

Mobile communication and LTE

Simply A1.



A1 LTE – the data network of the future

Next generation mobile broadband. The number of A1 customers using mobile broadband is increasing continuously due to smartphones and data sticks. In addition, multimedia applications require more and more bandwidth. We assume that the growth curve will continue to accelerate.

4th generation mobile communication, called LTE (Long Term Evolution) in technical jargon, will revolutionize communications in the coming years. LTE enables A1 to offer faster broadband services.

With data transmission rates of up to 150 Mbit/s, this technology is particularly suitable for the provision of data services at high speed. These services include complex online applications, video conferencing in HD quality, but also internet on the mobile phone.

Since 2008, A1 has been evaluating the framework for the new generation of mobile communication. After extensive testing, expansion has begun in 2010. In parallel, the HSPA+ network will also be further expanded.

Hannes Ametsreiter
CEO of A1 Telekom Austria AG

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New challenges for established technologies

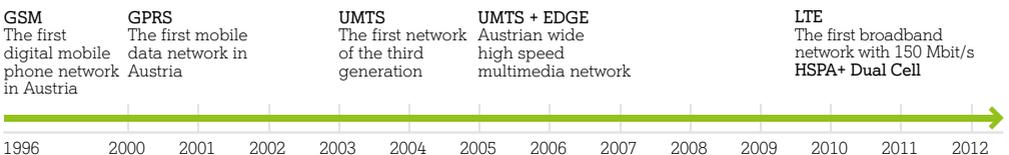
Expand data highways

We all use modern mobile technologies day in, day out. For a long time it has not just been about telephony alone. In the era of smartphones and tablet computers, mobile networks enable many new applications for mobile internet.

The expansion of existing mobile systems is important with ever-growing internet traffic due to more and more smartphones. Only by expanding these mobile systems will it be possible to ensure stable data transmission.

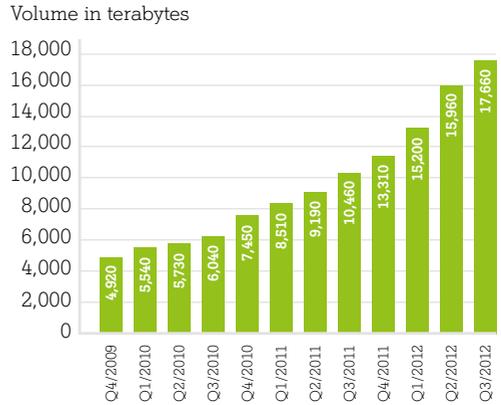
To enable the best possible transmission, new base stations have to be built where customers are located. Thus, the transmitting power is reduced, extending phone battery life and keeping emissions low.

LTE technology (for B-, C-, D-, GSM and UMTS networks) represents the latest generation of mobile telephony and enables more efficient use of the frequency spectrum, where the mobile signals are transmitted.



Development of the A1 mobile phone data network

By combining advanced mobile technology with a powerful landline network, LTE mobile network offers ideal conditions to cope with the ever increasing traffic. It allows transmission speeds of up to 150 Mbit/s and significantly shorter access times for data requests. This results in higher surfing speeds on the mobile internet.



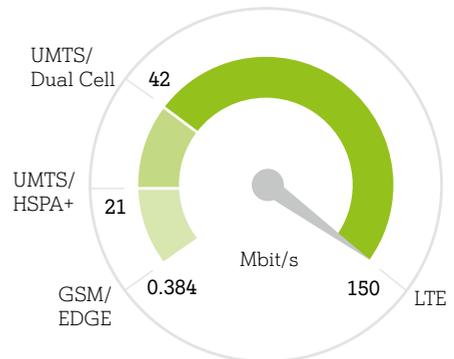
Used up and download volumes in the mobile phone end user market in terabytes.
Source: RTR Telekom Monitor 01/2013

Why was LTE technology developed?

The rapid increase in data traffic demands faster mobile networks.

