3GPP TSG RAN WG1#15 **Tdoc R1-00-1073**

Berlin, Germany, 22nd – 25th August, 2000

Agenda item:	
Source:	Samsung and Seoul National University
Title:	Performance results of basis selection transmit diversity for 4 antennas
Document for:	Discussion

Summary of this document:

In TSG-RAN WG1 meeting #14, 4-7th, July, 2000, Oulu, Finland, an algorithm and some simulation results are presented [1]. In that algorithm, we have introduced the basis selection method for more than two antenna transmit diversity. In summary of [1], there are two main objectives. One is that we can obtain reasonable gains at 3km/h. The other is that the complexity is increased a little when compared to that of the two antenna transmit diversity.

In this document, multipath simulation results are shown. Two multipath interference (MPI) models are used. One is the coherent interference model. The other is noncoherent model. As a result, using “4C2” scheme, maximum 3.5dB performance gain is obtained. (c.f., when using “4C3” scheme, we can obtain maximum 4dB gain.) These performance gains are similar as those of the single-path case.

1. INTRODUCTION

In TSG-RAN WG1 meeting #14, 4-7th, July, 2000, Oulu, Finland, an algorithm and some simulation results are presented [1]. In that algorithm, we have introduced the basis selection method for more than two antenna transmit diversity. The measure named “complexity” means that how much calculation is needed to estimate optimum weight of antennas. As shown in [1], the increase of the complexity is negligible when compared to the case of two antennas. Furthermore, it was clearly shown the performance gain is so large at 3km/h.

The simulation, however, was obtained under the assumption of the single-path [1]. So, in the previous meeting, the delegates are agreed to include the multipath assumptions into the simulation. In this document, two channel models are considered. One is the “modified ITU pedestrian A channel” and the other is “modified ITU vehicular A channel”. Furthermore, “coherent” and “noncoherent” multipath models are simulated for each channel models. The “coherent” multipath model is assumed that all UE’s weight’s are same. It means that the interference is maximum. On the contrary, in the “noncoherent” multipath model, all UE’s weights are uncorrelated. Then this model can be used as the minimum interference model.

2. PERFORMANCE SIMULATION RESULTS

2.1 Schemes for simulation and MPI modeling

Release 99 scheme and two other schemes are simulated as in Table3.

Table 3. Special simulation parameters

Scheme	Description
2-mode-2	· Closed loop mode 2 according to Rel.99 · Number of Tx antennas = 2 · Feedback bit rate = 1500 bps · Total bits of FSM = 4bits: 1bit for gain, 3bits for phase
4C2	· Number of Tx antennas = 4 · Feedback bit rate = 1500 bps · 2 best antenna selection among 4 transmit antenna · Total bits of FSM = 5bits: 3bits for selection, 2bits for phase
4C3	· Number of Tx antennas = 4 · Feedback bit rate = 1500 bps · 3 best antenna selection among 4 transmit antenna · Total bits of FSM = 6bits: 2bits for selection, 4bits for phase

2.2 Simulation parameters

Table 1. Basic simulation parameters.

Bit Rate	*12.2 kbps*
Chip Rate	*3.84 Mcps*
Convolutional code rate	*1/3*
Carrier frequency	*2 GHz*
Power control rate	*1500 Hz*
PC error rate	*4 %*
PC Step Size	*1 dB total*
Channel model(s) and UE velocities	*Modified ITU Ped. A: :3, 10, 40 km/h* *Modified ITU Veh. A: 10, 40, 120 km/h*
CL feedback bit error rate	*4 %*
CL feedback delay	*1 slot*
TTI	*20 ms*
Target FER/BlkER	*1 %*
Geometry (G)	*-3, 0 and 6 dB*
Common Pilot	*-10 dB total*
Correlation between antennas	*0*
CL feedback rate	*1500 bps*

Table 2. Special simulation parameters.

