Isolation

Broadband Antennas versus Narrowband Antennas

There are different opinions about when an antenna is "broadband":

Some manufacturers already describe an antenna as "broadband" if one frequency range can be covered with just one antenna version, e.g. 880 – 960 MHz for GSM 900.

With Kathrein antennas the term "broadband" is used if a minimum of two frequency bands can be operated with one antenna, e.g. 1710 – 2170 MHz for both GSM 1800 and UMTS.
Consequently, a Kathrein antenna for only one frequency band is termed narrowband.

What distinguishes a broadband from a narrowband antenna?

Many people are of the opinion that antennas work like filters. If a frequency range of 1710 – 1880 MHz is stated, then "the antenna will no longer function at 1900 MHz". For this reason it is also assumed that the decoupling between two narrowband antennas with neighboring frequency bands will be better than that of two similar broadband versions. This is, of course, not the case.

Modern radiating elements show up band widths that extend far beyond the stated frequency range, for which the specified values as given in the data sheet apply, such as VSWR, gain, half-power beam width, CPR (Cross Polar Ratio) etc. Above and below this range the functionality of the antenna still remains, but with increasing deviations from the specifications.

The situation is similar to that of a light-bulb which is designed for a power rating of e.g. 200 – 240 V, but which will still function at 180 V, even though it will not shine quite so brightly.

What factors affect the isolation values?

– Mounting spacing
– Radiating direction
– Half-power beam width
– Gain
– VSWR / Mismatch loss
– Electrical downtilt
– Antenna type and design

Which of these factors are related to the characteristics of broadband or narrowband antennas?

Mounting spacing
Radiating direction
When broadband and narrowband antennas are compared, the same spacings and radiating directions must exist so that the effect of these varying factors can be ignored.

Half-power beam width
If two neighboring directional antennas are pointing in the same direction, the isolation value is determined by the radiation at +/– 90° from this direction (radiation towards each other).
If the half-power beam width increases, the radiated power rating also increases in this direction and the decoupling value drops. 90° antennas therefore have a considerably lower isolation value than 65° antennas.

However, for a comparison of broadband and narrowband antennas this aspect does not have to be taken into consideration. Any possible difference in the beamwidth over the frequency is so minimal and also partially compensates itself, so that the isolation value is not affected by it.

Gain

Away from the specified frequency range, the gain in the farfield of an antenna gradually decreases. A good isolation value is above all necessary where there are small mounting distances, e.g. where the antennas for two different networks are mounted horizontally to one mast.

For spacings below 10 wavelengths the near field conditions are fulfilled, for which the given gain does not apply. Therefore any possibly varying gain pattern over the frequency of narrowband antennas compared to broadband antennas will not have any influence on the decoupling value.

VSWR / Mismatch loss

Narrowband antennas show up higher VSWR values in a neighboring frequency range than broadband antennas which are designed for this range. The resulting mismatch creates an attenuation which is called mismatch loss. This parameter describes the effect of the VSWR on the entire system. However, this value is often lower than it is assumed to be.

It amounts to 0.18 dB at a VSWR value of 1.5, but it only increases to 1.95 dB at an already very poor VSWR value of 4 (see Fig. 1). A growing mismatch loss also increases the isolation between two antennas.

For the above case the isolation of two narrow-band antennas with a VSWR of 4 in the outside band would increase by only 1.77 dB compared to broadband antennas with a VSWR of 1.5 in the whole range.