Whether we surf the internet in a café or make a mobile phone call at home – wherever we are, more and more data is transmitted in ever shorter times due to the intensive use of mobile telephony. This also makes the increasingly efficient use of mobile radio frequencies more important. LTE is ideal for this purpose, as it uses newer and better transmitting technologies.

Much more data can be transmitted simultaneously than ever before.



Faster surfing with LTE

With LTE on the fast track

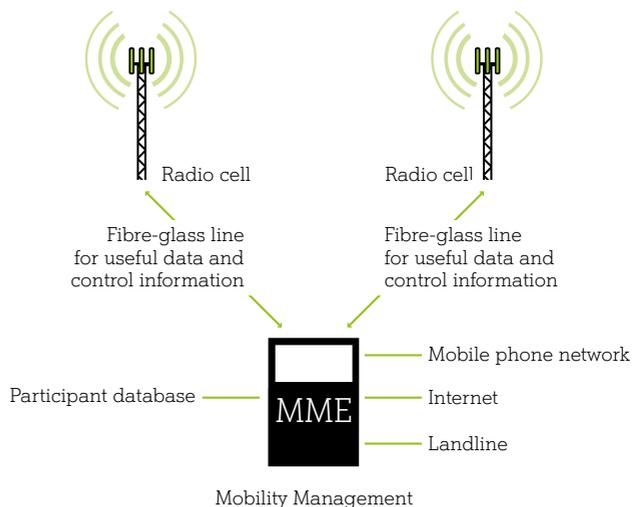
How the LTE mobile network works

Whenever you surf the mobile internet, your device in the mobile network is logged in a centralized mobility management entity (MME) first. This means your location within the mobile network is checked, so the conversation or the data reaches the correct destination.

Next, the radio link is tested to ensure that the call or internet data can be transmitted as quickly as possible. When a connection is established, the LTE terminal sends regular information about the reception quality to base station. A decision is made as to which modulation method, which encoding and transmitting methods should be used.

The following applies: The better the reception between base station and LTE device, the lower the necessary transmitting power. A better reception also allows for faster file transfers.

The mobility management entity MME is also used for transmitting data to the base stations. Thus large amounts of data can be forwarded as quickly as possible. This process takes place via fibre-optic lines or, if that is not possible, via directional radio. The MME organizes all connections to other mobile networks, landlines or internet.



LTE expansion in the mobile network

The LTE technology enables new applications with higher data transmitting rates. Applications that transmit large amounts of data can be used on the smartphone. For this purpose, the mobile network also needs to be adjusted accordingly.

For the expansion of the LTE network, the existing base stations are adapted as a priority. Depending on need, existing antennas are replaced or new antennas are fitted.

LTE for urban and rural areas

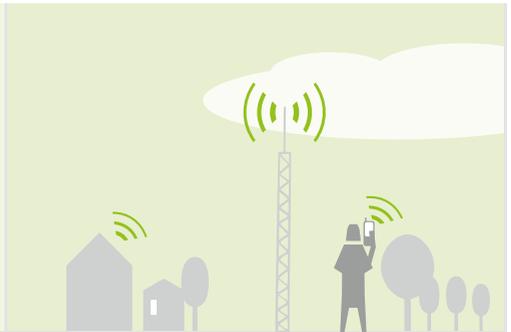
For LTE base stations, different frequencies can be used. Fast internet surfing in the city and in the countryside is therefore possible. Ranges between 300 m in

urban areas and up to 10 km in the countryside make high speed internet available throughout Austria.

LTE in the city



LTE in the countryside



LTE 2,600 MHz

Ideal for speed and capacity

cell radius up to 300 m



LTE 800 MHz

Ideal to cover great surface areas outdoors

cell radius up to 10 km

LTE emissions and exposure limits

WHO exposure limits for LTE

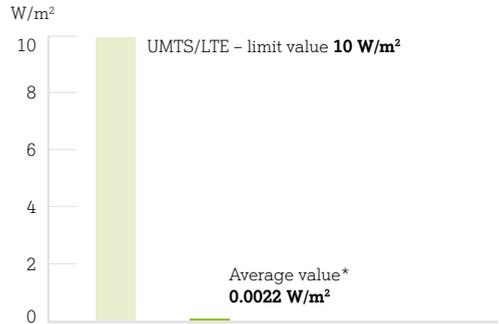
The spectrum for electromagnetic waves ranges from visible sunlight via infrared (heat effect) to the low-frequency current. A part of this range are radio waves for base stations and mobile phones.

