ETSI SMG2 Working Session on EDGE TDoc SMG2EDGE 097/98

December 2 - 4, 1998

Paris, France

Source: Ericsson

EDGE Usage on the BCCH Carrier

1 Introduction

The GSM standard 05.08 [1] states that the BCCH carrier (C0 carrier) should be constantly transmitted without any variation of RF level. This is required in order for the mobile to quickly perform e.g. cell selection and reselection.

Due to the linear 8PSK modulation used for EDGE, it will – at least initially - be difficult to design power amplifiers that operate with the same average output power for 8PSK and GMSK. Average Power Decreases (APDs) approximately corresponding to the peak to average ratio for 8PSK can be expected. This is especially true for high power amplifiers, which are typically used in macro cells. In such cases EDGE usage on the BCCH carrier would be prohibited by the standard. This would be devastating for EDGE deployment considering that in the same cases, only one carrier per cell is often used.

This paper discusses a relaxation of the requirements on constant average power on the BCCH carrier. It is proposed that a non-constant average power is allowed in the standard, and that an informative annex is introduced describing the consequences for any operator who wishes to allow it.

2 Why Constant BCCH Carrier Power?

The fact that the BCCH carrier is transmitted with a constant average power is used for the following purposes:

- Cell selection and reselection
- Open loop MS power control for GPRS

3 Impact on Cell Selection and Reselection

To investigate the impact of non-constant BCCH power some simple system level simulations are run. The effect of the non-constant BCCH carrier power is modelled by subtracting the APD from the pathgain for some of the BS candidates before cell selection is made. Further assumptions are given in Table 1.

Figure 1 shows signal strength (C) and carrier to interference ratio (C/I) distributions for up- and downlink. APD levels of 0, 2 and 4 dB are studied. To model non-ideal MS power measurements, a case where the MS randomly selects a BS within 3 dB from the strongest is also included (3 dB handover margin).

It is seen that for all cases the decrease in C or C/I is moderate. A decrease of approximately 1 dB at the 5^{th} percentile is achieved for an APD of 4 dB.

Simulation Assumptions	
Frequency reuse	3/9
Resource utilisation	50%
EDGE penetration	50%
Average Power Decrease (APD)	0, 2 or 4 dB
Pathloss	L = C + 35 log (d)
Log-normal fading standard deviation	6 dB
Multipath fading	Not included

Table 1. Simulation assumptions

4 Impact on GPRS MS Open Loop Power Control

In GPRS the MS power is set according to the formula [2]:

$$P_{CH} = min\ (\Gamma_0 - \Gamma_{CH} - \alpha * (C+48),\ PMAX)$$

Where *C* is the received signal level at the MS on either the BCCH or PDCH, and $\alpha \in [0,1]$ is a system parameter determining the whether open or closed loop power control is used. In case the BCCH is used for deriving *C*, the result of an *Y* dB APD on the BCCH would be that the MS 'underestimates' the received power by Y dB, and consequently – in cases down regulation is invoked - transmits with a $\alpha * Y$ dB too high power.

5 Conclusions

It is seen that the performance degradation for allowing EDGE with a small APD on the BCCH carrier is quite small. Combining this with the fact that the final decision is taken by the operator, it is proposed to relax the requirement on constant BCCH carrier power in the standard.

The following modification is proposed in 05.02 Section 7.1:

- "The BCCH carrier shall be continuously transmitted on all timeslots and without variation of RF level" is replaced by "The BCCH carrier shall be continuously transmitted on all timeslots with an RF level that can be considered constant by the MS, see further Annex X"

In addition to this, the introduction of an informative annex X (or note) is proposed, reading something like:

- "Allowing variations of the RF level transmitted on the BCCH carrier may cause a worsened cell selection and reselection performance. However, simulations indicate that variations limited to less than 4 dB yield only moderate decreases in signal strength and carrier to interference ratio. Also the GPRS MS open loop power control could be affected, resulting in MS transmitting with slightly higher power than necessary."

A CR containing the above changes could be submitted to the next SMG2 WPB meeting if well received by the EDGE working session.

