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WLAN

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A wireless local area network (WLAN) allows computers and laptops to be connected to each other, to peripheral devices (printers, scanners etc.) and to an Internet access point. WLAN-enabled mobile and cordless phones are increasingly being used for Internet telephony.

The data that need to be sent from one device to another are transmitted using a high-frequency radio link instead of a cable. Devices connected to a WLAN can both receive and transmit.

The level of electromagnetic energy emitted by the devices depends on their transmitting power and the volume of data being sent. This radiation is most intense when the maximum data volume is transmitted. It decreases rapidly with increasing distance from the transmitter. Even at maximum transmission power and data volume, the radiation emitted is 10 times lower than the recommended safety level at a distance of 20 cm from the transmitter, and 40 times lower at a distance of 1 metre.

It is currently not known whether the electromagnetic fields created by WLANs pose a risk to health. WLAN devices generally emit a low level of radiation, and caution should be exercised primarily when using devices held close to the body, such as laptops, PDAs and Internet telephones.

We would offer the following advice to people who prefer to minimise their personal exposure by keeping the electromagnetic fields in their home or office as small as possible:

- Only switch your WLAN on when you need it. With laptops, in particular, it is a good idea to switch the WLAN off as otherwise the device will repeatedly try to connect to a network, leading to unnecessary radiation and a shorter battery life.
- Don’t hold your laptop close to your body while it is connected to a WLAN.
- Wherever possible, install the access point one metre away from places where you work, sit or rest for long periods of time.
- Position the access point centrally so that all the devices in the network have good reception.
- Choose the WLAN g standard in preference to the b standard. Exposure to radiation is lower with this standard because it transmits data more efficiently.
- If it is possible to adjust the power of the network, the transmission power should be optimised at the access point for the area that needs to be supplied
- A WLAN transmitter must only be used with an antenna provided for this purpose by the manufacturer. If an unsuitable antenna with an excessive antenna gain is used, the maximum permitted transmission power may be exceeded.
- The measures recommended by the FOPH for reducing radiation exposure when using mobile

phones apply to WLAN-enabled mobile phones that are used for Internet telephony.

1 Structure and uses

Figure 1: A number of devices are connected with each other via the access point and with the Internet via the modem.

A WLAN is used primarily to network computers and laptops with each other, with peripheral devices (printers, scanners etc.) and with the access point. The access point transmits data between the devices and provides access to the Internet. The devices must be enabled for WLAN use; modern computers and laptops have an inbuilt WLAN chip, older devices can be fitted with a WLAN card. Electronic organisers (PDAs - personal digital assistants) and pocket computers which are WLAN-enabled can also be integrated into a wireless network.

WLAN-enabled mobile phones and cordless phones are used for Internet telephony via VoIP (Voice over IP) and can connect to the Internet through the access point. Hybrid models can use several radio technologies in parallel, such as DECT, VoIP and mobile telephony.

2 Technical data

The Institute of Electrical and Electronics Engineers (IEEE), an international professional organisation, has published a family of 802.11 standards for WLANs; their output characteristics are shown in Table 1.

Table 1: Properties of the various IEEE WLAN standards

IEEE standard	**802.11a**	**802.11b**	**802.11g**	**802.11h**
Max. transmission power (mW)	200	100	100	200/1000
Mean transmission power of beacon (mW)	1	0,5	0,5	0.5
Mean transmission power (max.) (mW)	< 200	< 100	< 100	< 200
Frequency (MHz)	5150 –5250	2400 – 2483,5	2400 – 2483,5	5150 –5350
Range (m)	50	Up to 200	50	50
Power regulation	no	no	yes, static	yes, dynamic
Max. raw data rate (MBits/s)	54	11	54	54
Proliferation	low	outdated	widespread	low

The most widely used standard nowadays is 802.11g. The frequency ranges of the a and h standards are also used for other services in Switzerland (and Europe). This is why a-standard devices may only be used at reduced power and inside buildings. The h standard has been adapted for Europe in such a way that it can free up the frequency immediately if it is needed by another service

Data rates

The more recent standards 802.11 a, g and h incorporate high data rates. If several devices try to use an access point at the same time (e.g. several computers in a classroom), the transmission capacity of the connection is split, with the data rate for each device dropping accordingly.

Regulating transmission power

In the h standard the transmission power is regulated automatically depending on the reception quality. In addition, the transmission power of g-standard and h-standard access points can be regulated by the software to suit the area to be served.

Radiation

The level of energy emitted is determined primarily by the volume of data being transmitted. Even when no data are being transmitted, the access point still sends a signal (the beacon) lasting 0.5 ms every 100 ms to enable the other devices to synchronise with it. If a 100 mW access point is only transmitting the beacon, the mean energy emitted over time is 0.5 mW. However, if a large volume of data is being transmitted, the mean energy emitted can be up to 70 mW.