These can be calculated or measured. For this purpose, exposure is determined; emissions are radio waves at a particular location. Depending on the frequency range, different limits apply which must be adhered to.

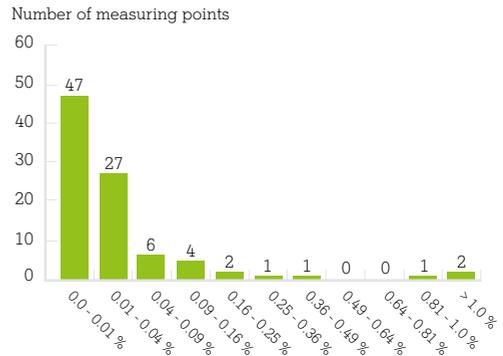
In order to assess the exposure, the results of a measurement or calculation are compared with these limits.

“The control functions of the new mobile radio standard LTE at locations which are used jointly by GSM and/or UMTS lead to an increase in mobile phone total emissions at very low levels.” Below is the measurement report for the nationwide series of measurements of the IZMF (IZMF) from January 2013 in Germany.

WHO exposure limit values in ÖVE/ÖNORM E 8850	
At 800 MHz (LTE)	4 W/m ²
At 900 MHz (GSM)	4.5 W/m ²
At 1,800 MHz (GSM)	9 W/m ²
Over 2,000 MHz (UMTS, LTE)	10 W/m ²



Result of the test series for UMTS frequency ranges by the Austrian Ministry for Transport, Innovation and Technology

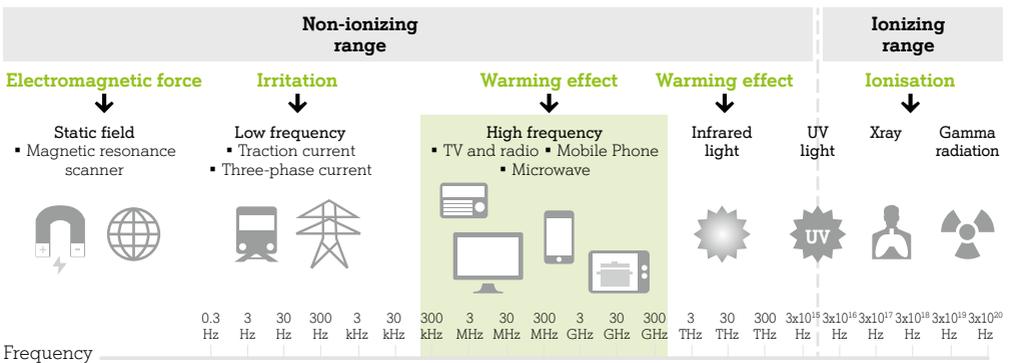


A nationwide LTE measurement by IZMF in Germany shows: The measured values at all measuring locations are far below the WHO limit value of 10 W/m²

Mobile communication under the magnifying glass

Biological effects of radio waves

The sun produces strong electromagnetic fields. We feel their effects in the form of heat. UV light highlights in the entire frequency spectrum the range between non-ionizing and ionizing ranges. The effect of electromagnetic fields is therefore dependent on the frequency. In the field of mobile communication, only radio waves cause a thermal effect. This is restricted by limits issued by the World Health Organization, which have to be strictly adhered to in Austria, both for base stations and mobile phones.



Exposure limits for mobiles

A set of safety policies and the SAR limit have to be adhered to for mobile phones. The Specific Absorption Rate (SAR) will ensure that the heating effect to the head area caused by radio waves is not more than 0.1 degrees Celsius.

