3GPP TSG RAN WG1 **TSGR1#15(00)1095**
Meeting #15
22-25th, August, 2000
Berlin, Germany

Agenda item:	AH25
Source:	Nokia
Title:	Text proposal on HARQ performance for HARQ TR
Document for:	Discussions and approval

Summary:

RAN WG2 is responsible for producing a Technical Report (TR) for the HARQ type II/III work item. In [1], extensive set of HARQ simulation results were presented. As performance evaluation of the HARQ is important part of the TR a text proposal is made based on the earlier presented simulation results. In order to keep the TR to a manageable size only condensed set of results are proposed to be included to the TR.

1. INTRODUCTION

RAN WG2 is responsible for producing a Technical Report (TR) for the HARQ type II/III work item. In [1], an extensive set of HARQ simulation results were presented. As performance evaluation of the HARQ is important part of the TR a text proposal is made based on the earlier presented simulation results. In order to keep the TR to a manageable size only condensed set of results are proposed to be included to the TR.

2. TEXT PROPOSAL TO HARQ TR

The following text is proposed to be added to HARQ TR:

---Start text proposal---

2 References

[1] Nokia. Hybrid ARQ methods for FDD in Release 2000. TSG-R WG1 document, TSGR1#14(00)0869, 4-7th, July, 2000, Oulu, Finland, 20 pp.

7.2 Performance evaluation

In [1] an extensive set of simulation results for various HARQ schemes have been presented. The schemes studied were:

- HARQ type I
  - Codes rates 2/3, 1/2 and 1/3
- HARQ Type II
  - Code rates after 1st and 2nd (re)transmission 2/3 and 1/3, respectively
  - Code rate after 1st, 2nd and 3rd (re)transmissions 1, 1/2 and 1/3, respectively.
- HARQ Type III with single redundancy version

For more detailed description of the schemes, see [1].

7.2.1 Simulation assumptions

The link simulations were geometry (G) simulations where the own cell interference was modeled explicitly (common pilot channel and N other users with random data) and other cell interference with Gaussian noise. The geometry G was defined as the ratio of the received own cell power to other cell interference:

$$G = \frac{average(rx\_I_{or})}{I_{oc} + N_0} \quad (1)$$

In practice, the thermal noise and the other cell interference were modeled with white Gaussian noise. Power control was modeled only for the desired user, for interfering users no power control was used. The common pilot channel was also transmitted with constant power.

Table 1 shows the assumptions used for simulations.

Table 1. Basic HARQ simulation assumptions.

Parameter	Explanation/Assumption
Chip Rate	3.84 Mcps
Closed loop Power Control	ON
PC error rate	4%
PC delay	1 slot
Propagation Conditions	Pedestrian A 3 km/h
Number of bits in AD converter	Floating point simulations
Downlink Physical Channels and Power Levels	CPICH_Ec/Ior = -10 dB No PCCPCH No SCH OCNS_Ec/Ior = power needed to get total power spectral density (Ior) to 1, divided equally between interfering users DPCH_Ec/Ior = total power needed to meet the required BLER target
Number of interfering users	20
Bit rates	8, 32 kbit/s
$\hat{I}_{or} / I_{oc}$ values (G)	3 dB
D (delay between transmissions of a packet)	6 TTIs

7.2.2 Summary of simulation results

Different HARQ schemes were compared based on the average throughput, average number of transmissions (delay) and the single cell capacity as defined in [1]. Here, a comparison of the different schemes is shown based on cellular capacity and average number of transmissions. Note that in the legend of the Figures 1 and 2 slightly different terminology has been used: *Type I with softcombining* refers to the same HARQ scheme as HARQ *Type III with single redundancy version*.

