Danish National Board of Health (Sundhedsstyrelsen)
Finnish Radiation and Nuclear Safety Authority (Säteilyturvakeskus, STUK)
Icelandic Radiation Safety Authority (Geislavarnir ríkisins)
Norwegian Radiation Protection Authority (Statens strålevern)
Swedish Radiation Safety Authority (Strålsäkerhetsmyndigheten)

16. nóvember 2009

Geislun á almenning frá fjarskiptasendum

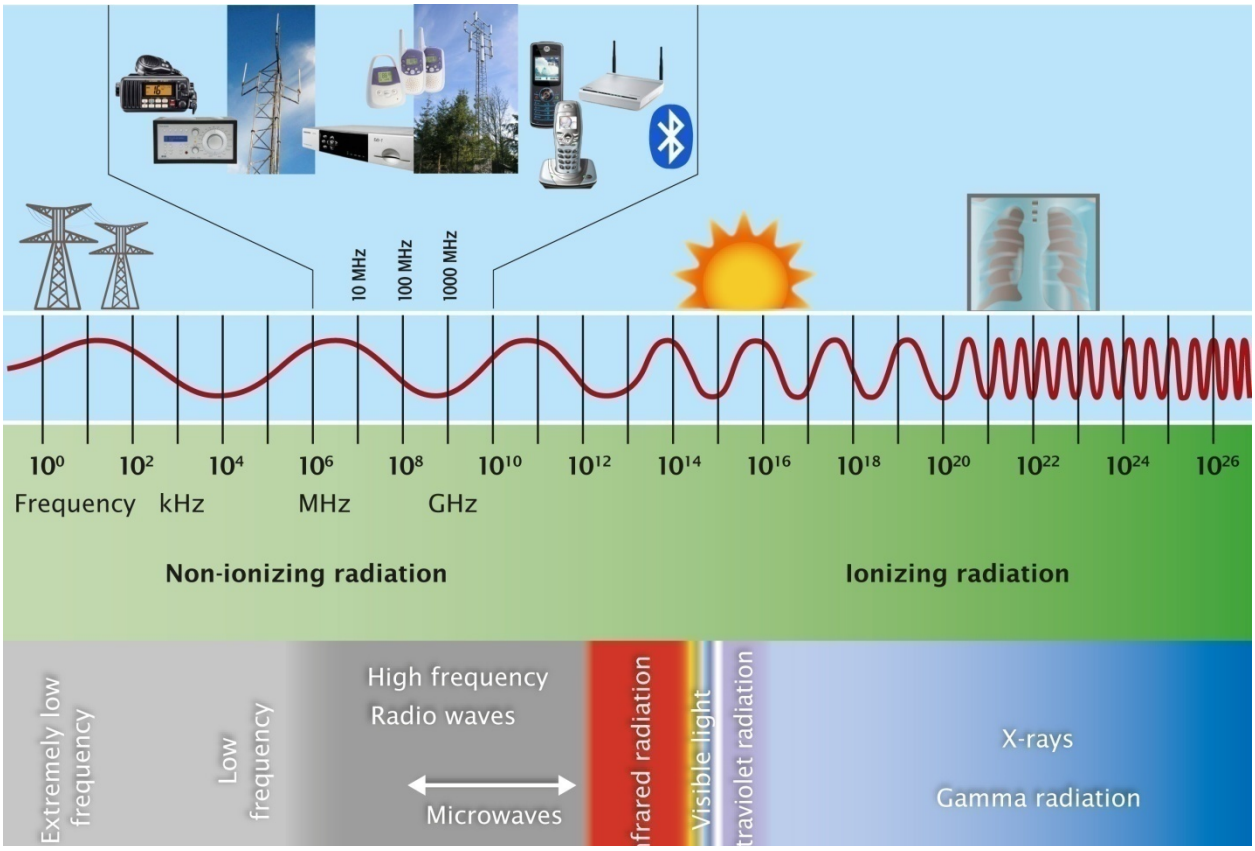
Sameiginleg yfirlýsing frá norrænu geislavarnastofnununum

Þessi yfirlýsing varðar rafsegulgeislun á almenning frá fjarskiptasendum. Sameiginlega yfirlýsingin varðandi farsíma frá árinu 2004 er enn í fullu gildi [*Mobile Telephony and Health – A common approach for the Nordic competent authorities*].