Comparing output	*Ec/Ior*
Modulation	*QPSK*
Physical channel rate	*30ksps*
Number of antennas	*Release 99: 2, Release 2000: 4 (New)*
Total FSM bits	*Release 99 Mode2: 4* *Release 2000 Case I: 5bits, Case II: 6bits*
Slot format	*#10 (6,2,0,24,8)*
Channel estimation	*WMSA – 4slots (1,4,4,1)*
MPI modeling	*All noncoherent except self (Fig1 and 2)* *Coherent and noncoherent (Fig 3 and 4)*

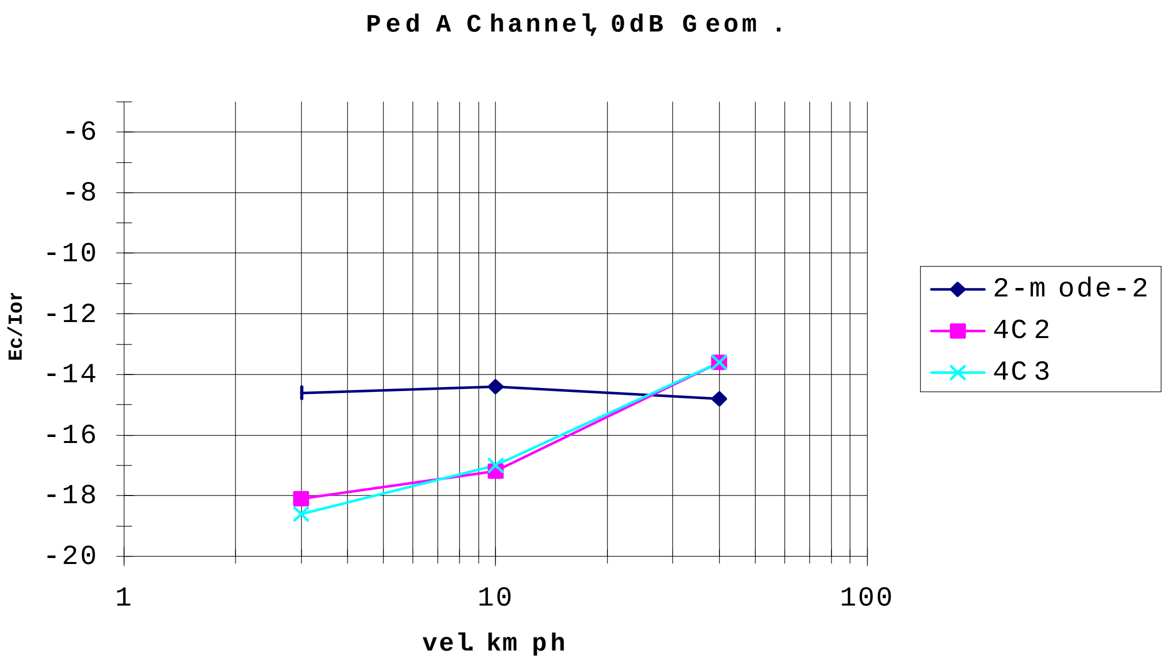

Figure 1. Simulation results for modified ITU Veh. A channel at 0 dB geometry

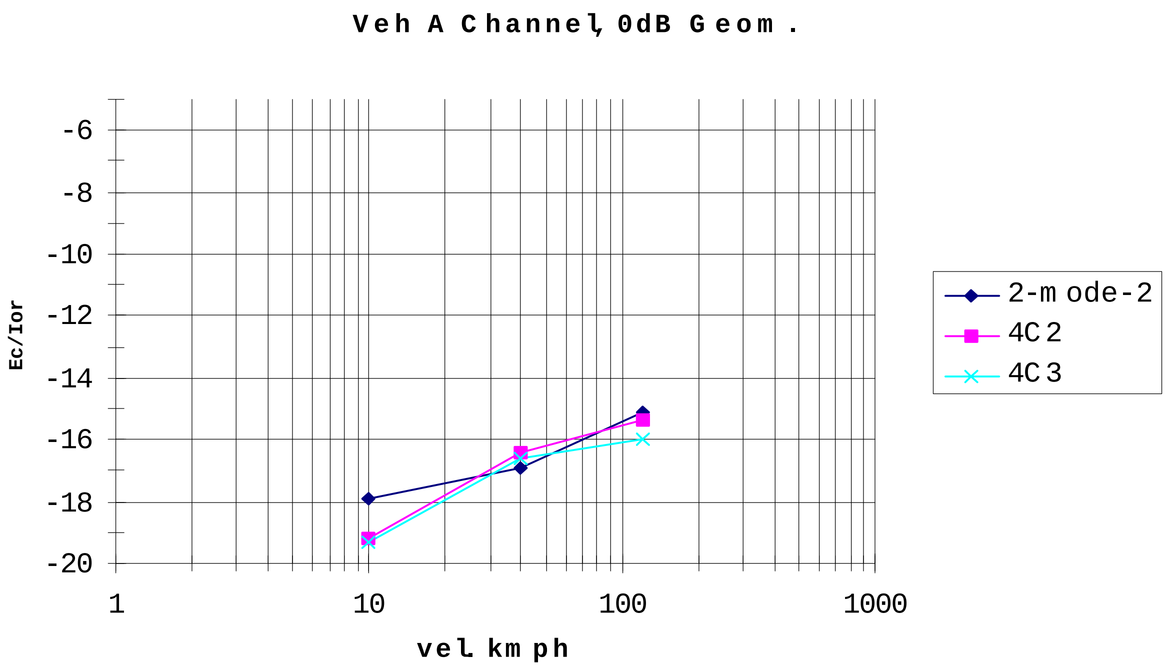

Figure 2. Simulation results for modified ITU Veh. A channel at 0 dB geometry

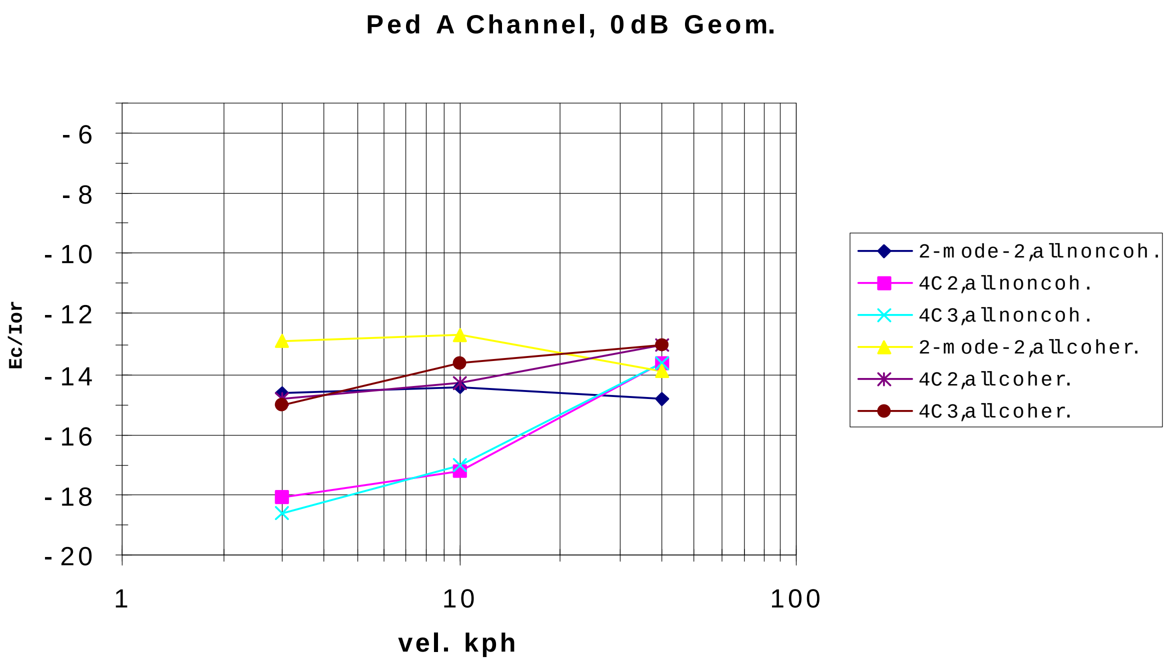

Figure 3. Bound for MPI model in modified ITU Ped. A channel at 0 dB geometry.