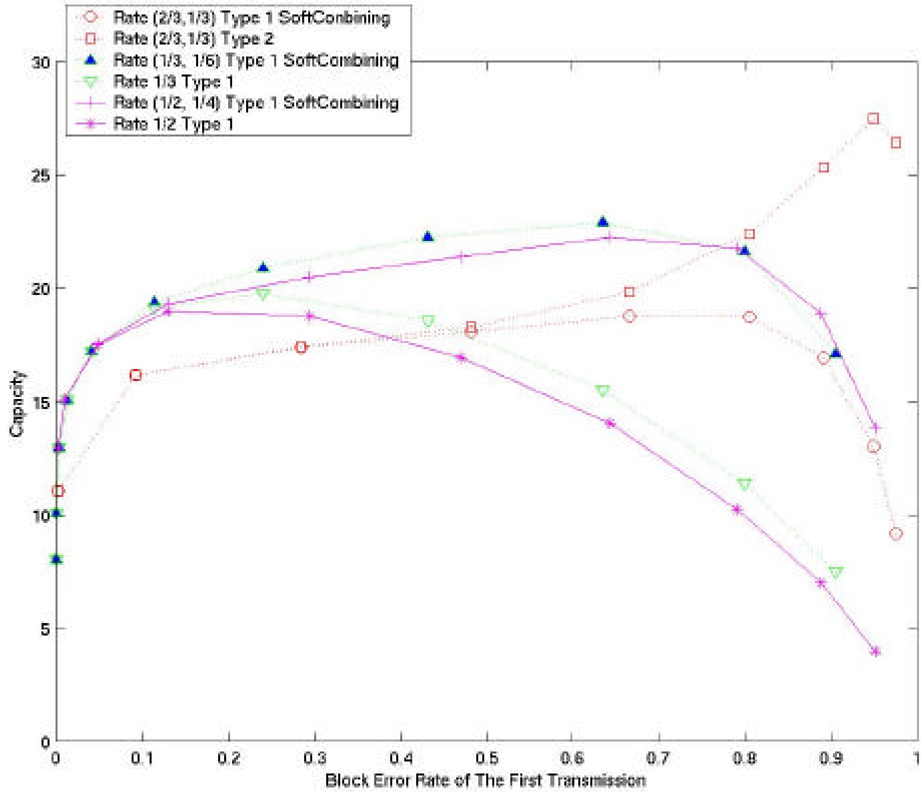

Figure 1. Block error rate of first transmission vs. cell capacity.

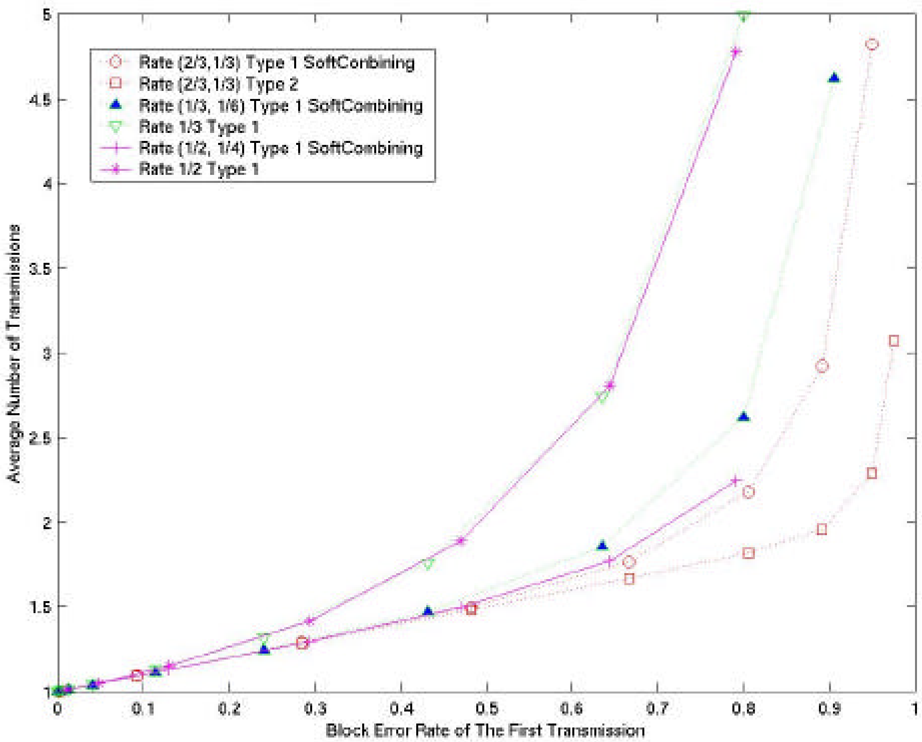

Figure 2. Block error rate of first transmission vs. average number of transmissions.

7.2.3 Discussion

Hybrid ARQ Types II/III do bring some capacity gain over HARQ Type I. The latter one reaches highest capacity when BLER is about 10%. When BLER of 50% is assumed, HARQ Type III with single redundancy version gives about 10-15% capacity increase over the HARQ Type I. Type II HARQ can achieve even higher capacity gain (starting code rate R=2/3) but this would require that BLER during the first transmitted frame is very high (around 90%). Note that the presented simulations were made with floating point processing so no quantization inaccuracies were considered in the receiver. In addition, no limitations on the receiver buffer size has been assumed so the results are somewhat ideal in that respect.

When the average number of transmissions is considered (Figure 2) HARQ Type II/III schemes result in approximately 50 % increase in Iub traffic at block error rates (50-90 %) that are needed to get some capacity gain.

---End text proposal--

REFERENCES

[1] Nokia. Hybrid ARQ methods for FDD in Release 2000. TSG-R WG1 document, TSGR1#14(00)0869, 4-7th, July, 2000, Oulu, Finland, 20 pp.