

# Mobile network and in-building systems

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# Mobile network and in-building systems

Some buildings do not receive an optimal signal from the existing mobile network. Calls frequently drop – often phone calls cannot be made at all. Particularly in buildings where many customers want to make calls, such as in shopping malls or office buildings, a separate in-building system is often the only way to ensure optimal coverage. In this case, the signal of the mobile radio system is divided over a plurality of antennas. The transmitting power and the exposure per antenna are thus very small – lower than with mobile phones in poorly served areas. By dividing the mobile phone signal over multiple antennas the consistent supply of the building with a mobile phone signal is guaranteed.

The three advantages of an in-building system:

1. The transmitting power per antenna is very low due to splitting it.
2. Mobile phones transmit with less power.
3. This means less exposure.

The great advantage of an in-building system is the optimum reception indoors. Mobile phones can – without having to penetrate thick walls or windows – establish a connection to the mobile phone network.

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# Mobile phones and antennas in office buildings

Each phone has a built-in power control. The transmitting power of a mobile phone increases when the distance between the mobile phone and a base station widens or thick walls worsen the reception. If the reception is very bad, then the mobile phone transmits using maximum transmitting power and the base station has to send with maximum transmitting power also in order to maintain the call.

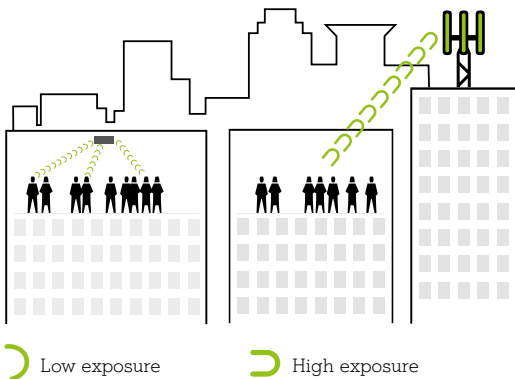
With an in-building system, this is not the case. Thanks to the optimal reception for in-building systems, the mobile phone automatically reduces the transmitting power to a minimum. If you compare the maximum transmitting power of an antenna with 0.1 watts with the typical transmitting power of a GSM mobile phone of up to 2 watts, then you quickly realize that a mobile phone signal within a building reduces exposure overall.

Transmitting power in comparison	
LTE mobile phone	maximum 0.2 watts
UMTS mobile phone	maximum 0.25 watts
GSM mobile phone	maximum 2 watts
Antenna for an in-building system	typical 0.01 – 0.1 watts

The mobile phone will automatically change its transmitting power if the reception conditions change. If reception is poor, the phone uses the maximum transmitting power.

## Planning and construction of an in-building system

For an in-building system, multiple antennas are installed in the building so that the entire building is supplied as evenly as possible with mobile signal. A single antenna only needs a transmitting power of about 0.1 watts thanks to cable connections and good planning. This is sufficient to ensure that all mobile phones in the building have optimal reception. In the technical execution of an in-building system, there are two options: The in-building system can be set up as a separate mobile signal plant or as a repeater system.



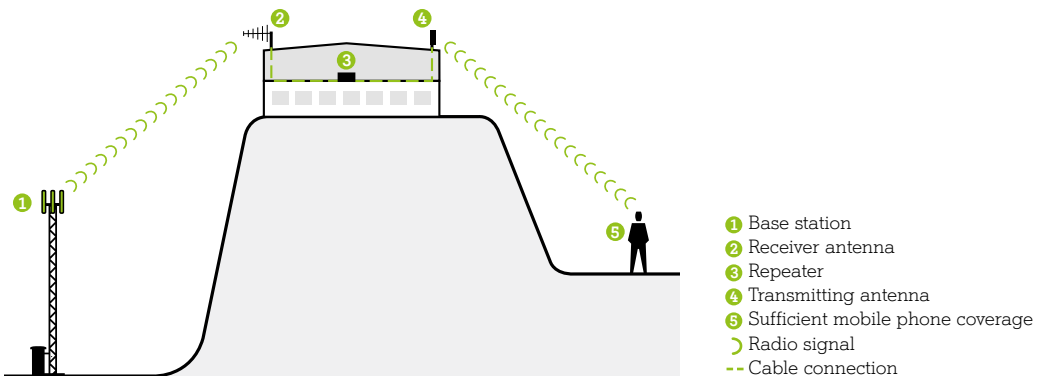
# Mobile networks in remote areas

Repeater systems are often used in order to supply remote areas such as ski resorts, hiking areas or tunnels with mobile signal. It is used wherever lower call frequencies are expected or where the construction of a base station is not possible e.g. due to technical reasons. The advantage of a repeater system is that no separate connection to the phone network is necessary for the repeater.

