TSG-RAN WG1 meeting #16 **R1-001235**
Pusan, Korea
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Agenda item: AH28
Source: GBT
Title: Optimized and imperfect OLPC-FACH versus CLPC-FACH simulations
Document for: Discussion (RAN WG1)

This document addresses the issue of gain provided by optimization of the open loop power control on FACH. Currently, the specification is such that the DL power level chosen by the Base Node, can not benefit from the measurement report which was sent to RNC more than 800 msec ago. We have shown a set of simulations capturing the difference in performance between the perfect open loop power control and closed loop power control on FACH [1]. The results are shown in the document again. We had also shown some simulation results where the Base Node has no information on the fast fading status of the signal [2].

1. Simulation Assumptions

Recommended simulation parameters for FACH simulations.

Bit Rate	60 kbps
Chip Rate	3.84 Mcps
Convolutional code rate	½
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	1-path Rayleigh:3, 10, 40, 120 km/h **ITU Ped A: 3, 10, 40 km/h** ITU Veh. A: 10, 40, 120 km/h
CL feedback bit error rate	4 %
CL feedback delay	1 slot
TTI	10,20, 40, 80 ms
Target FER/BlkER	10-5 %
Geometry (G)	12 dB
Common Pilot	-10 dB total
Slot Format	[data1,data2,TPC, TFCI, Pilot] [4,56, 4, 8, 16]
OLPC implementation Error	0 dB * * The impact of imperfect open loop power control to be simulated

	separately.
STTD	Enabled
Channel estimation	Two orthogonal CPICH used to estimate: No averaging over multiple slots
Correlation between antennas	0
CLPC Dynamic range	[-15, +5] dB
CL feedback rate	1500 Hz
Transmission Mode	Bursty

Geometry, *G*, is defined as:

$$G ? \frac{average(Rx\_I_{or})}{I_{oc} ? N_o} \quad (1)$$

where,

Rx_I_{or} = The total post channel transmitted power density

I_{oc} = The other cell interference power density

N_o = The thermal noise power spectral density

2. Presentation of Results

The results are presented in the following format:

Plot Eb/Ior versus BER for various channel Models
Plot transmit Eb/Ior versus speed at the fixed BER of .005 for each case.

3. Presentation and discussion of Results

Figure 1: Comparison of CLPC-FACH and OLPC-FACH versus FER (Perfect OLPC): 40 ms TTI, 5Hz, ITU Ped A
Figure 2: Comparison of CLPC-FACH and OLPC-FACH versus FER (Perfect OLPC): 10 ms TTI, 5Hz, ITU Ped A
Figures 3-5: Comparison of CLPC-FACH and OLPC-FACH versus BER (Perfect OLPC): 40 ms TTI, 5Hz/ 30 Hz and 120 Hz
Figures 6-8: Comparison of CLPC-FACH and OLPC-FACH versus BER (Perfect OLPC): 10 ms, 20 ms, 80 ms TTI, 5Hz
Figure 9: Fading Rate in Hz versus CLPC Gain over perfect OLPC
Table 1: TTI versus CLPC Gain

Figure 1: Comparison of CLPC-FACH and OLPC-FACH versus FER (Perfect OLPC): 40 ms TTI/ 5Hz

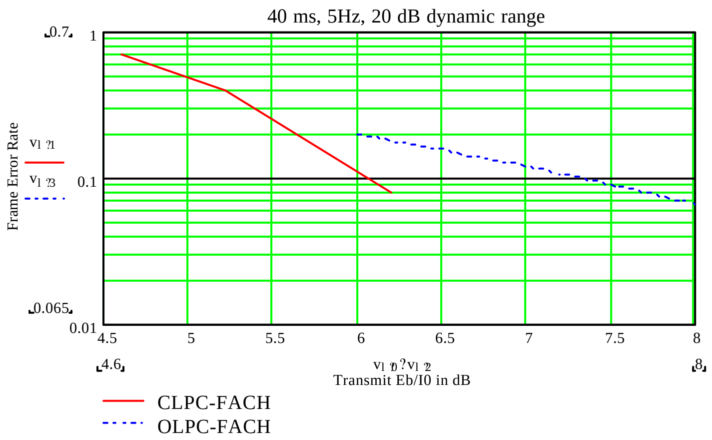


Figure 2: Comparison of CLPC-FACH and OLPC-FACH versus FER (Perfect OLPC): 10 ms TTI/5 Hz

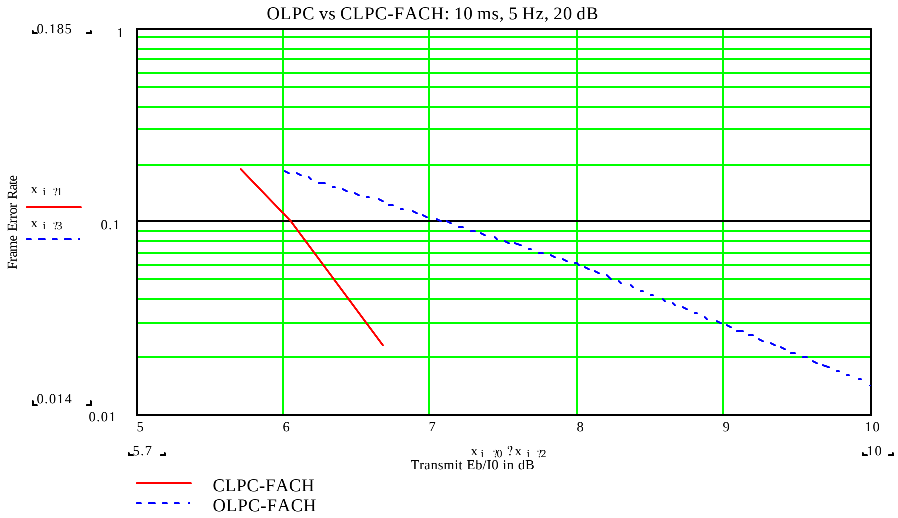


Figure 3: Comparison of CLPC-FACH and OLPC-FACH versus BER (Perfect OLPC): 40 ms TTI, 5Hz/ 30 Hz and 120 Hz

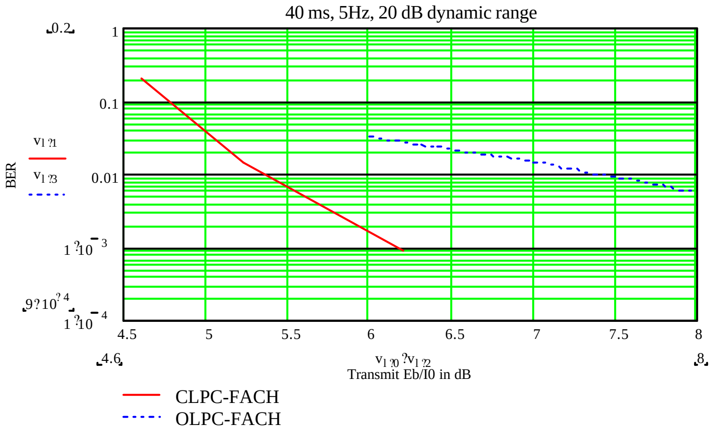


Figure 4:

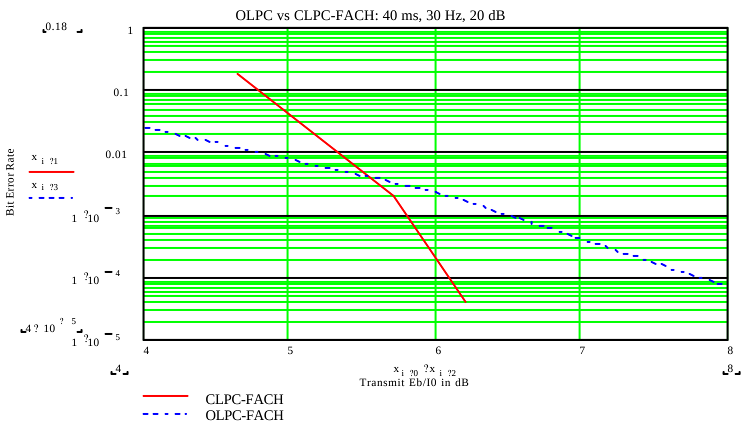


Figure 5:

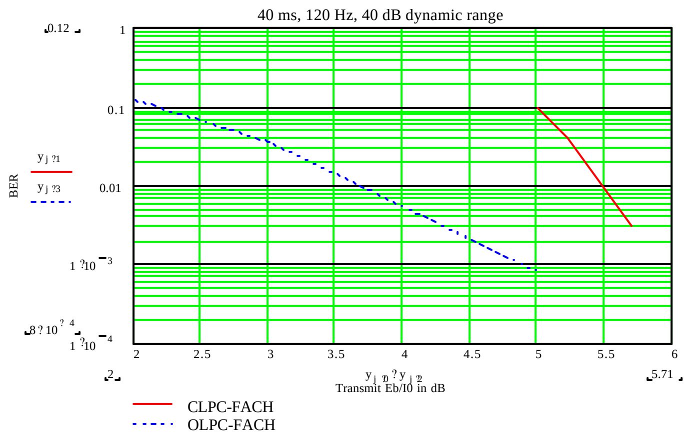


Figure 6: Comparison of CLPC-FACH and OLPC-FACH versus BER (Perfect OLPC): 10 ms TTI, 5Hz

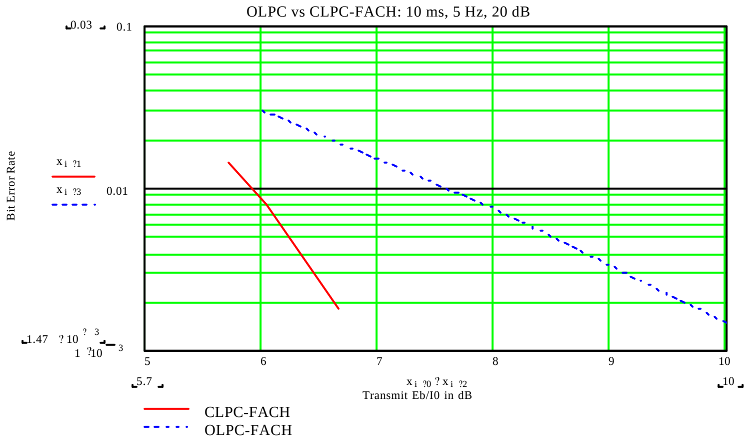


Figure 7:

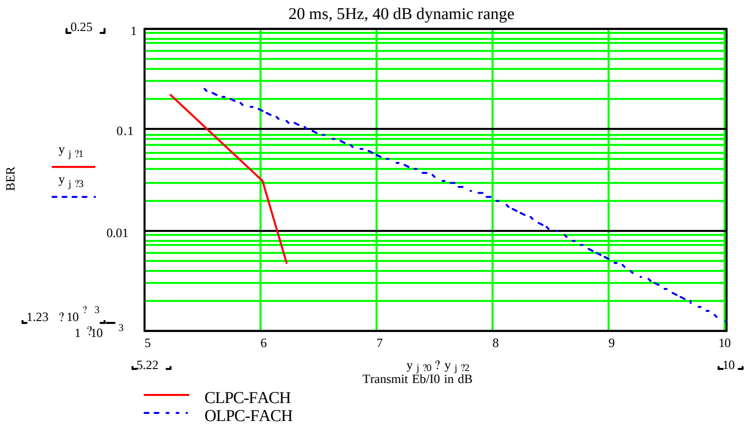


Figure 8:

