3GPP TSG-RAN WG4 Meeting #52 **R4-093168**
Shenzhen, China
24th – 28th August, 2009

Agenda item: **9.13**

Source: **Nokia**

Title: **Impact of antenna impairements to (DL) channel coverage**

Document for: **Discussion**

1 Introduction

In [1] it was proposed that RAN4 would discuss developing new additional UE requirements based on 1Rx assumption for small voice centric UEs, at least for lower frequency bands. In this contribution we briefly look at the impact of different antenna correlation and imbalance values on the PDCCH performance.

2 Discussion

In this section the simulation results for PDCCH DCI format 1A are shown. Performance of dual receiver terminal with different level of antenna correlation and gain imbalance is shown. The used propagation condition was 3GPP-TU with 3km/h UE velocity. The evaluated envelope correlation levels are [0, 0.3, 0.7, 0.9] (e.g. β in Table B.2.3.1-3, 1x2 case in 3GPP TS 36.101 v9.0.0). These were chosen as an example of possible range of antenna correlations that could be observed in handheld terminals. It should be noted that the final correlation is of course impacted by factors like the form factor as well experienced propagation conditions (AoA, etc.). Furthermore as it could be expected that for certain form factors the volume for the second cellular antenna can be limited and the need for additional switches and filters may lead to lower received signal power, different imbalance values were evaluated. This was modeled as increased RX path attenuation for the signal part. The evaluated values were {(0, 0), (-1,-1), (-1,-3), (-1,-6), (-1,-9), (-3,-6), (-6,-9)}, where (x1,x2)=(Rx path1 attenuation [dB], Rx path2 attenuation [dB]). Attenuation and correlation were only applied to the signal, e.g. noise was assumed to be spatially uncorrelated and unattenuated. Single and dual RX receivers without any RX path attenuation nor RX gain imbalance serve as reference.

Figures 1 to 4 provide the PDCCH BLER versus SNR for different RX correlation values. Different imbalance levels were evaluated for each correlation value. It can be seen that predominantly the loss to dual receiver performance comes from the gain imbalance which leads to reduced SNR level after combining. Correlation starts to have a visible impact to the performance at the level of 0.7. Naturally in interference limited conditions where the interfering signal experiences similar attenuation, the impact of gain imbalance is alleviated. However in such case the interference would also be correlated between receiver antennas, reducing the gain.

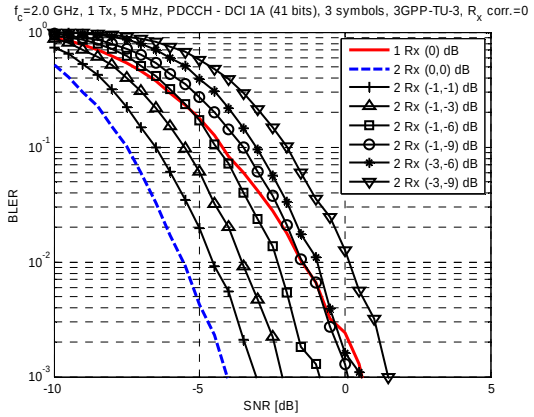

Figure 1. PDCCH BLER with Rx correlation = 0

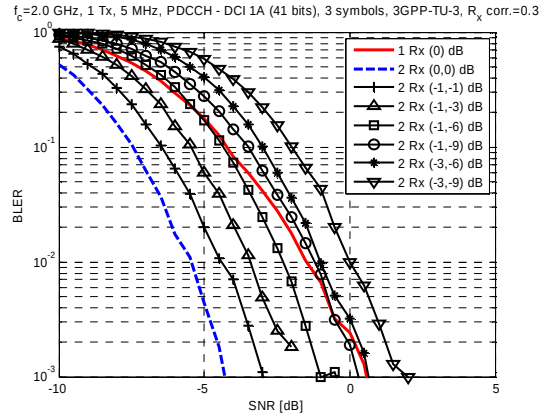

Figure 2. PDCCH BLER with Rx correlation = 0.3

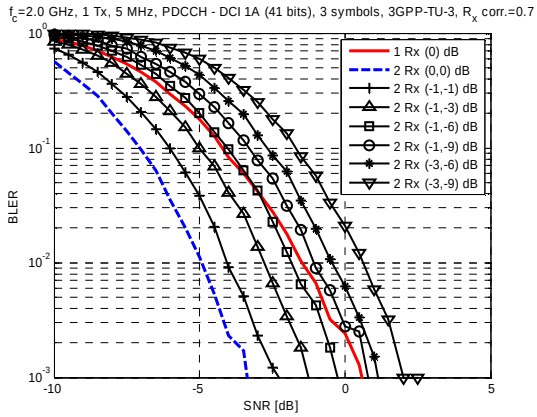

Figure 3. PDCCH BLER with Rx correlation = 0.7

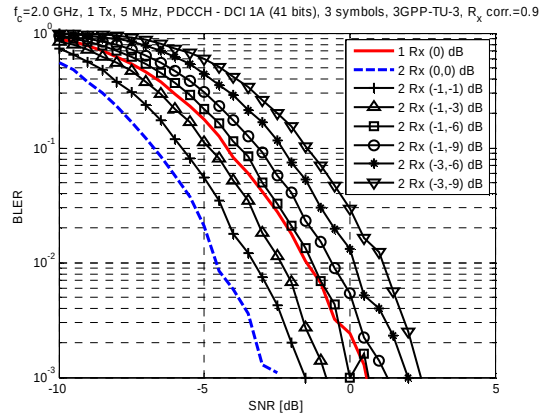

Figure 4. PDCCH BLER with Rx correlation = 0.9

3 Conclusion

In this contribution we have presented some simulation results evaluating the impact of different antenna parameters to the PDCCH BLER. In the used simulation set-up the gain imbalance had a predominant impact, but also higher correlation levels lead to reduction in observable diversity gain. It can be seen that when accounting for these two impairements jointly, the correlation and antenna imbalance need to be maintained at low levels to preserve the benefits of reveiver diversity.

References

[1] R4-093167, E-UTRA UE category enhancements, Nokia

Annex

Parameter description	Value / Comment
Carrier frequency	2 GHz
Transmission bandwidth	5 MHz
eNB antenna configuration	1 Tx
UE antenna configuration	A. 1 Rx B. 2 Rx
Channel model, UE velocity	3GPP-TU, 3 km/h
Spatial correlation	According to 3GPP TS 36.101 v9.0.0 – Annex B.2.3.1, Table B.2.3.1-3, 1x2 case, β={0, 0.3, 0.7, 0.9}
Noise statistics	Spatially white Gaussian noise
Rx path attenuation	A. 1 Rx: 0 [dB] B. 2 Rx: (Rx path1 attenuation [dB], Rx path2 attenuation [dB]) with values: {(0, 0), (-1,-1), (-1,-3), (-1,-6), (-1,-9), (-3,-6), (-6,-9)}
PDCCH / PDSCH configuration	3 / 11 OFDM symbols per sub-frame
Physical channel parameters	PDCCH, DCI Format 1A, aggregation level 8
Payload	41 bits (including 16-bit CRC)
Channel coding	Rel'8 convolutional coding
Modulation	QPSK
HARQ	None
Detector	MRC
Channel estimation for demodulation	2D realistic channel estimation over 1 sub-frame Rel'8 CRS
Simulation output	PDCCH BLER vs. SNR