The radiation pattern is very irregular because a device can transmit as soon as no other data transfer is taking place. The beacon transmitted by the access point produces relatively evenly pulsed energy with a repetition frequency of 10 Hz, for example.

The effect of distance

The energy emitted by an antenna decreases greatly with increasing distance. It can also be weakened or reflected by obstructions such as walls. The data rate can therefore drop if there is a considerable distance between the access point and the networked devices, or if data have to contend with obstacles.

Devices that use the h standard have a longer range in the open because their transmission power is greater. At the same time, however, the energy emitted by these devices is attenuated to a greater degree by walls because of the higher frequency at which they operate, resulting in a lower range inside buildings.

WLANs are very sensitive; in other words, they can network even if the energy level is very low.

3 Measuring exposure

The best way to describe exposure is in terms of SAR (specific absorption rate). The SAR (in W/kg) shows how much energy (W) is absorbed by the human body (kg). The electrical field can be measured for devices which are used away from the body, and this field can be used to calculate the SAR.

A study commissioned by the FOPH measured the electrical field and the SAR of various access points, PC cards and a PDA [1]. Since the radiation emitted by the WLAN depends on the transmission power of the device and the rate at which data are transmitted, all the measurements were carried out at the maximum transmission power and data rate. The various standards use different modulation methods which produce different levels of energy. Although the g standard has a higher data rate than the b standard, the level of energy emitted tends to be lower than that produced by the b standard.

SAR

Table 2: The maximum SAR measured and the data rate used are shown for each standard. SAR values were measured in a phantom human [1].

Maximum SAR values			
Standard	**Device**	**Data rate (Mb/s)**	**SAR (W/kg)**
802.11a	Access point	30	0,54
	PC card	13,3	0,07
802.11b	Access point	6	0,73
	PC card	6,3	0,43
	PDA	3,8	0,067
802.11g	Access point	26	0,27
	PC card	21,5	0,11

The maximum level recommended by the ICNIRP (International Commission on Non-Ionizing Radiation Protection) is 2 W/kg [2]. The SAR values of all the devices measured are below this level.

