3GPP TSG-RAN meeting #19 **RP-030020**
Birmingham, GB 11th –14th March, 2003

Source: NOKIA

Title: Emission limits proposed by CISPR for ITE above 1 GHz.

Agenda item: 7.1

Document for Information and Discussion

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1 Introduction

During the ETSI ERM#18 meeting emission limits proposed by CISPR for ITE above 1 GHz were discussed. It was questioned if the proposed limits for ITE above 1 GHz are adequate or if those are a threat to UMTS. Currently ETSI ERM is working on a LS to CISPR but this process is proceeding quite slowly.

2 Discussion

The amendments to CISPR publication 22, CISPR/I/65/CDV [1] and CISPR/I/66/CDV [2], propose emission limits for ITE in the range 1 to 18 GHz. According to the proposal the limit steps up at 1 GHz from 47 dB?V/m/120 kHz BW quasi peak to 54 dB?V/m or 74 dB?V/m / 1 MHz BW for average and peak detectors, respectively, all referring to a measuring distance of 3m.

All attempts to estimate the necessary limits needed to protect existing and future services in the 2 GHz band performed by CISPR WG members lead to more stringent limits: CISPR/H is presently studying the subject and has arrived to the recommendation based on the needs of the radio services, that limits in this frequency range shall be 45 dB(?V/m) at 3 m. (CISPR/H/39/CD) [3]. A very conservative estimate based on the premise, that DCS 1800 shall be offered the same level of protection as is presently realized for GSM900 with the existing emission limits (< 1GHz), has lead to a proposal for 48 dB(?V/m) / 1 MHz BW at 3 m (CISPR/I/49/CC) [4].

In order to understand the situation, simulations were performed by Nokia to study the effect of emissions at the level proposed by CISPR on the capacity of a UMTS pico cell scenario. The outcome is that a limit of order 46 dB(?V/m) / 1 MHz BW at 3 m might be acceptable. In spite of the agreement between all of these independent estimates it was decided by CISPR I at its meeting in Christchurch New Zealand Sep 24th 2002 not to change the proposal for ITE emission limits.

CISPR SC I decided to distribute 2 CDVs.

?? One for the frequency range 1 to 6 GHz [1],

?? Another for the frequency range 6 to 18 GHz [2].

The 2 CDVs are identical with respect to limits and test procedures. According to the proposal the limit steps up at 1 GHz from 47 dB?V/m/120 kHz BW quasi peak to 54 dB?V/m or 74 dB?V/m / 1 MHz BW for average and peak detectors, respectively.

The new 3G cellular system will operate in the frequency range around 2 GHz and it is a global system. It operates with very high receiver sensitivity, and the investments in licenses and in infrastructure is at a level where it has become of the utmost importance that the system is protected against interference from unintended radiators like ITE.

In order to investigate the influence of disturbances on the 3G UTRA WCDMA cellular system, Nokia have made some simulations based on a simplified model. The simulation employs a tool developed by Nokia Research Center and described in [5].

The model calculates the capacity reduction of the WCDMA system caused by randomly distributed noise sources. The parameters are the percentage of the total area affected by the noise and the strength of the individual noise sources. More information about the simulations are presented in the Annex A.

3 Conclusion

The emission limit from ITE in the frequency range 1 to 3 GHz should not exceed 46 dBµV/m@3 m in a 1 MHz bandwith. According to the simulation this would give a capacity loss of order 2 to 3 %.

This level is nearly coinciding with the limit suggested in CIS/H/39/CD [3].

We would like to ask all our colleagues in TSG RAN to influence their national committees (CISPR & CENELEC) in order to cast negative vote both to CISPR/I/65/CDV and CISPR/I/66/CDV. Please note that both CISPR documents are at CDV stage so no technical changes can be made to the current documents. To get a change national committee has to vote no and give a reasoning for that.

Also we kindly ask this meeting to consider sending a LS to CISPR I, CENELEC and ETSI ERM.

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4 References

[1] CISPR/I/65/CDV "EMC of information technology, multimedia equipment and receivers", Committee draft for vote, Jan 17, 2003

[2] CISPR/I/66/CDV "EMC of information technology, multimedia equipment and receivers", Committee draft for vote, Jan 17, 2003

[3] CISPR/I/39/CDV "EMC of information technology, multimedia equipment and receivers", Committee draft for vote, Nov 9, 2001

[4] CISPR/I/49/CDV "EMC of information technology, multimedia equipment and receivers", Committee draft for vote, Aug 9, 2002

[5] Seppo Hämäläinen, Harri Holma and Kari Sipilä: Advanced WCDMA Radio Network Simulator, Proceedings of PIMRC'99; Osaka; Japan; September 99; p.951 – 955.

5 Attachments

I_65e_CDV.pdf I_66e_CDV.pdf

I_49e_CC.pdf CIS-H-39-CD.pdf

ANNEX A, SIMULATIONS

1 The Noise model

Assume that each ITE is surrounded by a noisy area and that the emission is equal to the limit 54 dB?V/m at 3 m distance. The value 54 dB?V/m may be converted to –89 dBm in the receiver input using the equation

$$E\ (dB(\mu V/m)) = P\ (dBm) + 20\log(f(MHz)) + 77.3 - G_{RX};\ (1)$$

where G_{RX} is the gain of the antenna of the victim receiver.

The situation is simplified so that the emission is set to –89 dBm inside the circle with radius of 3 m and zero outside. Then a number of these noise sources are randomly distributed such that a specified fraction of the total area is infected by the noise.

2 The communication model

A number of 3G WCDMA terminals (UE) are moving randomly around in the area attempting to make calls. They move with walking speed 3 km/h. The UE will move in and out of noisy areas. The total area is intended to represent a typical office environment. It is served by 4 base stations (BS). The optimum BS TX power level is 21 dBm with a maximum of 24 dBm.

Without any noise present (all ITEs switched off) the system can serve a certain number of UE.

When the noise is switched on at the specified level then all the UE inside the noisy areas will request a larger power level from the BS and thus the system can serve fewer UE due to the limited power capability of the BS.

3 Simulations

Table 1. Simulation assumptions:

Parameter	Value
Service	speech 16 kbit/s
Scenario	Pico, 3 km/h
Antenna type	Omni antenna (gain 0 dB)
Number of cells	4
PtxTarget	21 dBm
Max BS power	24 dBm
Extra noise	-97 dBm, -89 dBm, -69 dBm
Noise in Fraction of area	0.1, 1, 5, 10, 50, 100 %

Noise sources are put randomly around the simulation area (Fig 1). Around the noise source the extra noise is specified to –97 dBm, –89 dBm, or –69 dBm. This is equivalent to 46 dB?V/m, 54 dB?V/m, and 74 dB?V/m, respectively. Outside the noise source the extra noise is 0 W. The simulations are performed so that first the reference case is simulated without extra noise. The system is loaded to reach the 21 dBm target level Then the simulation cases are performed with different noise levels and noise coverage.

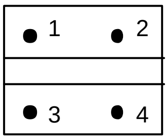

Figure 1 The simulation area. Numbers 1 to 4 are the base stations. An Indoor scenario is simulated: an office building with work areas and a corridor extending through the building.

The result is the capacity loss in the simulation area. It is defined as

$$Loss = (N\_ref - N\_case)/N\_ref \qquad (2)$$

Where N_ref = number of users in the simulation area in the reference case (no noise)

N_case = number of users in the simulation area in the simulation case (with noise in X % of the area).

The capacity loss is due to the Admission Control. When the Ptx Target is reached in the cell area no more UEs are admitted to that area.

The results of the simulation are shown in Fig.2. The capacity loss is plotted versus the fractional noise coverage. Curves for noise level –97 dBm, –89 dBm, and –69 dBm are shown.

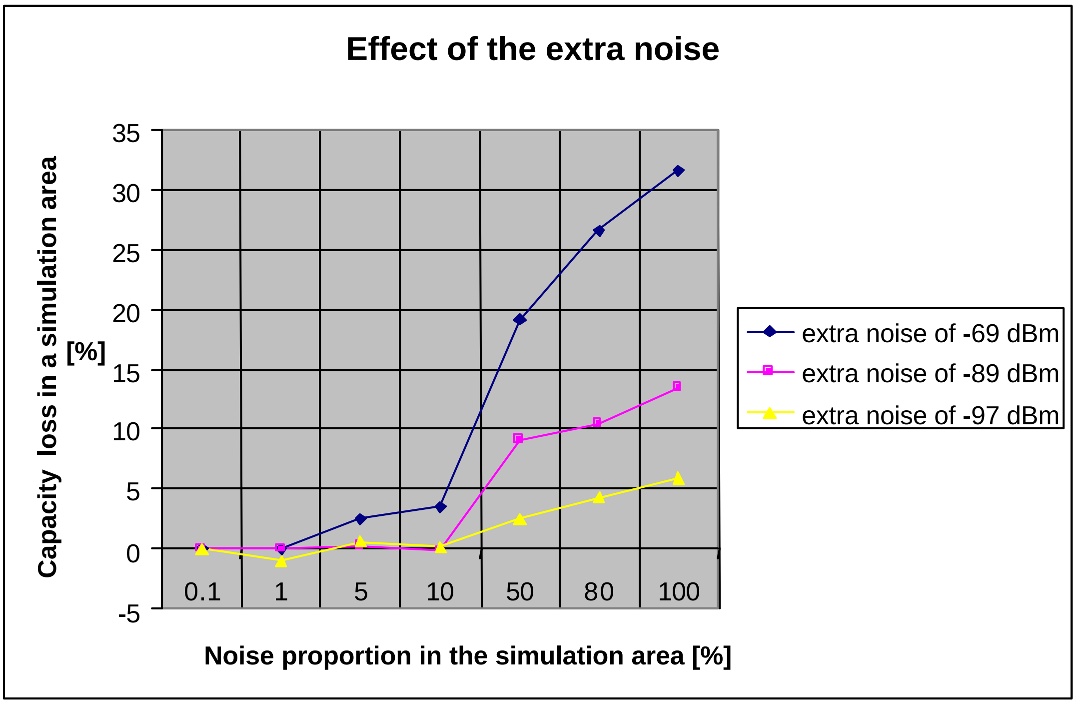

Figure 2 Capacity loss due to the extra noise

Fig. 3 Typical office layout

4 Noise proportion in Office environment

Fig. 3 shows a Nokia office plan from Espoo, in it's most highly packed area. Each person has a cubicle of around 6 m^2. This example is typical today in offices where people work with a computer and do not need much space for e.g. paper files. We may take this as an example where the noise will be at highest level.