Factor 10

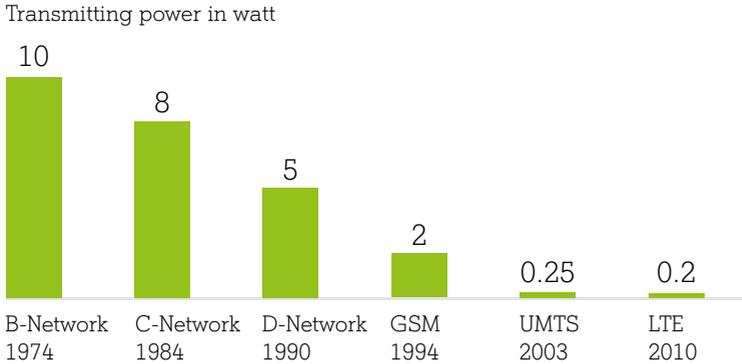
Factor 5

Biological effects and limit values in mobile telephony		
SAR*	Warming effect	Limit value
4 W/kg	less than +1°C	threshold
0.4 W/kg	low	occupational
0.08 W/kg	not measurable	general public

* SAR: specific absorption rate. Source: own research

The transmitting power of LTE

In recent years, a rapid development has taken place in the field of mobile communication. Modern LTE devices have significantly reduced transmitting power, e.g. in comparison with a B-network mobile phone from the 1970s.



This is how the maximum transmitting power of mobile phones has changed

However, the advancement of mobile technologies not only improve phone size and longer battery life, they also reduce emission levels. While the mobile phones of the first-generation transmitted all information without controlling the transmitting power, the transmitting power of modern mobile phones and data sticks is now adjusted automatically and regulated permanently.

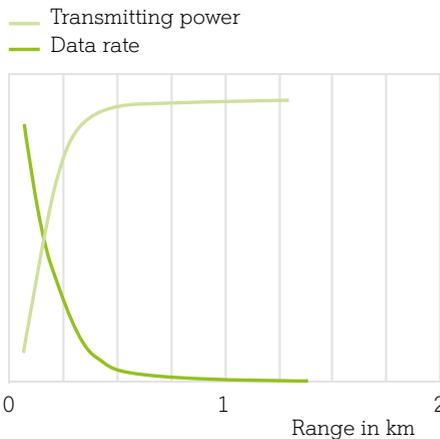
Less transmitting power. Better coverage.

The emissions from mobile phones and data sticks depend on two factors: the quality of the reception and the transmitted amount of data. If there is a good mobile phone signal between your mobile phone and base station, then the phone only has to “whisper” to be “heard” by the base station, i.e. for the signal to be received. The better the coverage, the lower the transmitting power of the mobile phone.

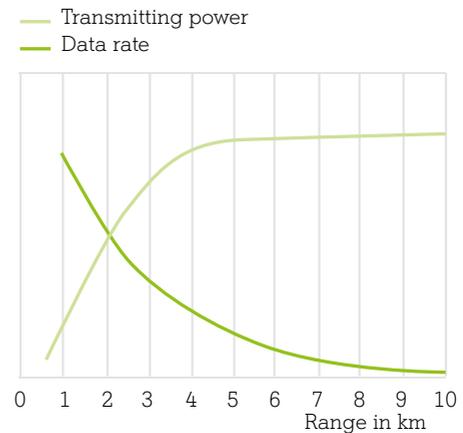
The basic requirement for a good mobile signal is a base station in the vicinity of the mobile phone user. If he/she is in the vicinity of such a station, then his/her mobile phone only needs very low transmitting powers – and therefore has low emissions.

In addition, the exposure of mobile phones are subject to strict legal restrictions. For mobile phones a SAR limit of 2 watts per kilogram of body weight applies. This ensures that you can call around the clock without any health effects. This limit must comply with the standard EN 62311 for all mobile phones.

