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Performance of Alternative Fast Power Control Schemes

1. INTRODUCTION

This document presents a simulation study on the effect of different power control intervals to the network level capacity.

It has been shown that ECSD Fast Power Control (FPC) can provide considerable capacity benefit at least in certain environments [1]. The ECSD FPC is 24 times faster than normal SACCH-based PC (20 ms vs. 480 ms). It has been proposed to adopt similar kind of scheme for 8PSK speech [2] . A proposal of 120 ms reporting and FPC period has also been made [3].

A simulation study [4] has been made which suggests that normal PC is enough for low mobility (3 km/h) users and that 120 ms PC period can provide some gain for fast moving mobiles (50 km/h).

This study shows results from dynamic system level simulations which compare the effect of different PC intervals on network capacity in a typical macro cellular network. Power control command and measurement report errors are not considered and only non-hopping case is studied with MS speed of 50 km/h.

2. SIMULATION MODELLING AND SCENARIOS

Simulations were run in a typical macro cellular environment with 3-sector sites. Both uplink and downlink directions were taken into account. Simulated speech service was AMR 7.4 with ETCH-FS with channel – no link or codec mode adaptation was applied.

Main simulation parameters are listed in Appendix A.

2.1 Signal Quality Reporting

An RXQUAL sample is collected from bursts over 20, 120 or 480 ms measurement period. A running average filter of the collected samples are fed to the PC algorithm with the frequency as which match to the quality reporting. For 120 ms and 480 ms case, the newest sample is not taken into account, for 20 ms period two newest samples are not taken into account – these model the delays between the measurement and the PC command.

During DTX no measurement reports or PC commands are sent. The performance of FPC mechanism during DTX presented in [2] will be studied later.

2.2 Power control algorithm

In order to have fair comparison between different PC intervals, same simple quality-based based PC algorithm was used. The algorithm adjust the transmission power according to the deviation of the target RXQUAL, see equation below

$$PCCommand\_dB = 2.0 * (Avg(RXQUAL) - RxqualTarget)$$

An RxqualTarget value of 2 was used in simulations.

3. RESULTS

Figure 1 shows the simulation results with different PC intervals. Satisfied user ratio is defined as (*NrOfBlockedCalls+NrOfDroppedCalls+NrOfBadQualityCalls / AllCalls*).

MS speed was 50 km/h and both DTX and no-DTX cases are shown.