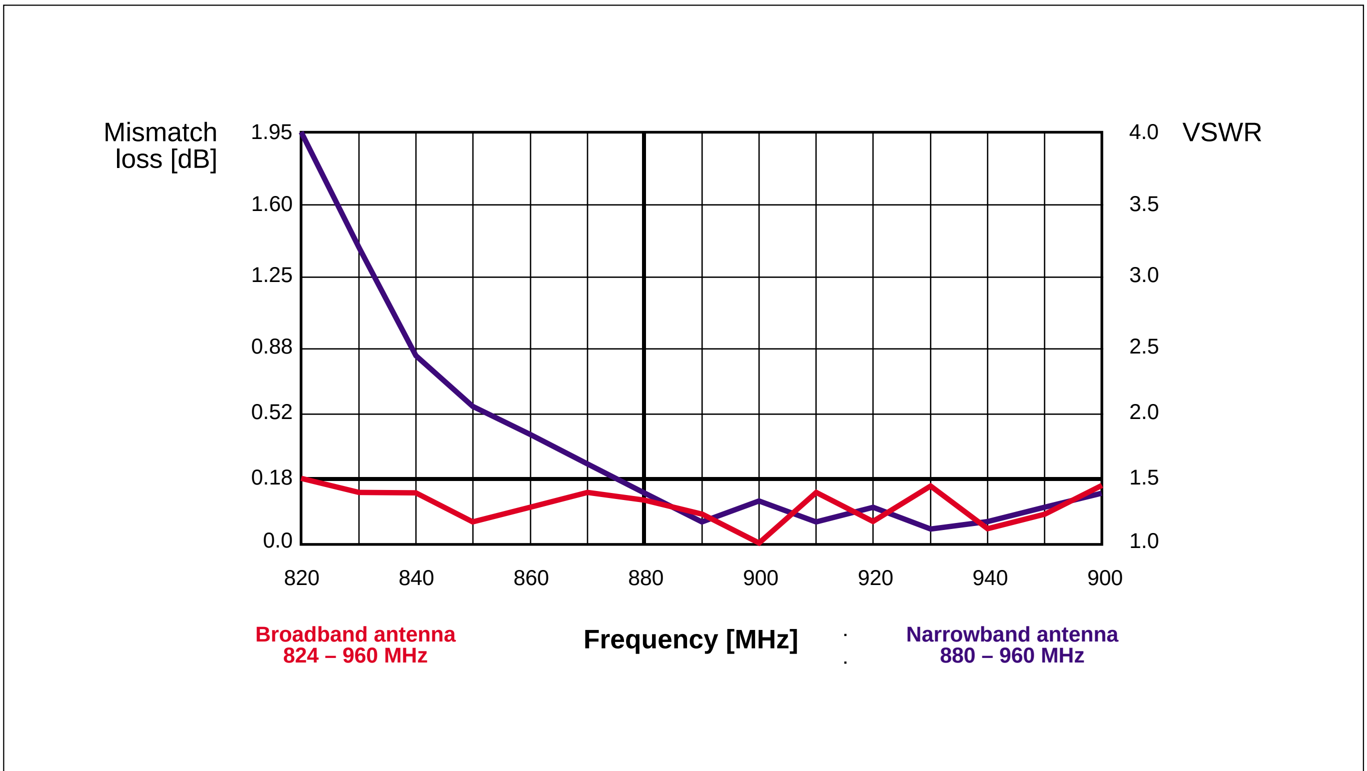

Fig. 1: Example showing VSWR curves and relevant mismatch losses.

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Electrical downtilt

Antennas with an electrical downtilt show up a higher isolation value (see Annex). This is due to unequal phases at the radiating elements, which makes the coupling between two antennas more difficult.
But for a comparison between broadband and narrowband antennas, the same downtilt angles are considered.

Antenna type and design

Particularly the currents running on the edges of the reflector screen have a significant influence on the isolation in the nearfield.
These currents are determined by the antenna construction and the kind of radiating element used (Dipole / Patch).

Kathrein antennas with their proven dipole constructions show up excellent isolation values (see Annex).

Special case: CDMA 800 – GSM 900

An example which shows the futility of the discussion about the isolation of narrowband antennas as compared to that of broadband antennas, is the situation with CDMA 800 and GSM 900 (see Fig. 2).

Especially critical in this constellation when both systems are working on the same tower, is the isolation value between the Tx range for CDMA 800 (869 – 894 MHz) and the Rx range for GSM 900 (890 – 915 MHz).

There is an overlapping of the frequency ranges which even makes separation using filters impossible, let alone achieving an improvement in the isolation by using narrowband antennas.

Summary

The mismatch loss has the greatest influence on isolation when narrowband and broadband antennas are compared. If one assumes that all the other factors together have a considerably lesser influence, then there results a higher isolation value of only 2 – 3 dB when narrowband antennas are used. This value is, however, negligible where antenna isolation values of more than 30 dB are required.*

More important than this small difference are the absolute decoupling values, which depend on the antenna type and the design.

* Please note: 3 dB ≙ factor 2; 30 dB ≙ factor 1000

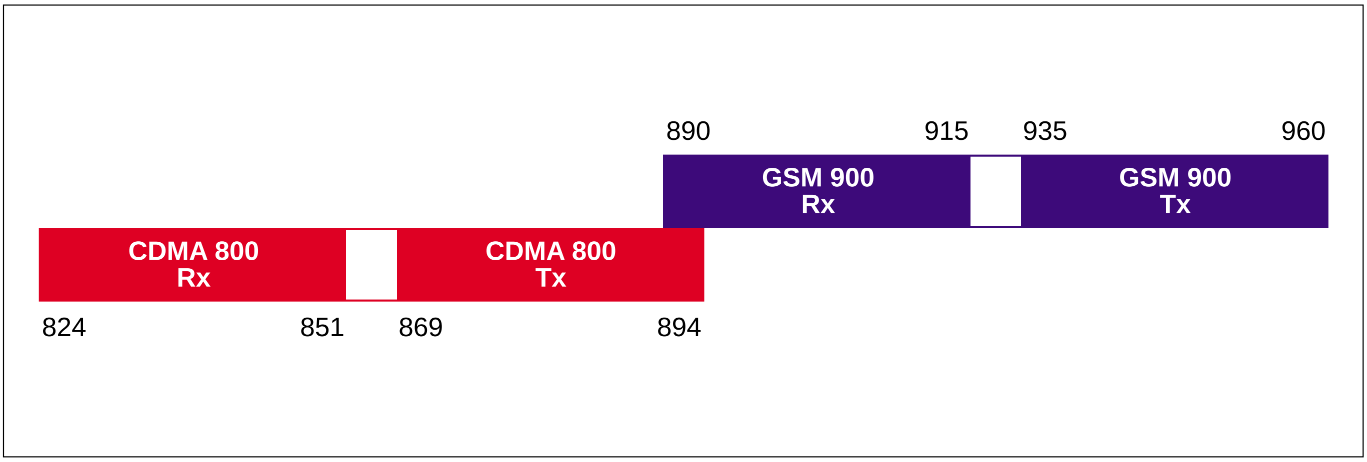

Fig. 2: Frequency ranges (MHz) for CDMA 800 and GSM 900.

