobile phone call in an urban area while walking.	0,1–5 %	The mobile phone adjusts the power down when the connection to a base station is good.
A mobile phone call using a wireless hands-free (phone itself e.g. on a table)	<1 %	A hands-free reduces the exposure to radiation significantly because the phone is farther from the body.
Several people talking on a mobile phone in a same bus or a railway car.	<1 %	Only a mobile phone kept close to the body can cause significant radiation exposure.
A mobile phone base station at a hundred metres distance on a mast	<1 %	In case the mast is closer, the main beam is so high that the exposure might be even lower.
A baby monitor 30 centimetres from the baby.	<1 %	The baby monitor should be placed at a short distance (about 30 centimetres) from the baby.
A mobile phone base station on a roof, on an outer wall of an apartment or on the roof of the opposite building	<0,1 %	Beams of correctly installed base stations are not directly aimed at nearby places where people have access.
Radio and TV transmissions	0,001–0,1 %	Commencing digital TV transmissions did not increase exposure to radiation.

The SAR value of cordless telephones is low

A DECT (Digital Enhanced Cordless Telephone) phone connected to a fixed telephone line can be used in the same way as a mobile phone, but only in a very small area, like at home. The same technique is applied also in interphone systems of offices and shops. The range of DECT phones is small so the transmitting power is low.

The SAR values of DECT phones are no more than five per cent of the limit values at the maximum according to published measurements. The transmitting power of a base station is the same as that of a phone connected to it, but the exposure caused by a base station is significantly lesser since the phone user is not touching the antenna.

Hands-free is handy also with radiotelephones

Radiotelephones, so-called walkie-talkies or two-way radios, can be used to talk to several receivers quickly and at the same time. For example hunting societies and boaters use licensed radiotelephone systems. In Finland, the police, the Rescue Department and other authorities have their own VIRVE telephone network. There are also

coupled radiotelephones that are exempt from licensing available for private use.

For example, with coupled radiotelephones, the trade name PMR446, you can talk to a distance of three kilometres at the maximum and with traditional shortwave radiotelephones ever farther away.

Generally, when people communicate with radiotelephones, they use short messages. Therefore radiotelephones expose people to radio waves only momentarily. In addition, when you speak on radiotelephone, you usually hold the phone in front of your face, near the mouth, and the antenna does not touch your head at all.

The SAR values of the most powerful radiotelephones may however approach the limit values when the phone is transmitting. This is why you should use a radiotelephone so that the antenna is as far from your head as possible. Many radiotelephones also have earphones and external microphones as accessories that decrease the exposure to head.


Rodeo

Safety distances should be considered when placing radars

Radars are used for several purposes in navigation, aviation, national defence and meteorology, among others. Radars can detect targets even from hundreds of kilometres away by sending short microwave pulses using a rotating or a turnable antenna and measuring their echoes. The bearing and the distance of the target can be determined and its size assessed by the direction of the antenna, the delay and intensity of the echo.

The exposure caused by a radar device is affected by the average power of the radar, the type of the antenna and the distance between the radar and people.

The intensity of a single radar pulse may be very high but the duration of the pulse is typically 100–10000 times smaller than the interval between the sequential pulses. Thus the average power of radar is 100–10000 times lower than the pulse intensity announced in the specification.

The highest pulse power is used in long-range radars. They however send pulses at long intervals because the following pulse must not be sent until the previous echo has arrived. Respectively, in short-range the pulses can be sent more frequently but a lower pulse power will suffice. The exposure caused by radar is therefore not directly dependent on the range but on the average pulse power comprised of the pulse power and their repetition interval.

All antennas of radars direct the microwaves into a narrow beam. The intensity of the microwaves in a narrow beam may be high even quite far away from the radar itself. The antennas are however mostly

rotating, which means the beam hits the exposed person only for a short moment on each rotation. This decreases the exposure significantly.

The largest radars are installed so that there is no access into their vicinity, and hence no harm is caused for general public. For example, on radar stations of Finnish Defence Forces and airports there are always protective enclosures around the antennas, outside of which the beam is already high above the ground.