The greater the distance to the base station, the slower the file transfers for LTE 2,600 MHz mobile telephony. In LTE 800 MHz cellular systems, the ranges are larger due to the lower transmitting frequency.



Transmitting power, data transfer rate and range of an LTE-2,600 MHz base station



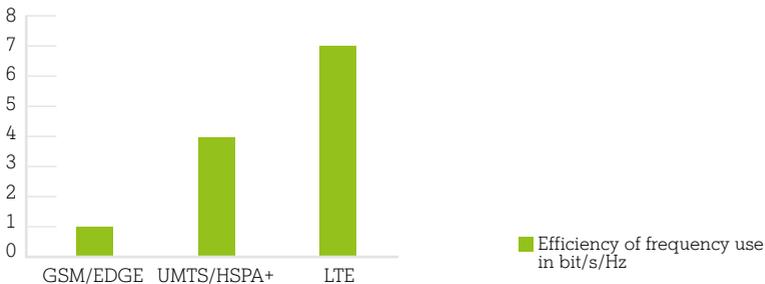
Transmitting power, data transfer rate and range of an LTE-800-MHz base station

Faster. Shorter. Less.

The advantages of LTE technology at a glance:

- Downlink transmitting speeds of up to 150 Mbit/s
- Latency (response time to data request) is reduced by a factor of 2-3
- Better use of spectrum efficient technology (transmission method MIMO = Multiple Input/Multiple Output)
- IP-based
- Reduced transmitting power necessary for mobile phone

Due to the advantages of LTE technology, the spectral efficiency improves in comparison with previous mobile technologies. This makes it possible to transmit more data more efficiently and makes better use of existing frequencies. The spectral efficiency of a radio signal is the ratio between the bandwidth of the signal and the rate of data transmission.



Mobile technologies in comparison (spectral efficiency)

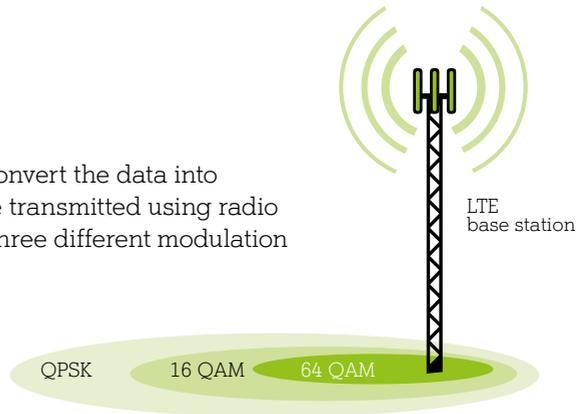
The spectral efficiency is described in bit/s/Hz and indicates how many characters can be transmitted in comparison with the same bandwidth (frequency range) per second. This calculated value allows you to compare different transmitting technologies.

The new LTE mobile standard

A better use of frequency in LTE allows you to transmit more data and calls via mobile phone frequencies. For example, the performance of file transfers is further improved with the LTE modulation techniques and MIMO.

LTE modulation method

Modulation techniques are used to convert the data into electronic signals. These can then be transmitted using radio waves or cables. In LTE technology, three different modulation methods are used for file transfers.

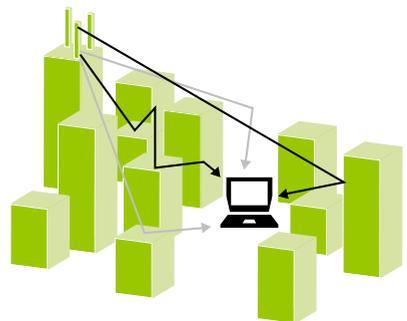


Data transfer rates

The modulation method is selected depending on the distance to the mobile phone and the reception quality. The closer the better. The mobile phone continuously measures the reception quality and reports this back to the base station. The modulation method is selected according to this data. In most cases the quality of reception will decrease with increasing distance. LTE uses the optimum modulation method in order to ensure the fastest possible connection.