Inngangur

Vegna tækniframfara í fjarskiptum fjölgar ört uppsprettum rafsegulgeislunar á Norðurlöndunum. Útvarpssendar hafa verið í notkun á Norðurlöndunum í yfir 70 ár og sjónvarpssendar í meira en 50 ár. Fyrsta kynslóð farsímanets (NMT) kom til sögunnar fyrir 30 árum, önnur kynslóðin (GSM) kom fyrir 25 árum þriðja kynslóðin (UMTS) byrjaði að sjást um árið 2000, og einnig hefur nýtt fjarskiptanet viðbragðsaðila verið sett upp á öllum Norðurlöndunum (eða mun verða það bráðlega). Að auki hafa þráðlausir símar verið í almennri notkun í yfir 25 ár og þráðlaus net eru víða notuð á heimilium, vinnustöðum og á almenningssvæðum. Þá er víða að finna þráðlaus þjófavarnakerfi, barnavöktunartæki og auðkennistæki sem öll nota útvarpsgeislun og Blátannar tæknin er orðin útbreidd, einkum í þráðlausum lyklaborðum, tölvumúsum og handfrjálsum búnaði fyrir farsíma.

Ofantalin tæki eru dæmi um senda sem gefa frá sér svo nefnda útvarpsgeislun á tíðnisviðinu frá 10 MHz til 2,5 GHz. Geislun á almenning á Norðurlöndunum vegna þessara tækja liggur langt undir þeim alþjóðlegu viðmiðunarmörkum sem Alþjóðaráð um varnir gegn ójónandi geislun (ICNIRP) hefur gefið út .



Myndin sýnir rafsegulrófið ásamt nokkrum algengum uppsprettum útvarpsgeislunar.

Hámarksgeislun

Innan alþjóðlega vísindasamfélagsins er það vitað og vel staðfest að rafsegulgeislun yfir ákveðnum mörkum er skaðleg. Árið 1998 gaf ICNIRP út leiðbeiningar um viðmiðunarmörk til að koma í veg fyrir slíka skaða [ICNIRP 1998]. Ráðlögð hámarksgeislun ICNIRP fyrir almenning fékkst með því taka minnstu geislun sem veldur marktækum og sjáanlegum áhrifum á vefi og deila í hana með 50. Þekkt og staðfest skaðleg heilsufarsáhrif útvarpsgeislunar yfir 10 MHz eru vegna hitastigshækkunar líkamsvefja. Þess vegna miða viðmiðunarmörk ICNIRP að því að koma í veg fyrir óæskilega upphitun líkamsvefja; sé ráðleggingunum fylgt verður mesta hitastigshækkunin af völdum útvarpsgeislunar nokkrir tíunduhlutar úr gráðu á Celsíus. Nýlega endurstaðfesti ICNIRP viðmiðunarmörkin frá 1998 fyrir útvarpsgeislun yfir 100 kHz [ICNIRP, 2009].

Styrkur geislunar

Skipta má tækjum sem gefa frá sér útvarpsgeislun í tvo flokka, handtæki (eða færanleg) og kyrrstæða senda. Geislun frá handtækjum eins og til dæmis farsímum, getur nálgast viðmiðunarmörk ICNIRP í sumum tilfellum, en geislunin varir eingöngu á meðan viðkomandi tæki er í notkun (t.d. meðan talað er í farsíma.) Geislun frá kyrrstæðum sendum er aftur á móti stöðug og berst víða. Samkvæmt mælingum sem gerðar hafa verið á öllum Norðurlöndunum er geislun á almenning vegna þessara tækja undir venjulegum kringumstæðum langt undir einum hundraðasta af viðmiðunarmörkum.

Frekari upplýsingar um útvarpsgeislandi tæki og styrk útvarpsgeislunar í venjulegum vistarverum má sjá í viðaukanum “Exposure of the general public to radiofrequency fields” aftan við yfirlýsinguna.

Ofurnæmi tengt rafsegulgeislun

Skráð tilfelli um ofurnæmi tengt rafsegulgeislun (EHS, Electromagnetic HyperSensitivity) eru flókin og erfið viðureignar. Samkvæmt Alþjóða heilbrigðisstofnuninni (WHO) er ekki vísindalegur grundvöllur fyrir því að tengja einkenni EHS við rafsegulgeislun, [WHO 2005]. Þess vegna líta Norrænu geislavarnastofnanirnar svo á að EHS sé læknisfræðilegt vandamál, á verksviði heilbrigðisyfirvalda, en ekki málefni geislavarna. Einkennin geta verið raunveruleg og alvarleg hjá þeim sem til þeirra finna. Einmitt þess vegna er mikilvægt að halda áfram rannsóknum til að fá betri skilning á orsökum EHS.

Niðurlag

Að mati norrænu geislavarnastofnanna liggja ekki fyrir vísindalegar sannanir um heilsutjón vegna útvarpsgeislunar í umhverfi okkar við venjulegar aðstæður nú. Þessi niðurstaða er í samræmi við álit þeirra alþjóðlegu vísindastofnana og ráðgefandi stofnana sem er vísað til í heimildaskrá hér fyrir neðan [ICNIRP, 1998 og 2009; WHO, 2005 og 2006; SCENIHR 2009; SSI's Independent Expert Group on Electromagnetic Fields, 2007]. Þar af leiðandi sjá norrænu geislavarnastofnanirnar að svo stöddu ekki þörf á að beita sér sameiginlega til að draga úr framangreindri útvarpsgeislun.

Engu að síður ber að hafa í huga að í sumum tilvikum hefur tæknibúnaður sem sendir frá sér útvarpsgeislun verið notaður skemur en tvo áratugi. Það er því mikilvægt að halda á virkan hátt áfram rannsóknum á mögulegum heilsufarsáhrifum útvarpsgeislunar og endurmati á vísindaniðurstöðum varðandi slík áhrif. Jafnframt er það mikilvægt að fylgjast með þróun útvarpsgeislunar frá ýmsum tækjum og hugsanlegum heilsufarsáhrifum af hennar völdum.

Norrænu geislavarnastofnanirnar ítreka að til þess að draga úr heildargeislun á almenning frá fjarskiptabúnaði, þarf í skipulagi bæði að taka mið af geislun frá sendimöstrum og handtækjum, t.d. farsímum. Farsímarnir valda mun meiri geislun á almenning en möstrin. Yrði farsímamöstrum fækkað þyrftu símarnir að senda út af auknu afli til að viðhalda tengingu, með hugsanlegri aukningu geislunar á notendur þeirra í kjölfarið.

Frekari upplýsingar um þetta og mögulegar aðgerðir til að draga úr geislun frá farsímum og öðrum tækjum má finna á vefsíðum geislavarnastofnanna hér fyrir neðan.

Heimildir

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Vefsetur geislavarnastofnana Norðurlanda

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  www.ssm.se
- Geislavarnastofnun Noregs
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Viðauki

Exposure of the general public to radiofrequency fields

1. Introduction

This document presents typical exposure of the general public to radiofrequency (RF) radiation in every-day situations. The lists of RF source technologies/devices (see Table 1 & 2) and exposure scenarios are not complete since there are many applications that can emit radiofrequencies and new sources appear regularly. It is however unlikely, due to general rules governing the design of radio systems, that any new technology will cause significantly higher exposures to the general public in the foreseeable future than the examples introduced here.

Table 1. An overview of the properties of commonly used RF emitting devices that are used close to the individual. The general public's exposure limit for local specific absorption rate (SAR[1]) for the head and trunk regions is 2 W/kg. The limit for occupational exposure (e.g. police radio) is 10 W/kg. The given values are for maximum exposure i.e. direct contact between RF transmitter and affected tissue.

Technology	Related acronyms	Frequency (MHz)	Maximum (time averaged) output power (mW)	Maximum SAR (W/kg)
Mobile phones	GSM 900	900	250	1.4
	GSM 1800 (formerly DCS 1800)	1800	125	1
	UMTS (also 3G)	1950	125	1
Wireless internet terminals of the computers (For base stations, see Table 2)	WLAN (also WiFi)	2450	100	1
	3G	1950[2]	125	1
	WiMAX	3500	160	1
	Flash-OFDM (@450 in Finland)	450	200	0.5
Cordless phones	DECT	1900	10	<0.1
Cordless mouses and keyboards	Bluetooth	2450	1 or 2.5	<0.01
Cordless hands free sets	Bluetooth	2450	1 or 2.5	<0.01
Baby monitors	PMR446	446	500	0.4
	DECT	1900	10	0.03
	+ others	27 (typical)	10	<0.01
Professional mobile radio (police etc.)	TETRA	400	250 (750 also)	1 (3)