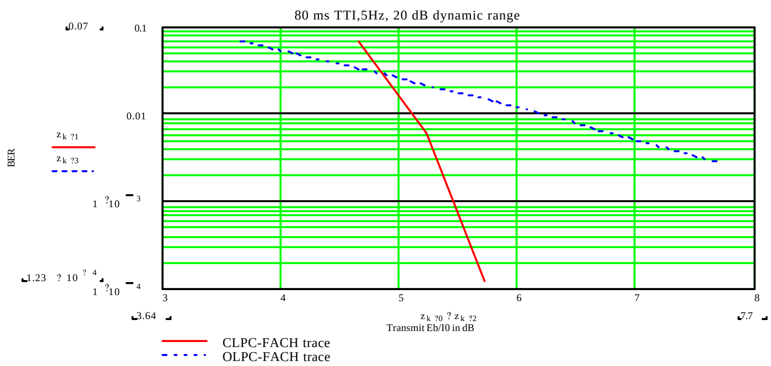


Figure 9: Fading Rate in Hz versus CLPC Gain over perfect OLPC

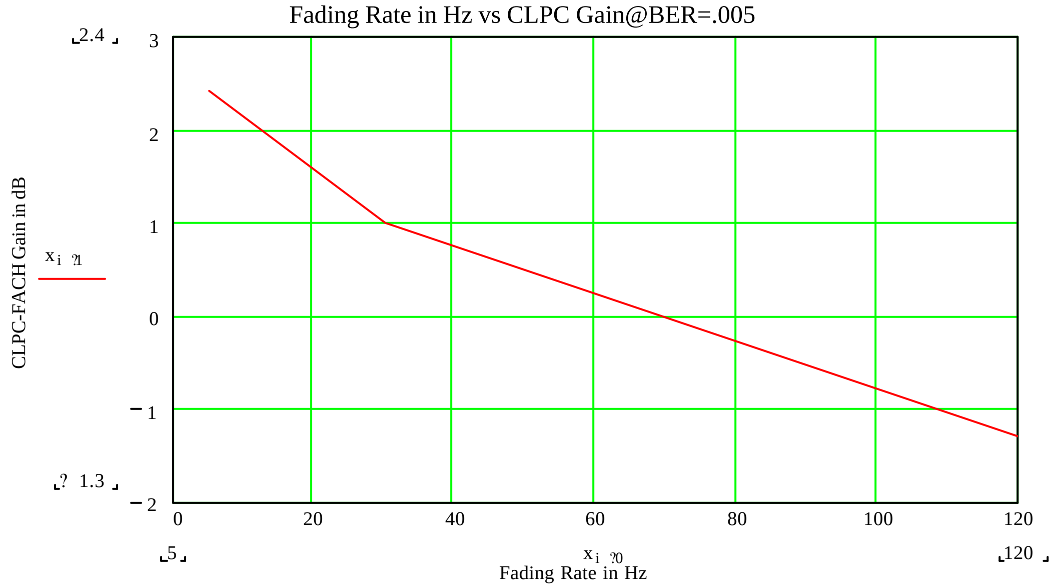


Table 1: TTI versus CLPC Gain (5Hz fading)

TTI length	Gain of CLPC over OLPC-FACH BER=.005
10 ms	2.3 dB
20 ms	2.8
40 ms	2.4
80 ms	2.6

4. Discussion of Results: As can be seen from the simulation results presented in the previous section, there is a 2.3-2.8 dB gain at the BER of .005 for various TTI lengths. Figure 2 clearly shows a 2dB gain at the FER of .05 for the 5Hz fading environment. These gains are for perfect OLPC.

5. Imperfect open loop power control on FACH

In [2], we showed the following results which have been obtained by simulations [W-CDMA slot format, K=9, R=1/3, 64 kbps, antenna diversity, 4% Power Control error rate]:

Table 2. CLPC Gains vs. Imperfect OLPC

Bit Error Rate	Gain in Indoor CLPC over imperfect OLPC	Gain in Vehicular CLPC over imperfect OLPC
10^{-2}	5 dB	1 dB
10^{-3}	6.5 dB	1.5 dB

Figures 10-11 show these results for the range of BER values.