More data may be transferred faster – the LTE transmission technology MIMO

The principle of MIMO (Multiple Input/Multiple Output) is already in use for proven technologies such as WLAN and WiMAX. Multiple antennas are used to transmit more data faster. By using multiple antennas, better transmitting power and reception performance is achieved during data transfers as well as a higher connection quality and thus higher data transfer rates.



Faster data transmission with MIMO

Mobile communications and health

50-fold safety factor

Electromagnetic waves (radio waves) have already been used as standard for new technologies a lot of research has been done about the possible effects on humans since radio waves have been in use. However, adverse health effects from radio waves have so far not been detected since the advent of mobile phones, despite intensive research.

WHO exposure limits are in use in Austria to protect your health. These limits have a 50-fold safety factor and thereby protect the entire population – including the elderly and children.

Many completed measurements show that the measured values are in general well below the exposure limits. Current RF measurements by the Austrian Ministry for Transport, Innovation and Technology show an average emission value of just 0.0022 W/m^2 for UMTS mobile communications.

These measured values are on average a factor of 4,500 below the legal limit.

More and more Austrians call and surf the internet using their mobile phone or smartphone – whether at home or outdoors. Modern transmission technologies such as LTE are a significant reason that exposure is minimized by better transfers. The more efficient LTE technology requires less transmitting power for file transfers than a comparable transfer in the GSM mobile network.

How high the transmitting power used, and the associated emissions for the mobile phone and the base station, are ultimately determined by the intensity of mobile phone use by the customer.

FAQs

Why was LTE developed?

Due to the intensified use of mobile communications, it is necessary to ensure that more and more data can be transmitted in ever shorter time periods. With LTE much more data can be transmitted simultaneously than ever before. So you can surf even faster, have faster download speeds and experience social media applications in real time.

What do I need for LTE reception?

For surfing in the LTE network you need a LTE data stick or a LTE smartphone. LTE is also referred to as 4G technology. Therefore, many data sticks and smartphones have a label saying 4G. When 4G is displayed on the screen of a smartphone then data can be transmitted with up to 150 Mbit/s.

Do LTE data sticks and smartphones send a stronger signal?

No! LTE uses more efficient transmission technologies than GSM and UMTS. Therefore with LTE, up to 1,300 people can surf the internet simultaneously. In this case, the maximum transmitting powers used are lower than for all other mobile technologies. A GSM mobile phone has up to 2 watts transmitting power – a modern LTE smartphone is 0.2 watts.

Is LTE safe?

WHO exposure limits are in use in Austria to protect your health. These limit values protect the entire population including the elderly and children. Furthermore, we also check every mobile phone and every data stick for its adherence to SAR limits.

What does the SAR limit of a mobile phone or smartphone mean?

SAR (specific absorption rate) indicates how the energy emitted by the terminal is absorbed by the body. The SAR of a terminal is always measured at maximum transmitting power and must not exceed the limit value of 2 watt per kilogram of body weight.

The EMF-Team is happy to answer your questions:

Email: emf@A1.net

Phone: 050 664-0

Further information can be found at:

A1.net/gesundheit

A1.net

TAG-EMF:

www.telekomaustria.com/en/csr/emf

3rd Generation Partnership Project:

www.3gpp.org

World Health Organisation:

www.who.int/peh-emf/en/

International Commission on Non-Ionizing Radiation

Protection:

www.icnirp.de

Federal Ministry for the Transport, Innovation and

Technology:

www.bmvit.gv.at

Austrian Regulatory Authority for Broadcasting and

Telecommunications:

www.rtr.at

Register of all public broadcast- and mobile base stations

in Austria:

www.senderkataster.at

Forum Mobilkommunikation:

www.fmk.at/en

Guideline for the establishment/construction of a mobile

base station:

www.senderbau.fmk.at

Mobile communication test series:

www.messwerte.fmk.at

EMF portal (of the) Research center for Bioelectromagnetic

Interaction:

www.emf-portal.de

About this site

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