6 References

[1] ETSI TS 100 911 V6.2.0, “Digital Cellular Telecommunications System (Phase 2+); Radio Subsystem Link Control (GSM 05.08 version 6.2.0 Release 1997)”

[2] ETSI TS 100 350 V6.1.0, “Digital Cellular Telecommunications System (Phase 2+); General Packet Radio Service (GPRS); Overall Description of the GPRS Radio Interface; Stage 2 (GSM 03.64 version 6.1.0 Release 1997)”

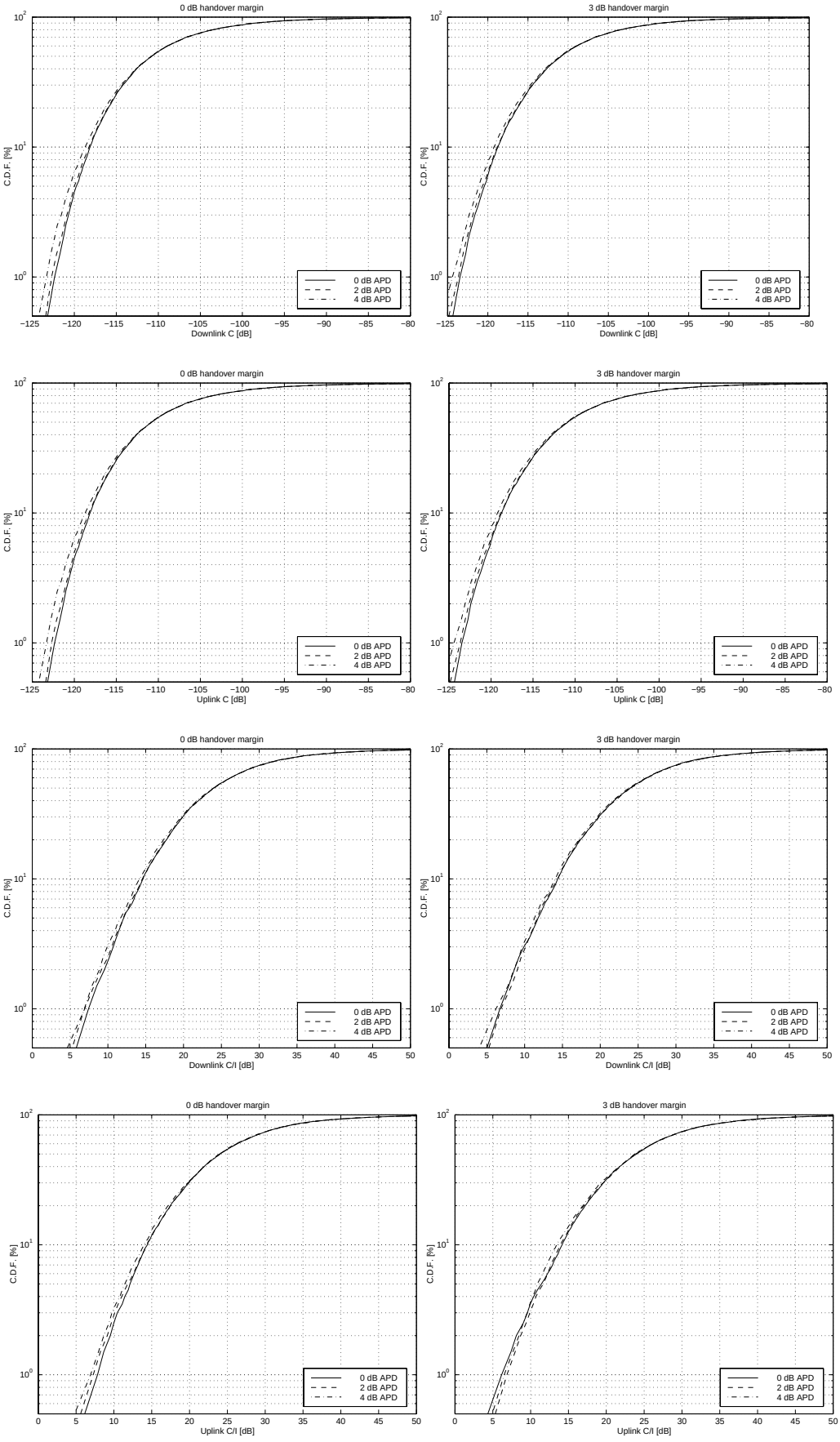

Figure 1 a-h) Down- and uplink distributions of C and C/I.