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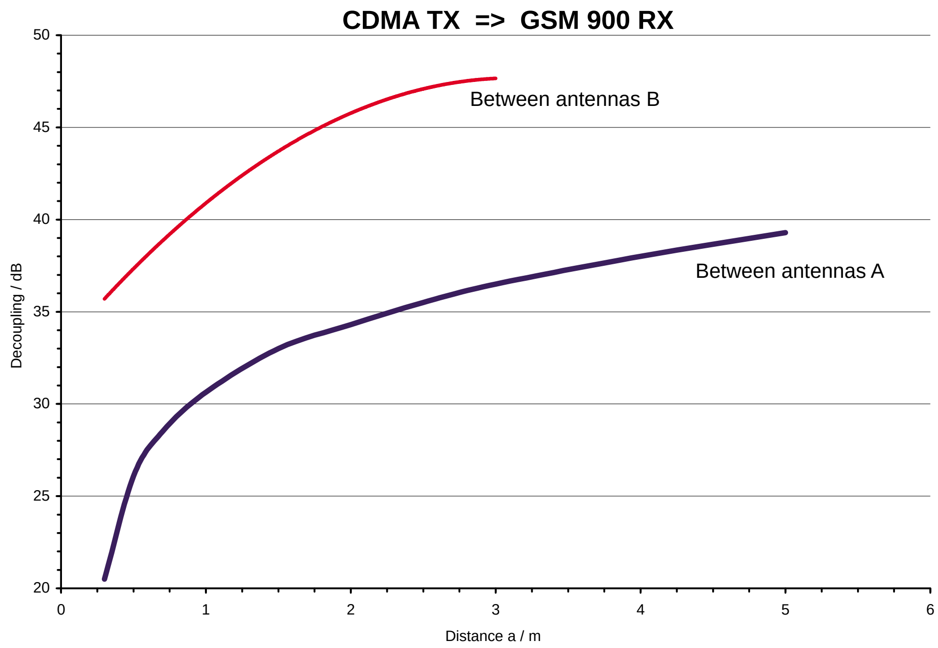

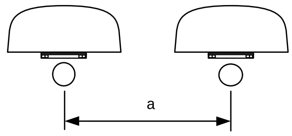

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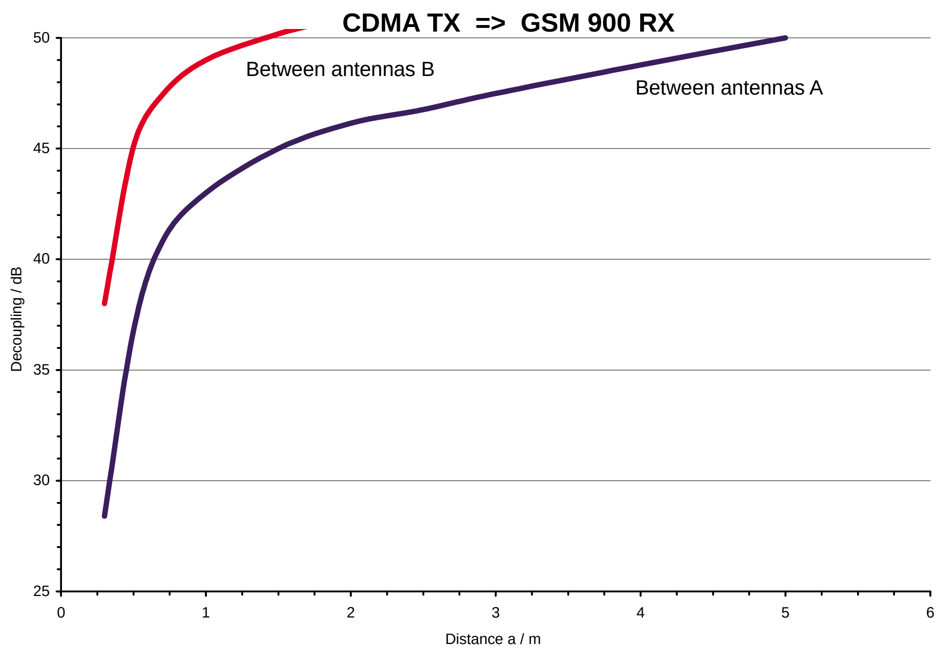
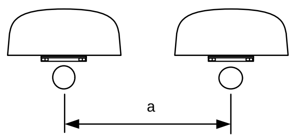
	Name		Type “B” VPol Panel 824-960 90° 15.5 dBi 6°T
	Hb	870 – 915 MHz	Sheet:





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	Name		Type “B” VPol Panel 824-960 65° 17 dBi 6°T
	Hb	870 – 915 MHz	Sheet: