TSG-RAN Working Group 4 meeting #6
Queensferry, Scotland
July 26-29, 1999

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Agenda Item:

Source: Siemens

Title: Simulation results on FDD/TDD co-existence including real receive filter and C/I based power control

Document for: Discussion and Decision

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1 Introduction

A complete set of simulation results on FDD/TDD co-existence considering the 1920 MHz frequency border was presented at WG4#3 [1]. The main items of discussion raised at that meeting was the use of an ideal receive filter and the use of C based power control only. This contributions provides new results including real receive filters. Additionally C/I based power control was implemented. It is proposed to include requirements on ACLR/ACS for UE and BS based on the simulation results.

2 Modification of simulator

Beside the modifications given in this section the simulation method and parameters are the same as described in [1].

2.1 ACLR, ACS

Based on the agreements achieved at the last WG4#5 meeting in Miami, the parameters used for ACLR and ACS have been adopted. The used settings are summarised in the following table:

FDD and TDD					
BS			UE		
$ACLR_1$	$ACLR_2$	ACS	$ACLR_1$	$ACLR_2$	ACS
45 dB	55 dB	45 dB	32 dB	42 dB	32 dB

Table 1 ACLR and ACS parameters

2.2 C/I based power control

The model for power control uses the Carrier to Interferer (C/I) ratio at the receiver as well as the receiving information power level.

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Figure 1 Power Control algorithm

The model considers the interference caused by alien systems as well as the intra-system interference. The control algorithm compares the C/I value at the receiver with the minimum required and the maximum allowed C/I value. In order to keep the received C/I in its fixed boundaries the transmission power is controlled (if possible). Consequently the most important value during power control is the C/I. If the C/I is in the required scope, the transmission power is varied to keep the received power in its fixed boundaries, too. Figure 2 shows an example of the power algorithm. The axis of ordinate contains the C/I threshold and the axis of abscissa contains the C-thresholds.

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Figure 2 Example of power algorithm

The two straight lines include all possible values for C/I(C) for a received interference power I_1 and I_2. The area defined by the thresholds is marked with grey. The control of the corresponding station's transmission power should get the point on the straight line into the marked area. Regarding the interference I_1, the transmission power must pulled up until the minimum receiving power is reached. The upper C/I threshold demand cannot be fulfilled here. Concerning I_2, the grey marked area can be reached.

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pcul.eps
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Figure 3 Power control in UL

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Figure 4 Power control in DL

It has to be remarked that the power control strategy in CDMA systems is different for uplink and downlink. In the uplink, each mobile has to be controlled in the way that the base station receives as low as possible power while keeping C/I requirements. Therefore the pathloss for each connection has to be considered. Concerning the downlink, the base station transmits every code with the same power regardless of the different coeval active connections. Consequently the power control must consider the mobile with the lowest receiving power level to ensure a working connection for each mobile.

3 Simulation results

In the following the simulation results are summarised. In all cases no power control, C based power control as used in old simulations [1] and C/I based power control as described in section 2.2 is included in one figure in order to allow comparison of the different schemes. These simulations cover the macro environment and the speech service only. The C/I requirements needed are based on the ETSI L1 ITU submission results (September ’98). It should be emphasised that one important parameter in the simulation is the user density in the relevant mode. For both the FDD and TDD mode a worst case full loaded system is used (exact user densities can be found in [1]). This method differs from the method used to define ACIR requirements in the FDD mode as described in [2]. Thus the results can be seen as rather pessimistic.

3.1 TDD/FDD

Having in mind the 1920 MHz frequency border between paired and unpaired frequency bands two interference scenarios are considered. Those are the interference from TDD MS towards the BS receive band (BS/BS co-siting is not subject to this contribution) and the interference form the FDD MS transmit band towards TDD. In the latter case the interference to TDD MS was judged to be the most relevant one, since the distance between MSs in both systems may become much smaller than the distance between MS and BS (see also results in [1]).

3.1.1 TDD MS perturbs FDD BS

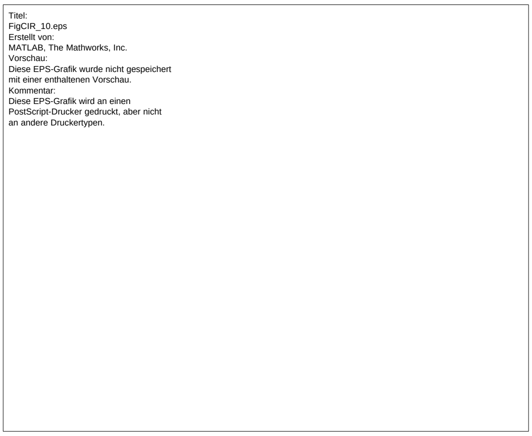

Figure 5

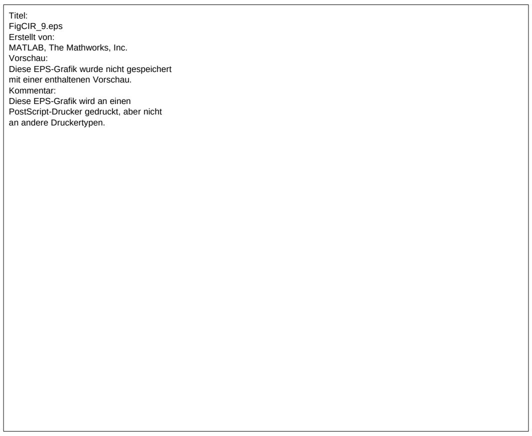

Figure 6

Figure 5 and 6 give the results for the 500m and 2000m cell radius, respectively. As expected the C/I based power control is in between the no PC and C-based PC case for the small cell radius. For high cell radius C based and no PC is very similar since the probability that mobiles are located at the cell border is high. Taking into account a C/I requirement (speech) of about –23 dB for the FDD BS, the probability that this requirement is not met is about 1.5%.

3.1.2 FDD MS perturbs TDD MS

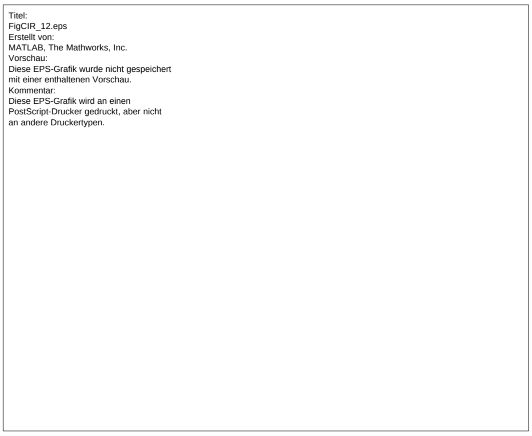

Figure 7

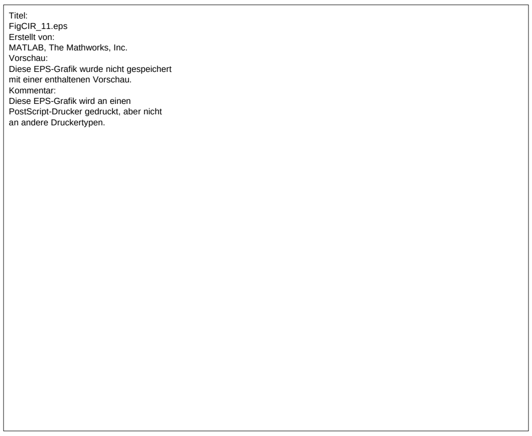

Figure 8

Again 500m and 2000m cells are compared. Again it can be seen that for the 500m cell interference is high, thus C/I based power control is considerably different than c based power control only. However the probability that the required C/I for the TDD MS (about –5.6dB) is not met is as low as 1.8%.

3.2 TDD/TDD

For TDD/TDD interference indeed all interference scenarios are possible (BS/MS, MS/BS, MS/MS). Two cases have been studied first.

3.2.1 TDD MS perturbs TDD BS

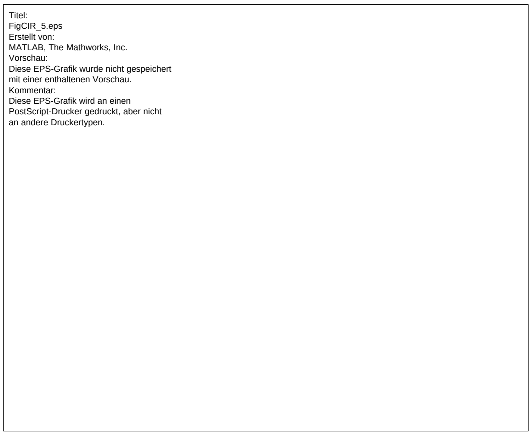

Figure 9

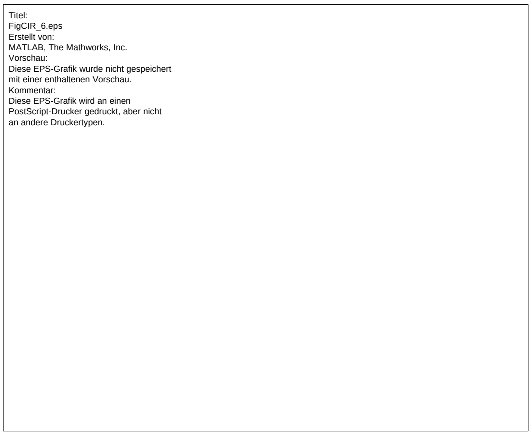

Figure 10

Figure 7 and 8 give the results for the two cell radii. Again the difference in case of the 2000m cell is small. Assuming that the C/I requirement for the TDD BS is about –8dB, the fail probability is at most –2.5%.

3.2.2 TDD MS perturbs TDD MS

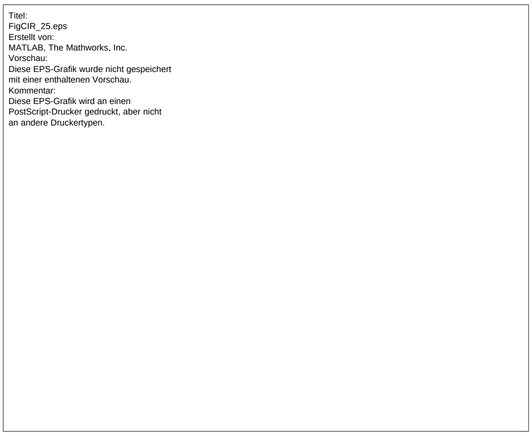

Figure 11

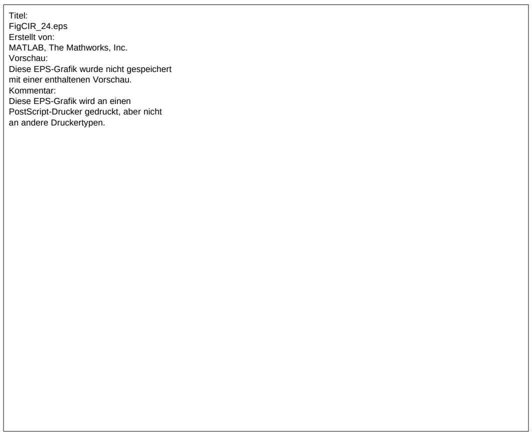

Figure 12

Please note that the cell radius value in Figure 11 and 12 have to be exchanged, i.e. Figure 11 covers the small cell and Figure 12 covers the 2000m cell radius. Due to the fact that both victim and interferer are mobiles the probability of an critical interference scenario is quite low, i.e. 0.3% if a C/I requirement of –5.6dB for the TDD MS is taken into account.

4 Proposal

In [1], [3] and in this contribution a substantial amount of simulations were carried out in order to determine ACLR and ACS requirements for the TDD mode. No critical scenario in terms of system interference was observed. It is therefore proposed to include the ACLR and ACS requirements used in this contribution in the relevant TDD specifications (25.102 and 25.105). Since not all possible cases have been simulated it is proposed to put the values in section 2.1 in brackets. These brackets can then be removed at the next WG4#7 meeting in Japan in case the missing simulation results have been provided.

5 Conclusion

New simulation results on FDD/TDD co-existence have been presented including the most recent requirements on ACLR and ACS. The simulated cases indicate that no additional guard band between FDD and TDD is required. It is proposed to add ACLR and ACS requirements in brackets to the existing TDD specification.

6 References

[1] TSG RAN WG4#3 Tdoc 96/99 “TDD/FDD co-existence – summary of results”
[2] TSG RAN WG4 TS 25.942 “RF system scenarios”
[3] TSG RAB WG4 Tdoc 362 “ ACIR simulation results for TDD mode: speech in UpLink and in DownLink”