White Paper

will'tek

Shielding requirements in (W)CDMA-based testing

boosting wireless efficiency

Summary

Once performed over a cable, measurements on mobile phones and wireless data devices today are conducted over the antenna, partly because modern phones rarely have a cable connector for an external (e.g. car) antenna and also because the antenna is an important part that needs to be included in testing.

But measurements over the antenna imply that the radio signal is sent over the air where there are lots of other signals that intermix with those between the unit under test and the instrument. This paper details both how unwanted signals may affect measurements and how the test setup may affect other equipment in the vicinity, if no or insufficient shielding is applied.

Adjacent mobile problem

Figure 1 illustrates a typical case in the service environment, where two mobiles are located close to each other while being tested.

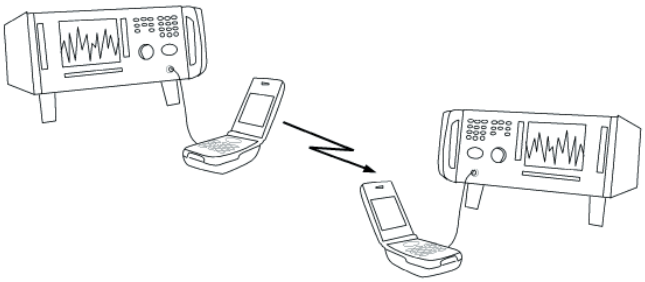

Figure 1: Without shielding, the two mobile phones may affect each other in the measurements.

In this case, two mobiles are located quite close to each other and are attached to independent sets of test equipment. In WCDMA tests, the worst case in transmitter tests occurs when one mobile phone is in a maximum power test while the other is in a minimum power test, both on the same frequency. In this situation, the first mobile may be transmitting at +33 dBm, while the second is transmitting at –50 dBm. Measurements over an antenna coupler are standard, so the test equipment that is bound to measure the minimum power does in fact measure the maximum power of the adjacent phone.

To properly isolate the two mobiles from each other, 80 dB of isolation are required between the two phones. This could be realised either by placing one phone in a shielding box with 80 dB shielding, or by using separate shielding boxes of at least 40 dB for each phone.

Local base station problem

Another issue that can be avoided with good shielding is related to local mobile networks. In CDMA, the mobile will attempt to lock onto the strongest base station in its record of base station frequencies. Therefore, the mobile may ignore the test equipment signal and instead lock onto the local off-air network, thus inhibiting measurements. Even if the mobile locks onto the simulated base station signal from the instrument, the high power level may affect the phone's ability to properly receive the low test signal, in particular when the frequencies used are close or even overlap. This would then result in a failed receiver test although the mobile phone performs within specifications. As a consequence, the repair service would run fault diagnostics without finding an error, thus spending time and money for a service that cannot be charged to the customer.

To remedy this problem, the mobile is placed in a shield box as shown in Figure 2.

The mobile received power (off air) typically ranges from –104 to –25 dBm, effective at the mobile. In the worst case, without a shield box, the mobile will receive –25 dBm from the base station. A typical receiver test, however, is performed at –104 dBm. In order to avoid that the base station signal transmitting on the same frequency interferes with the signal from the instrument, the isolation must be at least –104 dBm – (–25 dBm) = –79 dB.

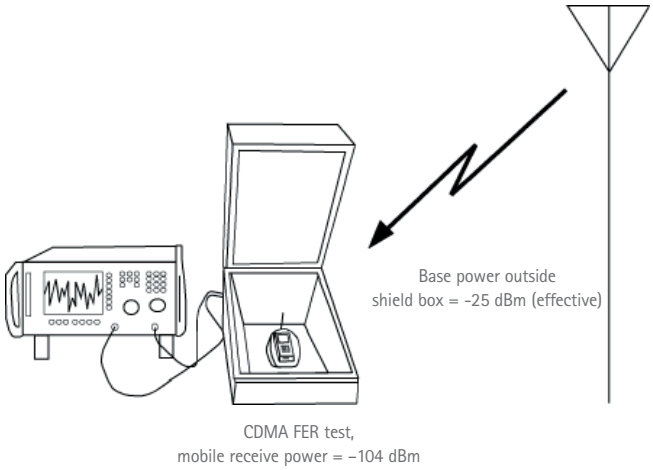

Figure 2: Proper shielding avoids base stations signals affecting the receiver measurements

