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Source: Motorola

Title: CPICH cancellation, 2-way soft-handoff capacity gain

Agenda item: 9.1

Document for: Discussion

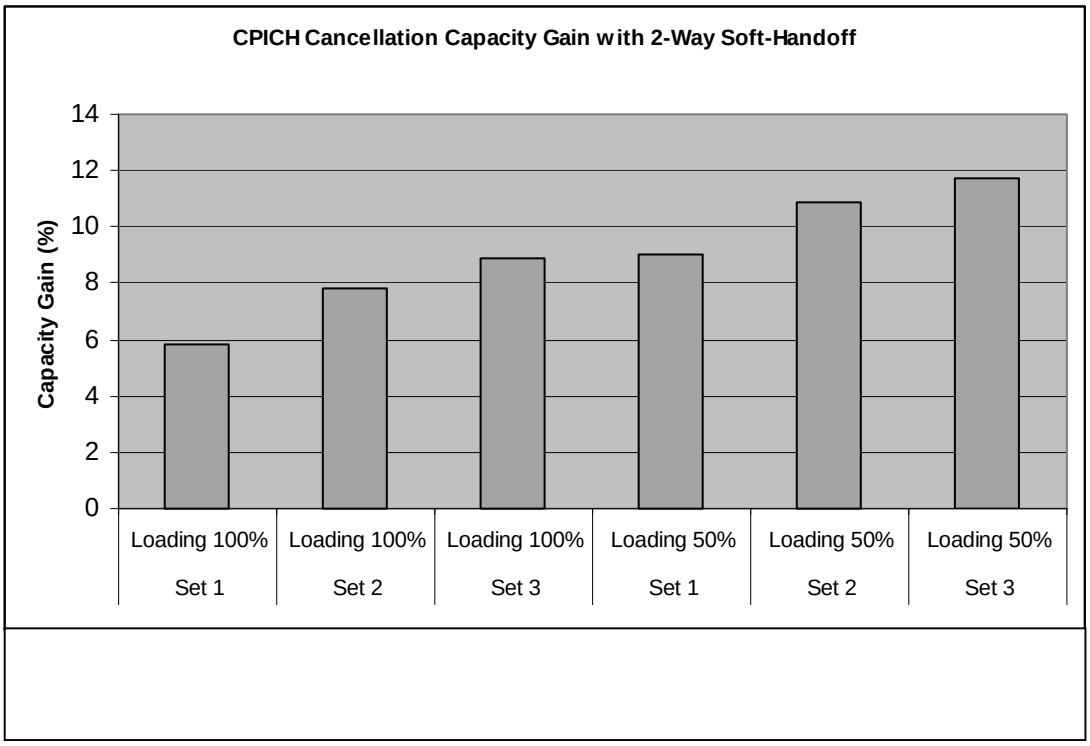
1.0 Introduction

A number of contributions [1]-[4] to 3GPP have pointed out the benefits of CPICH cancellation at the UE. As pointed out in [5] the capacity gain due to CPICH cancellation is best evaluated by system-level simulations rather than link-level simulations, as the link-level performance (SIR vs. BER/BLER) is a function of the cell geometry (*Îor/Ioc*). The capacity simulations presented in [5] did not include soft handoff. This contribution addresses to some extent the handoff issue. Using a simplified soft-handoff capacity simulation, capacity gains using CPICH cancellation are shown to be a function of the channel model set and adjacent cell loading. These results should aid in evaluating the performance/cost trade-off for CPICH cancellation.

2.0 Simulation results

A list of simulation assumptions is given in Table 1. The following key points should be noted.

- The simulation methodology is based on a static model that supports 2-way soft handoff.
- The UE is randomly placed in the cell (sector) and randomly assigned a given multipath channel model from a set of channel models. (Different simulation runs use different channel sets.)
- The channel models are based on the power profiles used by RAN4 (Case 1 and Case 3, 3GPP TS 25.101).
- Three sets of channel models are considered:
    - Set 1 uses 100% Case 1 (represents the least loss of orthogonality with little diversity).
    - Set 2 consists of 50% Case 1 and 50% Case 3.
    - Set 3 uses 100% Case 3 (represents an increasing loss of orthogonality and the most diversity).
- Adjacent cell loading is fixed at 50% or 100%. Cell loading is defined as the percentage of full power at which the other base stations are operating. (In any case, the CPICH power is held at a constant –10 dB of full cell power.)