On the other hand, on ships and boats the antennas of maritime radars may be located very near to such places where the public has admittance. The antenna is best installed as high as possible so that it is clearly above the passengers onboard. The sufficient, device type-specific safety distance should be defined, e.g. from the operation manual or from the importer of the device.

The safety distance of radars used on large ships may be long and, for example, an antenna installed on the foredeck is located on the same deck level as passengers or the personnel facilities. In this case the radars must have an azimuth blanking, i.e. the transmitter shuts down when the beam points at the ship.

According to present day knowledge, the occurrence of harmful health effects due to microwaves is affected only by the average power as an average value of several minutes. Nevertheless, the pulsed radiation of radars has one specific effect, which is why the exposure guidelines set a separate limit for the pulse energy, i.e. the intensity of the pulse multiplied by its length. The pulse-shaped radiation may cause vibration in the skull due to minor but very quick heat expansion. You can hear the vibration as a hum if the repetition frequency is in the hearing range of humans. This is no hazard as such but certainly disturbing, for example, when trying to get to sleep.

Radio amateur antennas can be safely installed on roofs

Radio amateur activity is a hobby where you can contact other radio amateurs, DXers (distant reception), around the world using your own radio transmitter. DXers also get training to get more skills, e.g. for making radio technical experiments. The radio amateurs have had a great influence on the development of radio engineering, which is why they have several frequency bands reserved for their use. In Finland, there are about 6 000 radio amateurs and worldwide their number exceeds three million.

Radio amateur antennas are often installed on high masts in order to extend the range as long as possible in far away target areas. When the antennas are placed high above the people, the exposure caused by them is minor.

Even antennas placed on shorter masts or on house roofs do not, according to measurements made, cause any major power densities to homes and yards below. Nonetheless, you should not go near any high-power transmitter antennas when the power is on.

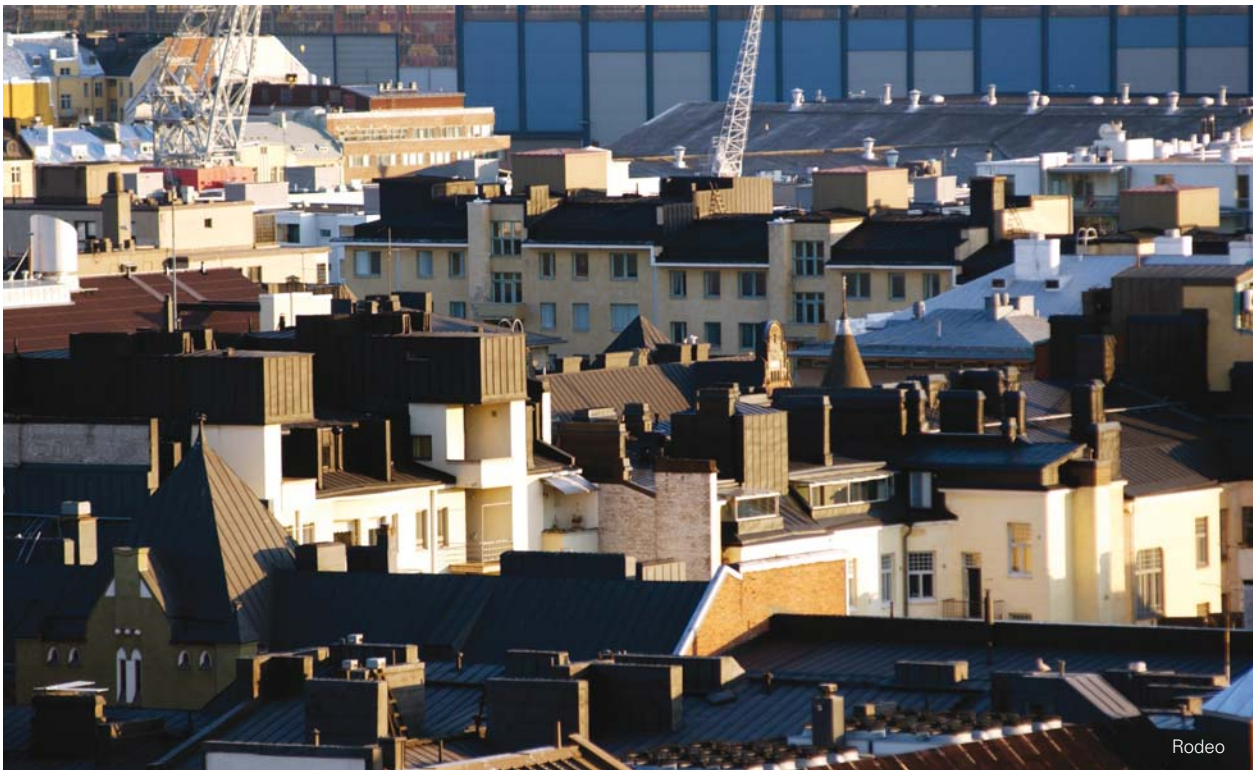
New low-power radio appliances launched non-stop