Affecting real networks

As the nearby base station may affect the mobile phone under test, so does the phone affect the network. The transmitter of the phone may be tested at high power levels on a frequency that is also used by a nearby phone that is on a call in a real network. If the phone under test starts transmitting at +33 dBm while the network keeps the other phone's transmit power level at –50 dBm[1], it becomes apparent that the test will drastically affect the call quality.

This scenario is realistic and would impair communication within the whole cell and hence the network operator's business. To avoid trouble with that network operator, a shielding of 83 dB is required.

Tests may also be carried out in a repair centre that is colocated to a mobile phone shop where customers want to test the quality of phones and networks. With both transmitting on the same frequencies, the measurement scenario will interfere with and affect the customers' trials and hence may even impact the shop business.

[1] –50 dBm is the minimum power level in WCDMA. In cdmaOne and CDMA2000 systems, the minimum level that the mobile phone must support is –25 dBm.

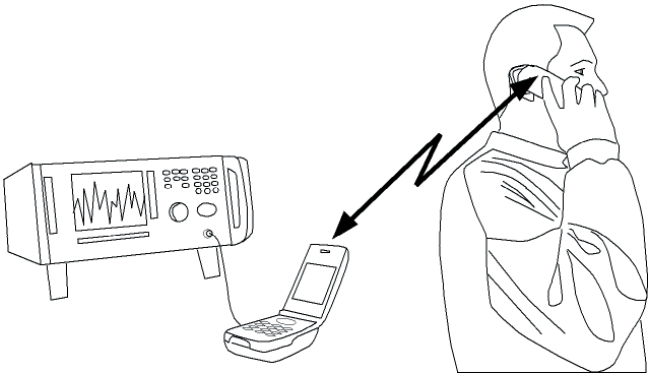

Figure 3: Radiation from the phone being tested may affect subscribers' calls

Conclusion

All three examples show that proper shielding of the mobile phone under test is essential to ensure reliable test results and to avoid conflicts with real networks. The most stringent requirement for mobile phone tests in WCDMA environments is that of the real network with 83 dB shielding, while in CDMA2000 environments the „local base station problem" stipulates 79 dB of isolation. Considering that WCDMA systems are getting more and more commonplace all over the world, a shielding solution supporting a minimum of 80 dB isolation should be chosen to minimise a repair shop's risk of wrong results and associated commercial risks, not to speak of the risk of legal action by the network operator of the local base station.

Willtek Communications GmbH
85737 Ismaning
Germany
Tel: +49 (0) 89 996 41-0
Fax: +49 (0) 89 996 41-440
info@willtek.com

Willtek Communications Inc.
Parsippany
USA
Tel: +1 973 386 9696
Fax: +1 973 386 9191
sales.us@willtek.com
willtek.cala@willtek.com

Willtek Communications
Cheadle Hulme, Cheshire
United Kingdom
Tel: +44 (0) 161 486 3353
Fax: +44 (0) 161 486 3354
willtek.uk@willtek.com

Willtek Communications SARL
Roissy
France
Tel: +33 (0) 1 72 02 30 30
Fax: +33 (0) 1 49 38 01 06
willtek.fr@willtek.com

Willtek Communications
Singapore
Asia Pacific
Tel: +65 943 63 766
willtek.ap@willtek.com

Willtek Communications Ltd.
Shanghai
China
Tel: +86 21 5835 8039
Fax: +86 21 5835 5238
willtek.cn@willtek.com

CDMA/WP/657/0105a/EN

will'tek