[1] Specific absorption rate (SAR) is a measure of the rate at which energy is absorbed by the body when exposed to a radiofrequency electromagnetic field. It is defined as the power absorbed per mass of tissue and has units of watts per kilogram. SAR is usually averaged either over the whole body, or over a smaller sample volume. Recommended exposure limits are set by the International Commission Non-Ionizing Radiation Protection (ICNIRP).

[2] also other mobile phone bands, if 3G not available

2. Exposure sources

The exposure to an individual caused by any single RF source is strongly dependent on the distance between the source and the individual, the source output power and duration of RF transmission. Therefore, regarding exposure there are two main types of devices; small devices used close to the individual (hand-held and/or body-worn) and fixed transmitters. Exposure caused by devices used close to the individual is localised and usually occasional, since RF transmission shuts down while not in use, though exposure to RF can be near the ICNIRP exposure limits when such devices are in use. Fixed transmitters often use high output powers and typically transmit RF continuously. Recommended exposure limits can therefore be exceeded in close proximity to such sources. Fixed transmitters are, however, usually installed in places where the general public does not have access, such that the typical exposure caused by fixed transmitters is very low. Table 1 and 2 list some properties of the most common RF technologies in use.

Table 2. An overview of commonly used fixed radio transmitters including information regarding frequency and output power

Technology	Related acronyms	Frequency range (MHz)	Typical output power	Typical power density mW/m^2
Mobile phone base stations	GSM 900	900	20 W	< 0.1
	GSM 1800 (former DCS 1800)	1800		< 0.1
	UMTS (also 3G)	2150		< 0.1
TV broadcasts (digital)	DVB-T	500 - 900	15 kW	< 0.01
Voice radio broadcasts	VHF, FM-radio	87-108	50 kW	< 0.001
Wireless internet connections (base stations)	WLAN (also WiFi)	2450	100 mW	
	3G		♠	
	WiMAX	3500	1 W	
	Flash-OFDM (@450 in Finland)	450	up to 20 W	
Cordless phone (fixed part)	DECT	1900	10 mW (single phone system)	
Professional mobile radio (police etc.)	TETRA	400	up to 100 W	

♠ 3G is based on regular mobile phone base stations (see above)

2.1 Handheld and body worn devices

The highest output powers of hand-held/ body worn devices (e.g., mobile phones, laptops incorporating a WLAN card or other wireless network adapter) are typically in the 100–500 mW range. The output power is therefore relatively low, though a large fraction can be absorbed by the user leading to exposures of the same order of magnitude as recommended exposure limits for localised exposure to the general public (*SAR* limit of 2 W/kg). However, average whole-body

exposures will always be small due to the low output power of such devices. In addition, such devices are typically used only occasionally and transmit RF only when the device is communicating. Moreover, some devices such as mobile phones automatically decrease output power if possible i.e., in areas where reception is good. Hence, typical exposure from these devices is lower than the theoretical maximum; 0.1-0.5 and <0.01 of maximum values for GSM and 3G, respectively. Exposure caused by small-range devices (e.g., cordless DECT phones, Bluetooth devices etc.) is typically only a few percent of exposure limits.

Exposure to RF caused by a small-size low power transmitter generally decreases rapidly with increasing distance from the source. A 30 cm gap between the receiving body and the transmitter typically decreases exposure by a factor 100 when compared to direct contact exposure. Therefore, exposure concerns mainly the user of the device. The individual exposure from such sources is reduced by increasing the distance between user and device. This can be easily done by e.g., using hands-free for voice calls and/or placing baby monitors, WLAN terminals etc such that they are not touching the individual.

2.2. Fixed transmitters

Numerous technologies utilise fixed RF transmitters. Signals from WLAN, WiMAX and mobile phone networks are transmitted by base stations, while TV and voice radio broadcasts are sent via fixed transmitter antennas in high masts. Transmission powers in these devices range from milliwatt (mW) to kilowatts (kW).