Figure 10: Indoor environment:

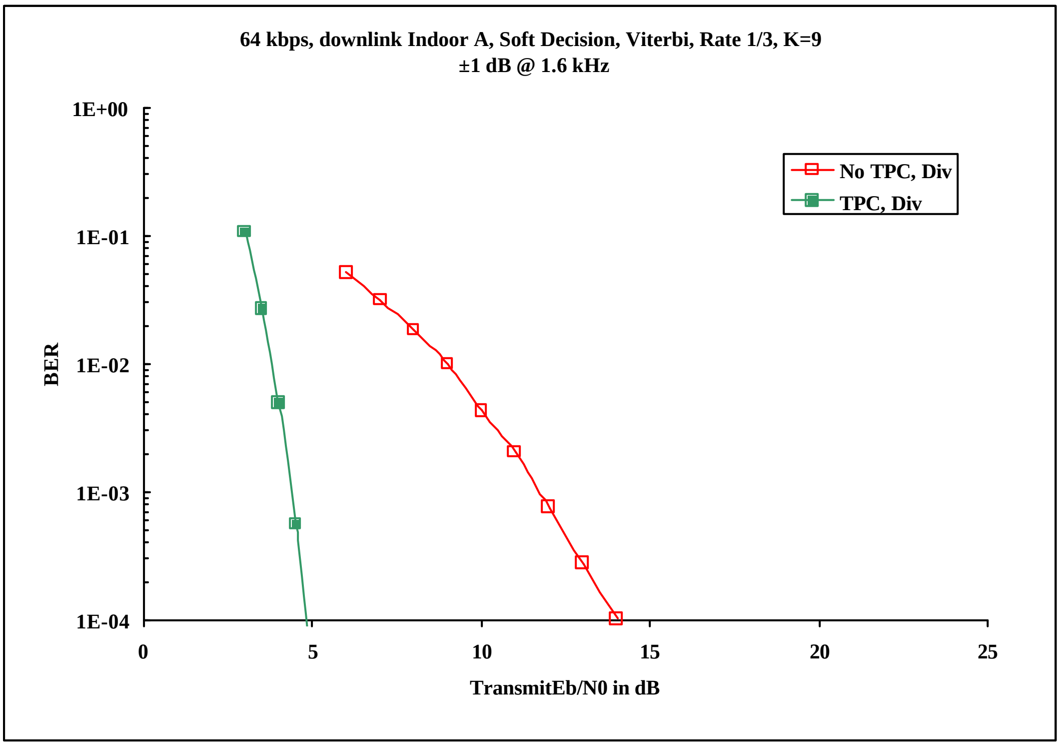
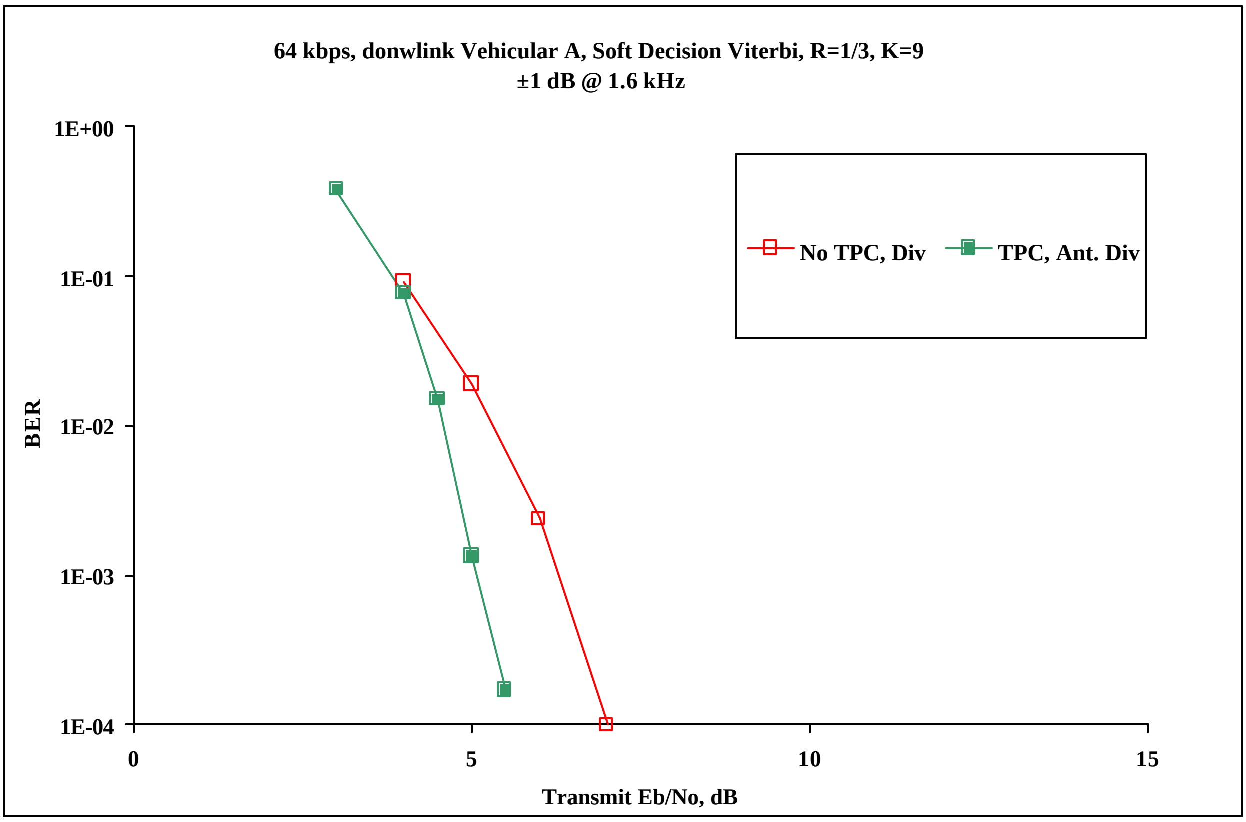