Apart from bluetooth devices, there are numerous low-power short-range radio transmitters. For example, the remote controls of automobile central locking, the belts of pulse counters, helmet phones of motorcyclists and cordless alarm devices at home all use low-power radio transmitters for data transfer. The exposure caused by these devices is very small due to low transmitting power, even if the devices come into contact with the body.

In recent years also the RFID (radiofrequency remote sensing or identification) devices have become extensively more general, and they operate, according to their name, with radio waves. The appliances of this technique is found, for example, in shops' electronic article surveillance gates, i.e. anti-theft alarm devices, in stock logistics and access control systems.

The detectors attached to products send very low-power radio waves or none at all. The exposure caused by the receiving devices is only momentary. For example, a customer who walks through a production protection gate post based on the RFID technique is exposed to radio waves for less than a second when leaving the shop.

For example, the belt of a pulse counter sends the pulse rate to the display device held on the wrist using a low-power radio transmitter.



Most of the exposure is caused by one or two nearest radiation sources in our living environment and the effect of other sources comprises only parts of per cent to the total exposure.

Sources near the body expose the body locally in which case the limit value for SAR is 2 W/kg. Exposure due to sources farther away is distributed more evenly to the body. The limit value for SAR as a whole body average is 0.08 W/kg.

Only the closest radiation sources affect the overall exposure

No single radio appliance, when used and installed correctly, causes an exposure that would exceed the limit values set for the population. But what is the combined effect of all devices, the total exposure, when there might be a multitude of sources in our living environment.

The number of sources found in the immediate surroundings does not normally affect significantly the total exposure. In practice, only a few nearest sources are important, since the power density dies out quickly (by the square-law) when pulling away from the antenna. The combined total exposure of a number of sources located farther away increases the exposure only per cents on top of the exposure due to one or a couple of closest sources.

For example, the SAR value caused by a mobile phone held on the ear could be a hundred times higher that of a WLAN base station a metre away, even if the transmitting power of both these devices is approximately the same. Respectively, the exposure caused by a mobile phone base station at a hundred metres distance is a hundred times lower than the exposure of a similar base station at ten metres distance.

Total exposure is not directly caused by, for example, the living environment. However, in urban area there are often clearly more different radiation sources than in rural area. In cities, the service areas and power densities of transmitters are however smaller, respectively, so the total exposure not necessarily grows any bigger in urban areas.

The technological development has increased the number of different radiation sources and the amount of wireless data transfer a great deal. In addition, the new mobile technologies demand more base stations. On the other hand, the more effective error correction of the new devices, data packing and more dense base station network enable the same amount of data transfer with much lower power. This is why the total exposure will not increase at least as quickly as the number of technical applications. A good example of this is the third generation mobile phones that cause a significantly lower exposure than the GSM phones, which is due to their more advanced power control in a typical operating situation.

Devices producing radio waves are all around us in our living environment. For example mobile phones, microwave ovens, wireless internet connections, radars and TV transmissions are based on radio waves.

In normal conditions the most significant RF exposure is caused by appliances that come into contact with the body such as mobile phones and other wireless terminal devices. The exposure caused by transmitters that locate farther away from people, e.g. mobile phone base stations or TV transmitters, is typically thousands of times lower than that caused by sources near the body.

There is no evidence so far on the health effects due to long-term exposure to radio frequency radiation but anyone can reduce one's own exposure easily.

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