The antennas transmitting at the highest power levels (kilowatt-range) are the mast-mounted TV and VHF voice radio transmitters. Power densities measured at ground level are low, however, since the antennas are mounted 100–300 m above ground. The main RF transmission beam is targeted towards the horizon; hence virtually all the RF power surpass people living in the vicinity of the mast (see Fig. 1). Measurements performed around typical broadcasting masts have shown that the field strengths depend more on the terrain (by factor 1000) than on the distance from the source. The highest measured values in a normal living environment have been approximately 0.1 mW/m^2, according to measurements in the Nordic countries, though more typical values are between 0.0001 – 0.001 mW/m^2. The introduction of digital TV broadcasting appears to have decreased overall exposure, due to a lower transmission power being necessary for a single TV program. However, the number of TV channels will increase and presumably all former frequencies of analogous TV will be utilised again for digital broadcasts at some time in the future leading to background RF fields being in the same order of magnitude as before the digitalisation.

Fig.1. Radiowaves from mast-mounted antennas surpasses the people living in the vicinity of the mast.

The largest mobile phone base-stations transmit at approximately 100 W (rms[3]) and they are also mounted on masts. Lower power levels are used in the antennas that are mounted on roof tops/ building walls (typically 1-20 W). The main transmission RF beams are narrow in the vertical cross-section and targeted towards the horizon or some degrees below it. Hence, they are not transmitting directly towards people living underneath or in the vicinity of the source (as in Fig. 1). Contractors are instructed to install base-stations in places inaccessible from e.g., ventilation windows or balconies. Moreover, high power RF antennas should not be pointed directly towards any neighbouring house, even though the safety distance in the main beam is only a few meters. If these precaution measures are followed, the exposure to the general public caused by such base-stations is very low. Measurements have been conducted in upper floor apartments with base-station antenna either directly above or on the roof of a neighbouring house: typical power densities have been 0.1–10 mW/m^2 with measured maximums in individual cases up to 50–250 mW/m^2. Measured outdoor power densities at street level have been lower, typically well below 0.1 mW/m^2. The reference value given in ICNIRP recommendation is 4 500–10 000 mW/m^2, depending on the frequency.

The TV- and radio broadcasts as well as GSM base-station networks cover most areas of the Nordic countries. According to measurement campaigns, these technologies produce the highest background RF fields in the environment. However, measured values are still typically only 1/10000–1/1000 of the reference levels for power density given in the ICNIRP exposure limits. Many other technologies, such as TETRA base-stations might cause power densities that are in order of magnitude of 1/10000 of the reference levels, but only present in the proximity of such source. As the exposure level decreases rapidly with increasing distance from the source, the exposure caused by small transmitters, such as WLAN base stations, falls below the GSM base-station level if the distance is approximately more than a meter, such that peoples overall exposure does not increase.

The rapid decrease in exposure from RF with increasing distance from the source also leads to the fact that exposure from multiple sources seldom increases the overall exposure when compared to exposure from one or two nearby sources. Moreover, old technologies such as AM-radio or analogous TV broadcasts have been replaced by technologies capable of significantly more efficient use of the radio spectrum. Therefore, the fast development of technologies utilising radio waves has not lead to a similar fast increase of the exposure of the general public; indeed, according to a Swedish measurement campaign the “background” RF field level has remained the same in the period 2001-2007.

In addition to the radio transmitters mentioned here, there exist a large number of short range devices, such as RFID (radio frequency identification) electronic article surveillance gates in e.g. libraries, car keys, wireless thermometers and alarm systems in shops. The power output of these devices is small and hence the additional exposure is expected to be very low. Various high power applications such as radars and satellite links also exist, though according to measurement campaigns and risk assessment studies (e.g. Mulige helseeffekter av yrkesmessig strålingseksponering fra radar, 2007; Riks-Radiumhospitalet HF 05.07) these do not cause significant exposure to the general public under normal conditions.

More information about background RF fields and exposure of the general public is available on the internet sites of the Nordic radiation safety authorities. The data presented in this document is mainly based on the results of a Swedish background field measurement campaign (reported in SSI rapport 2008:13) and a Finnish study (reported in STUK-TR 5 2008 in Finnish). Both reports are available on the web.

[3] Root mean square