The signal of a remote base station is received, amplified and passed to a transmitting antenna. With a well-planned repeater, a mobile supply of high quality can be realized even in remote areas.

## How a repeater works:

The signal of a mobile base station is received, amplified and passed through a separate antenna.



## Emissions for in-building systems and repeater technology

Emissions, i.e. radio waves at a particular location, can be calculated using technology or can be measured on site. The result is the so-called power density (S), which is expressed in watts per square meter ( $\text{W}/\text{m}^2$ ).

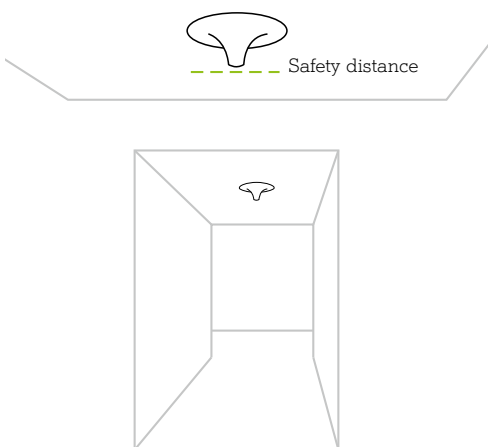
The Telecommunications Authority carries out measurements to verify compliance with the limits of the World Health Organization. These values are also found in the personal protection standard ÖVE/ÖNORM E 8850. A1 also carries out regular emission measurements. In these measurements, the emissions of a base station are determined exactly and compared with the limits of the World Health Organization. The measured values for an in-building system are about 4,500 times within the mandatory exposure limits for ÖVE/ÖNORM E 8850 for personal safety which is mandatory in Austria.

WHO exposure limits in ÖVE/ÖNORM E 8850	
At 800 MHz (LTE)	4 $\text{W}/\text{m}^2$
At 900 MHz (GSM)	4.5 $\text{W}/\text{m}^2$
At 1,800 MHz (GSM)	9 $\text{W}/\text{m}^2$
Over 2,000 MHz (UMTS, LTE)	10 $\text{W}/\text{m}^2$

Exposure limits for emissions of base stations

# Safety and personal protection

Safety distances for base stations and for antennas for building and repeater supplies are calculated based on the limits of the ÖVE/ÖNORM E 8850. Directly in front of the antenna for an in-building system, the safety margin is only a few centimeters due to the low transmitting power. The antenna are usually located within the building. Since antennas are fitted indoors to ceilings, this safety area is not accessible. The emissions of the antenna for an in-building system are far below the prescribed limits, the same as other areas of Austria which are supplied with a mobile signal.



Safety distance for an in-building system

## National and international standards for personal protection

The limits of the World Health Organization (WHO), which are also binding for Austria according to the ÖVE/ÖNORM E 8850, include a fifty-fold safety factor. Therefore, these scientifically defined limits offer additional protection for the elderly and children.

The last review of the limits in June 2011 by the World Health Organization revealed, "a large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use." WHO Fact Sheet No. 193, June 2011.



## Mobile coverage in hospitals

In order to ensure that mobile coverage and medical-technical devices do not interfere, there is a wide range of applicable standards and guidelines that have to be adhered to. Since June 1998, the Medical Device Directive 93/42/EEC has been in force for all electromedical equipment(s). With the ÖVE/ÖNORM EN 60601-1-2, all medical devices meet these safety requirements.

This standard ensures that life-support equipment in hospitals, such as cardiovascular equipment, have a higher immunity and are thus more reliable. A distinction is made between non-life-supporting and life-supporting medical devices. Within this differentiation, there are different limits to be observed by the equipment manufacturer.

### What is electromagnetic compatibility (EMC)?

When testing for EMC, technical devices are specifically influenced by radio waves to see whether they comply with the conditions laid down in the standard EMC levels. From computer to the mixer, all devices are checked for compliance with the interference immunity. Strict standards apply to devices in hospitals which have to be adhered to.

The values given in the table are minimum requirements that must be met by medical devices which are launched into the marketplace.