Electrical field

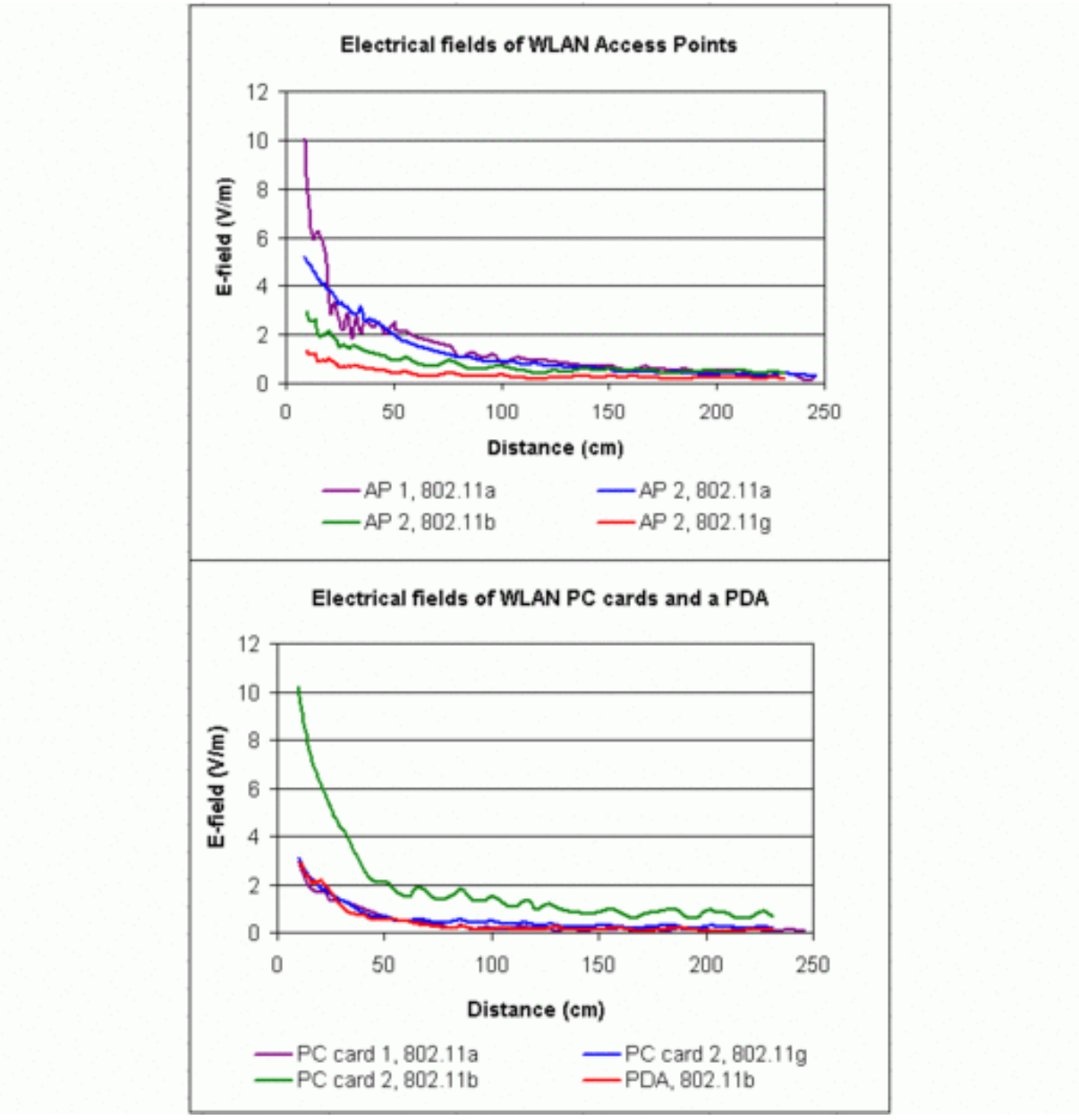

Figure 2: Electrical field as a function of distance for two different WLAN access points (AP), PC cards and a PDA. Access point 2 can be operated using the 802.11 a, b or g standard, the PC card 2 using 802.11 b or g.

Electrical fields decrease greatly as the distance from the transmitter increases. The values are in all cases below the ICNIRP's recommended threshold of 61 V/m. None of the devices reaches more than 10% of the ICNIRP's recommended threshold at a distance of 20 cm, and they reach less than 2.5% at 1 metre.

WLAN hotspots

An area in which Internet access is available via a WLAN is called a hotspot. Hotspots may be accessible to the public (in stations, airports etc.) or limited to a specific set of users (in hotels, for example). Access points in buildings are typically mounted in the ceiling or walls, in rare instances in cavity floors; access points that supply outdoor areas are installed on the façade of a building or on the roof. Several access points may be installed in one hotspot.

The energy emitted by hotspots is also well below the ICNIRP's recommended maximum level of 61 V/m.

ICNIRP. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)

4 Effects on health

Based on the current state of knowledge and available exposure measurements, the high-frequency radiation emitted by wireless networks is too weak to have an acute impact on health due to an increase in temperature following absorption. Long-term and non-thermal effects have not been researched sufficiently. The available studies on the effects of exposure to high-frequency EMF at low doses below the current thresholds do not suggest any risk to health from wireless networks.

Individual WLAN devices, such as WLAN-enabled laptops, mobile phones and PDAs, can lead to longer-term radiation exposure when used close to the body. At the moment the impact on health of such devices when used close to the body is uncertain; international research is currently investigating them in detail in connection with the effects of radiation emitted by mobile phones. Suitable precautions as described in the introduction to this fact sheet can minimise this exposure.

5 Regulation in law

WLANs are governed by the Swiss regulation on telecommunications systems (FAV) [3], which sets out the fundamental requirements that have to be met to protect the health and safety of users and other people. The threshold values on which the applicable standards are based are the same as the thresholds recommended by the ICNIRP. They are issued by bodies such as the European Committee for Electrotechnical Standardization CENELEC.

Legislation governing hotspots

The access points of public hotspots are stationary transmitters and as such are governed by the Regulation concerning protection against non-ionising radiation (NISV) [4].

Since the maximum permitted transmission power of WLAN access points is below 6 watts ERP, they do not have to comply with a precautionary limit on emissions, i.e. they do not have to operate below

an additionally reduced limit for systems. However, hotspots have to comply with the less strict emission thresholds stated in the NISV if the whole human body is exposed equally to the radiated energy.

If people remain so close to the antenna of a hotspot that their whole body is not exposed equally, or only parts of their body are exposed, the emission threshold stated in the NISV does not apply. In this case the requirements of the Regulation on telecommunications systems (FAV) [3] and the ICNIRP threshold of 2 W/kg [2] for the specific absorption rate apply.

SR 814.710: Verordnung vom 23. Dezember 1999 über den Schutz vor nichtionisierender Strahlung (NISV)

6 References

1. Kühn S et al. Development of Procedures for the EMF Exposure Evaluation from Wireless Devices in Home and Office Environments. Sup-plement 1: Close-to-Body and Base Station Wireless Data Communication Devices. 2006. IT'IS Report.
2. ICNIRP. Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields up to 300 GHz. Health Phys. 75: 494-521. 1998.
3. Regulation of 14 June 2002 concerning telecommunications systems, SR 784.101.2.
4. Regulation of 23 December 1999 concerning protection against non-ionising radiation, SR 814.710 (NISV). See "Further information"

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