Calculating the cubicles and corridors around them, and assuming one PC per workplace, there are 45 PC's in 23x18 m area = 414 m^2.

Assume that each of the PC's radiate at a level that has 3 dB margin to the limit, which is a quite reasonable assumption. It means that instead of 3 m, the limit is met at 0,71 x 3 m or at 2,1 m.

ITE does not radiate isotropically in each direction, and Figure 4 shows a measured radiation pattern from a 500 MHz tower PC at three frequencies. The coverage area of the level corresponding to the maximum level is 45-48 % of the circle. In other words, the area where the noise level is at least the level that is radiated to the maximum direction, is about 45% from the case where the EUT would radiate the same level to every direction. For the calculation with the office plan it means that the total noise area needs to be scaled down with a factor of 0.45.

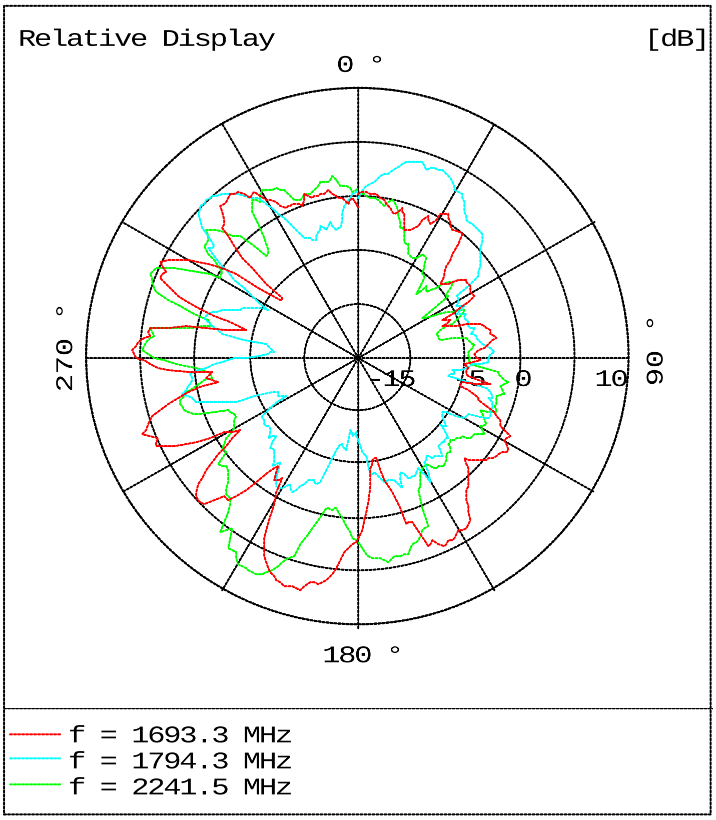

Fig. 4 Radiation pattern of a PC, three frequencies

So, the total noisy area in the office can be calculated as follows: 45x0.45x3.14x2.1^2 =281 m^2. This represents 281/414 = 68 % noisy area in the office.

Having a 6 dB margin to the limit would mean 1,5 m distance with limit level, and the noisy area would be 35 % of the total.

Attenuation from cubicle walls is not included since that is normally very small at 2 GHz.

Looking at the simulation results for a noise coverage of between 35 % and 68% (50 % point) we find a capacity reduction of 2.5 %, 10 % and 20 % for a noise level of –97 dBm, -89 dBm, and –69 dBm, respectively. This translates directly into lost revenue for the Operator. We suggest that a 2.5 % loss compared to the optimum is close to the pain threshold. A 10 % loss seems quite unacceptable.

The –97 dBm curve corresponds to an emission limit of 46 dBµV/m@3 m.

This is of the same order as the emission limit that can be derived if the existing GSM1800 service is protected similarly to the protection offered to the GSM900 service by the existing emission limit at 900 MHz.

Please recall that in the present discussion the proposed emission limit is derived from a scenario, where

1. The noise sources comply with the limit at 3 m distance with a margin of about 3 to 6 dB
2. The increase in noise as you get closer to the source has been neglected in the model
3. The victim is assumed to move around in and out of the noise infected areas.

It has not been taken into account that most often the UE will be used in front of the PC and not be moving, i.e., the will be exposed to a (higher) noise level 100 % of the time.

5 Conclusion

The emission limit from ITE in the frequency range 1 to 3 GHz should not exceed 46 dBµV/m@3 m in a 1 MHz bandwith.