Figure 11: Outdoor environment: Downlink



Introduction of improved Open Loop Power Control operation on FACH reduces the simulated gains in both environments to the following tabulated values:

Table 3. CLPC Gains vs. Improved OLPC

Bit Error Rate	Gain in Indoor CLPC over improved OLPC	Gain in Vehicular CLPC over improved OLPC
10^{-2}	1.5 dB	-3.5 dB
10^{-3}	3 dB	-1.5 dB

Table 2. CLPC Gains vs. Imperfect OLPC (duplicated here)

Bit Error Rate	Gain in Indoor CLPC over imperfect OLPC	Gain in Vehicular CLPC over imperfect OLPC
10^{-2}	5 dB	1 dB
10^{-3}	6.5 dB	1.5 dB

Table 4. Improved OLPC Gains vs. Imperfect OLPC

Bit Error Rate	Gain in Indoor	Gain in Vehicular
10^{-2}	3.5 dB	4.5 dB
10^{-3}	3.5 dB	3.0 dB

Comparing Table 3 with Table 2 and taking the difference provides the results comparing imperfect OLPC with improved OLPC as shown in Table 4. Thus if the Base Node uses improved OLPC to acquire an accurate estimate prior to the message transmission, the performance improves by 3.5 dB in the indoor environment and a 3.0 - 4.5 dB in the vehicular environment. Assuming a 1.5 dB measurement inaccuracy, we can potentially have a gain of 4.5 – 6.0 dB depending on the environment.

6. Conclusion: GBT have already shown (Tdoc R1-00-0917) that the forward link system-wide capacity gain is directly proportional to the gain in transmit Eb/N0. In this contribution, we have documented the gain in dB associated with an improved OLPC on FACH as compared to imperfect OLPC-FACH. A potential 4.5-6.0 dB gain will translate into significant amount of capacity.

[1] GBT contribution, R1-00-1034-CLPC-FACH: CLPC-FACH simulations

[2] S.Ghassemzadeh, et.al. "On The Performance of Multi-Code CDMA Systems: A Simulation", IEEE Sarnoff Symposium on Wired and Wireless communications, March 1999