Other channel models and combinations can be used to represent typical scenarios. In the absence of any agreed-upon assumption, it is felt the choosen channel models and combinations based on TS25.101 represent a suitable starting point.

From Figure 1 it is observed that the capacity gain ranges from 5.8% to 11.7%. The value of 5.8% is associated with 100% adjacent cell loading with channel model Set 1, while the gain of 11.7% is associated with 50% adjacent cell loading with Set 3. The trend of these results, increasing capacity gain, is to be expected since with greater cell loading the fractional part of the noise that is due to CPICH is less, and channel model Set 1 is more like flat-fading compared to Set 3. (Note: with flat fading there is no capacity gain due to CPICH cancellation.)

In [5] Motorola presented capacity simulation results without soft handoff. This simulation was based on 100% adjacent cell loading and Channel Set 3. It was conjectured that soft handoff would improve the capacity gain due to CPICH cancellation. Comparing this result with the capacity improvement shown in Figure 1 for the same loading and channel set, it is seen that 2-way soft handoff improves the capacity gain due to CPICH cancellation by about 2% (i.e., approximately 9% compared to 7%). If the active set is increased to 3 (as agreed in WG4), then additional gain is expected.

3.0 Conclusion

System-level capacity simulations show that the capacity gain realized by CPICH cancellation is dependent upon the channel distribution experienced by the set of UEs in a given cell and the amount of cell loading. With 2-way soft handover included in the simulation, the capacity gain ranges from 5.8% to 11.7%. Additional gain is expected if the number of cells in soft handover belonging to the active set is increased to 3.

These results should help determine if CPICH cancellation provides sufficient capacity gain, when compared to the complexity increase, for inclusion in the UE.

4.0 Reference

[1] 3GPP TSGR1-00-1371, “CPICH interference cancellation as a means for increasing DL capacity,” Intel Corporation, Nov. 2000.

[2] 3GPP TSGR1-00-0030, “Further Results on CPICH Interference Cancellation as A Means for Increasing DL Capacity,” Intel Corporation, Jan. 2001.

[3] 3GPP TSGR4-01-0238, “CPICH Interference Cancellation as a Means for Increasing DL Capacity,” Intel Corporation, Feb. 2001.

[4] 3GPP TSGRP-01-077, “Mitigating the Effect of CPICH Interference at the UE,” Intel Corporation, Mar. 2001.

[5] 3GPP TSGR4-01-0967, “CPICH cancellation,” Motorola, July 2001.

Annex A Simulation assumptions

Table 1. Parameters used for capacity evaluation

Item	Parameter	Comments
Pathloss exponent	3.7	
Log normal standard deviation	8 dB	
Log normal decorrelation distance	100 meters	
Cell radius	1000 meters	
Antenna front to back ratio	20 dB	
Number of rings of interferers	3	
Number of interfering sectors	110	Three rings of interferers
Mobile antenna	omnidirectional	
Number of sectors per site	3	120° ideal sector antennas[1]
Other-cell interference	AWGN	
Sector loading conditions	1.0 W for the desired sector, 1.0 W (100%) or 0.5 W (50%) for other sectors	
Soft handoff	Two-way soft handoff using equal power from the two serving sectors	
Soft-handoff threshold (T)	6 dB	
Total transmit power	1.0	System is interference limited
Pilot fractional power	10%	
Power control	Perfect	
Target SINR at RAKE output	+2 to +7 dB	Results are not sensitive to this value
Multipath channel gains (dB), relative to ray with maximum gain	Channel I = [0, –10] Channel II = [0, –3, –6, –3 –9]	RAN4 Case 1 RAN4 Case 3
Channel set composition	Set 1: 100% Channel I Set 2: 50% Channel I, 50% Channel II Set 3: 100% Channel II	
Multipath tap spacing	1 chip (3.84 Mcps)	
Processing gain	128	

[1] A 120-degree ideal antenna pattern with 20db front-to-back antenna ratio refers to a "brick wall" antenna pattern with that front-to-back ratio.