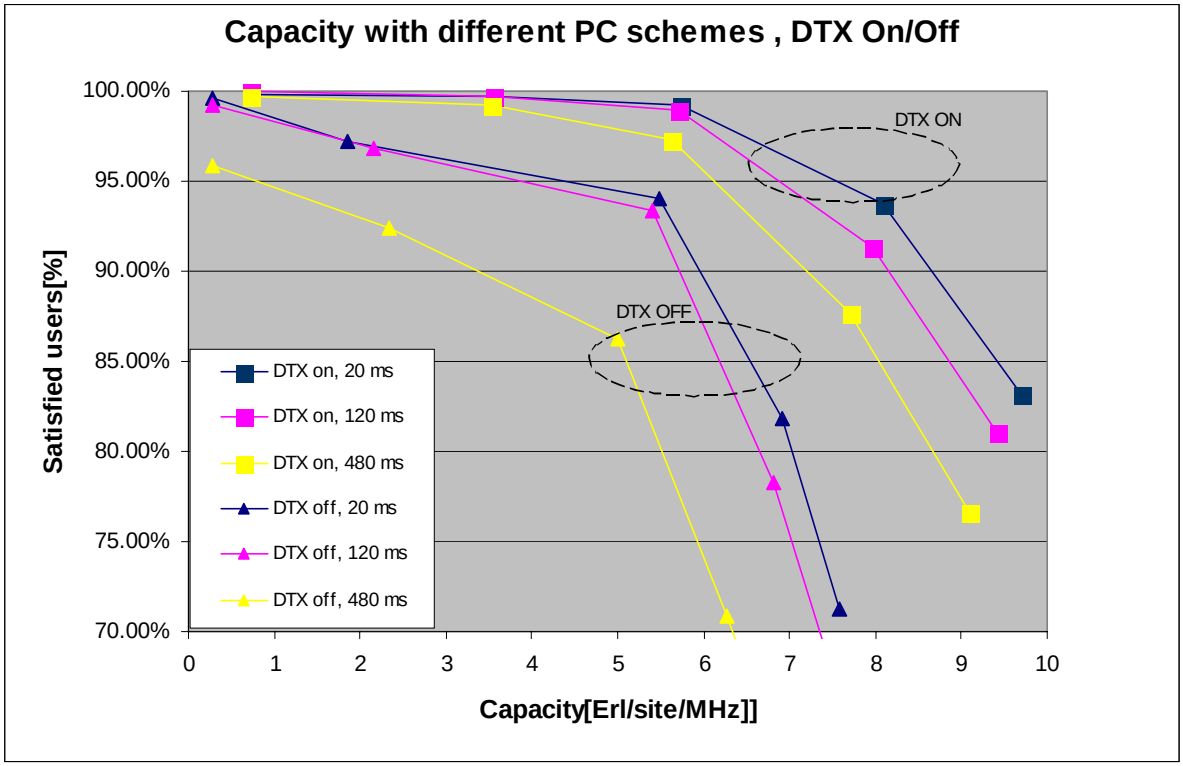

Figure 1. Capacity with different PC intervals. 50 km/h MS speed, DTX Off or On.

4. CONCLUSION

This document presents network simulations results on the effect of different PC measurement reporting and PC command interval. Three different cases are considered: 20ms, 120 ms and 480 ms PC cycles. Initial simulation results show that gain can be achieved from 20 ms PC interval, although it seems like most of the gain is already achieved by reducing the interval to120 ms.

Shorter PC interval could give more gain for example in a network with bursty packet data and/or in an environment with more aggressive interference behaviour, like in indoor or micro cell scenario. Together with e.g. the effect of cyclic and random hopping and PC errors, these items are for further study.

5. REFERENCES

[1] Tdoc SMG2-2e99-331:"Fast measurement reporting and power control for ECSD" (Source: Nokia). ETSI SMG2 Working Session on EDGE, 24th-27th August 1999, Versailles, France.

[2] 3GPP TSG GERAN Adhoc #2, Tdoc GAHW000064, Fast Adaptation Mechanisms for 8PSK Speech Bearer, Nokia, 9th-13th October 2000, Munich, Germany

[3] Tdoc GERAN Adhoc 052/00: "SACCH Stealing Bits for 120ms EGPRS Voice Power Control (source AT&T)".)". 3GPP TSG GERAN Adhoc #1, 7th-11th August 2000, Helsinki, Finland.

[4] Tdoc GERAN Adhoc 061/00: "System performance impact of power control interval (Source: Ericsson)". 3GPP TSG GERAN Adhoc #1, 7th-11th August 2000, Helsinki, Finland.

ANNEX A. Main simulation parameters

Parameter	Value	Unit	Comment
Frequency band	900	MHz	
Bandwidth	4.2	MHz	Incl. BCCH
Reuse and number of TRXs	TCH 1/3, BCCH 5/15, 3TRXs per cell		
Frequency hopping	Not used.		
Cell radius	500	m	
BTS power	20	W	
MS power	2	W	
Noise floor	- 114	dBm	
Path loss exponent	3.67		
Slow fading standard dev.	6	dB	
ACP value	18	dB	1st adj. taken into account
Simulation time step	4.615	ms	1 TDMA frame
Simulation length	200000	TDMA frame	~15.5 minutes
Call arrival rate	0.001389	1 / h	5 calls / hour / user (Poisson process)
Avg. call length	120	sec.	
Handover margin	6	dB	
Handover check interval	4	SACCH multiframe	
Voice activity	66	%	

Table 1. Main simulation parameters.