ÖVE/ÖNORM EN 60601-1-2	EMC in W/m²	EMC in V/m
for non-life-supporting electro-medical equipment	0.024 W/m²	3 V/m
for life-supporting electro-medical equipment	0.265 W/m²	10 V/m

EMC of medical equipment

Regarding the use of mobile phones in hospitals, please adhere to signs and do not use in areas where the use of mobile phones is banned.

# FAQs

## **What is an in-building system?**

Thick walls or distant base stations often lead to poor reception inside buildings. To make calls in those areas, the mobile phone signal is split over multiple antennas with an in-building system located within the building itself.

## **What is the advantage of an in-building system?**

An optimal mobile phone coverage in buildings creates better reception conditions. Exposure is therefore lower than it would be if the supply were to come from outside.

## **What is the exposure of an in-building system?**

Thanks to the built-in control in any mobile phone, the transmitting power decreases, if the reception is good. An in-building system needs only limited transmitting power due to the short distance between the phone and antenna inside a building. The emission values for an in-building system are about 4,500-times below the mandatory limit values for ÖVE/ÖNORM E 8850 that govern personal safety in Austria.

## **What is the transmitting power of an antenna inside a building?**

Typical transmitting power of an antenna for an in-building system is approximately 0.01 to 0.1 watts. In comparison, the maximum transmitting power of a GSM phone is 2 watts and a UMTS cell phones 0.25 watts. If a building is poorly supplied with a mobile phone signal, then more transmitting power is required by the phone when making phone calls. Hence, there are even stronger emissions from a mobile phone within a building than a single antenna for an in-building system would cause.

## **Can an in-building system interfere with medical equipment?**

Each manufacturer must comply with the standard for the so-called EMC for medical devices. This standard guarantees a high reliability of medical electrical equipment. According to the ÖVE/ÖNORM EN 60601-1-2, the interference immunity value for non-life-support equipment is at  $0.024 \text{ W/m}^2$  ( $3 \text{ V/m}$ ) – this value must be adhered to for medical devices.

### **What is electromagnetic compatibility?**

When testing for interference immunity, technical devices are specifically influenced by radio waves to see whether they comply with the conditions laid down in the standard interference immunity levels. From computer to the mixer, all devices are checked for compliance with the interference immunity. Strict standards apply to devices in hospitals in particular.

### **How does a repeater work?**

The signal of a mobile base station is received, amplified and passed through a separate antenna. This means that even remote areas can have a mobile phone signal.

### **Can you use mobile phones in hospitals?**

Regarding the use of mobile phones in hospitals, please adhere to signs and do not use in areas where the use of mobile phones is banned. In general, there is no reason why you should not use mobile phones in hospitals. Mobile phones play an important part in maintaining contact between patients and relatives.

### **What does electromagnetic compatibility mean?**

This refers to the ability of electronic devices to work flawlessly and not to interfere with other devices. Noise emission and interference immunity requirements are regulated by norms and directives issued by the European Parliament and by national laws. All electronic equipment placed on the market must be such that the generation of electromagnetic interference is limited so that an intended operation of other devices is also possible.

## **The EMF-Team is happy to answer your questions:**

Email: [emf@A1.net](mailto:emf@A1.net)

Phone: 050 664-0

## **Further information can be found at:**

[A1.net/gesundheit](http://A1.net/gesundheit)

[A1.net](http://A1.net)

A1 field simulator:

[A1.net/feldsimulator](http://A1.net/feldsimulator)

TAG-EMF:

[www.telekomaustria.com/en/csr/emf](http://www.telekomaustria.com/en/csr/emf)

Forum Mobilkommunikation:

[www.fmk.at/en](http://www.fmk.at/en)

Register of all public broadcast- and mobile base stations  
in Austria:

[www.senderkataster.at](http://www.senderkataster.at)

Mobile communication test series:

[www.messwerte.fmk.at](http://www.messwerte.fmk.at)

Austrian Regulatory Authority for Broadcasting and  
Telecommunications:

[www.rtr.at](http://www.rtr.at)

Federal Ministry for the Transport, Innovation and  
Technology:

[www.bmvit.gv.at](http://www.bmvit.gv.at)

Accredited Testing Institutes:

[www.seibersdorf-laboratories.at/home/emc-optics.html](http://www.seibersdorf-laboratories.at/home/emc-optics.html)

[www.tgm.ac.at](http://www.tgm.ac.at)

[www.tuev.or.at](http://www.tuev.or.at)

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