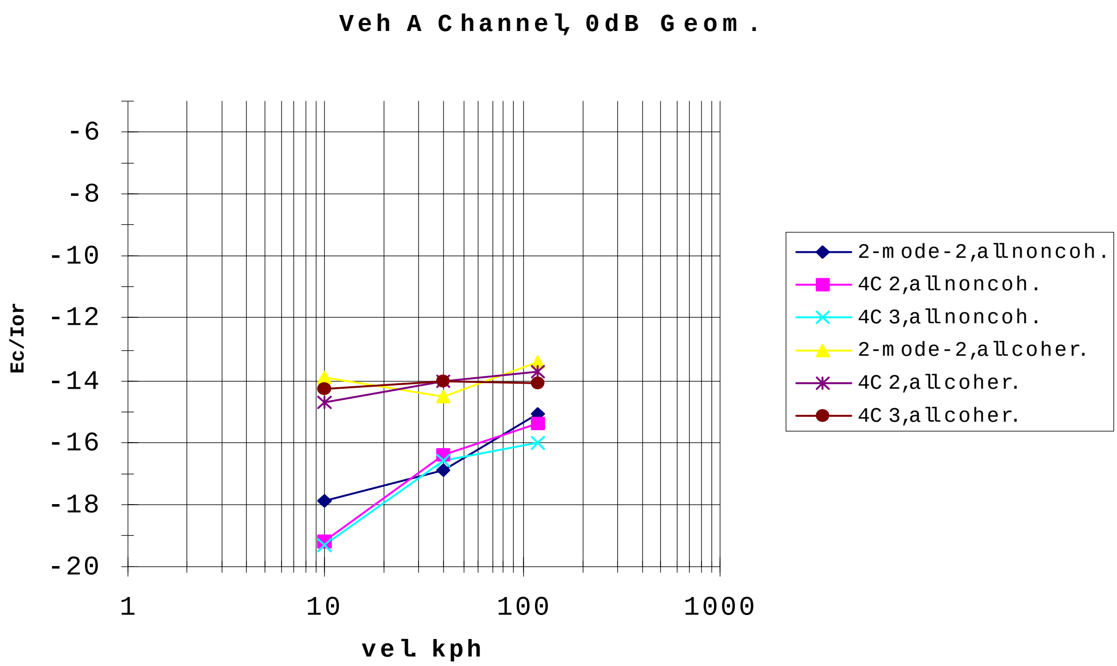

Figure 4. Bound for MPI model in modified ITU Veh. A channel at 0 dB geometry.

2.3 Multipath simulation results

In these simulation results, we compared “2-mode-2” scheme, “4C2” scheme, and “4C3” scheme. The “2-mode-2” scheme is closed loop Tx diversity mode 2 of two antennas in Rel 99. And the “4C2” and “4C3” schemes are the basis selection methods of closed loop Tx diversity for more than two antenna. In the “4C2” scheme, the UE selects two antennas among four antennas. As a consequence, the UE selects three antennas in “4C3” scheme.

As shown in Fig.1, the “modified ITU pedestrian A” channel model is used. The multipath model is “noncoherent”. When compared to “2-mode-2” scheme, performance gains of “4C2” scheme and “4C3” scheme are 3.5dB and 4dB, respectively. The cross-over point between “2-mode-2” scheme and other schemes is about 25km/h.

In Fig.2, these schemes are compared in the “modified ITU vehicular A channel”. As the same as in Fig.1, the “noncoherent” multipath model is used. The suggested “4C2” and “4C3” scheme have better performance (approximately 1.3dB) in low speed than that of the “2-mode-2” scheme. If, however, the velocity is higher than 30km/h, performance is similar for three schemes.

In Fig.3 and Fig.4, the both “coherent” and “noncoherent” multipath models are simulated. As mentioned before in section 2, “coherent” and “noncoherent” multipath models can be used the “minimum” and “maximum” performance bound, respectively. In general, the probability of the “noncoherent” multipath model is higher than that of the “coherent” multipath model in the real world. Furthermore, in the worst case, i.e., in the “coherent” multipath model, we can obtain the reasonable performance gain.

3. FURTHER STUDY

It is well-known that the coherence combine gain is important for transmit diversity. Unfortunately, it is not proved yet that suggested schemes have got sufficient coherence combine gains. For further study, it is necessary to investigate increasing method of the coherent combine gain.

4. CONCLUSIONS

In multipath simulation, the performance gain of “4C2” scheme is maximum 3.5dB. These performance gains are similar as those of the single-path case. Furthermore, the increase of the complexity is negligible when compared to the two antenna diversity.

REFERENCES

[1] Samsung and Seoul National University. Preliminary version of algorithm and Simulation results for Tx Diversity with more than 2 Tx Antennas. TSG-R WG1 document, TSGR1#14(00)0882, 4-7th, July, 2000, Oulu, Finland.