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Las Vegas, USA, 27th February – 2nd March 2001

Agenda Item: 12

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Title: Cell Selection in HSDPA

Document for: Discussion

Introduction

This document presents some results on the potential benefits of fast site selection in HSDPA. In general the common assumptions for modelling HSDPA have been adopted.

The basic mechanism is that the cell sending the downlink packet to a particular UE is determined according to the strongest CPICH signal. Two special cases are considered.

1) "Fast" Cell Selection: The best cell is indicated to the Node B every frame (with some signalling delay). Here we assume that there is a measurement error in determining the CPICH power (normal distribution with standard deviation = 1dB). We also neglect the signalling delay, and further assume that any changes in the channel are slow relative to the frame duration.

2) "Slow" Cell Selection: The best cell is signalled at a slow rate (with higher layer signalling). Here we assume that the selection is done on the basis of the long-term average CPICH power (ignoring fast fading). In this case we assume that this selection is made without any error.

Given these two ways of cell selection it is possible to calculate the SIR which would be obtained at the UE using either of them.

Results

The results here were obtained under the following additional assumptions:

?? Thermal noise neglected
?? 20% of Node B power allocated to common channels in all cells
?? 80% of Node B power allocated to HSDPA in all cells
?? Spreading factor not considered
?? Single path Rayleigh fading model
?? Shadowing correlation between sites = 0.5
?? Number of UE's per sector = 50

In order to investigate the effect of different channel models the following conditions were considered:

?? A: Propagation exponent =3.76, standard deviation of log-normal shadowing = 8dB
?? B: Propagation exponent =2.5, standard deviation of log-normal shadowing = 10dB

The second case is intended to represent more severe propagation conditions.

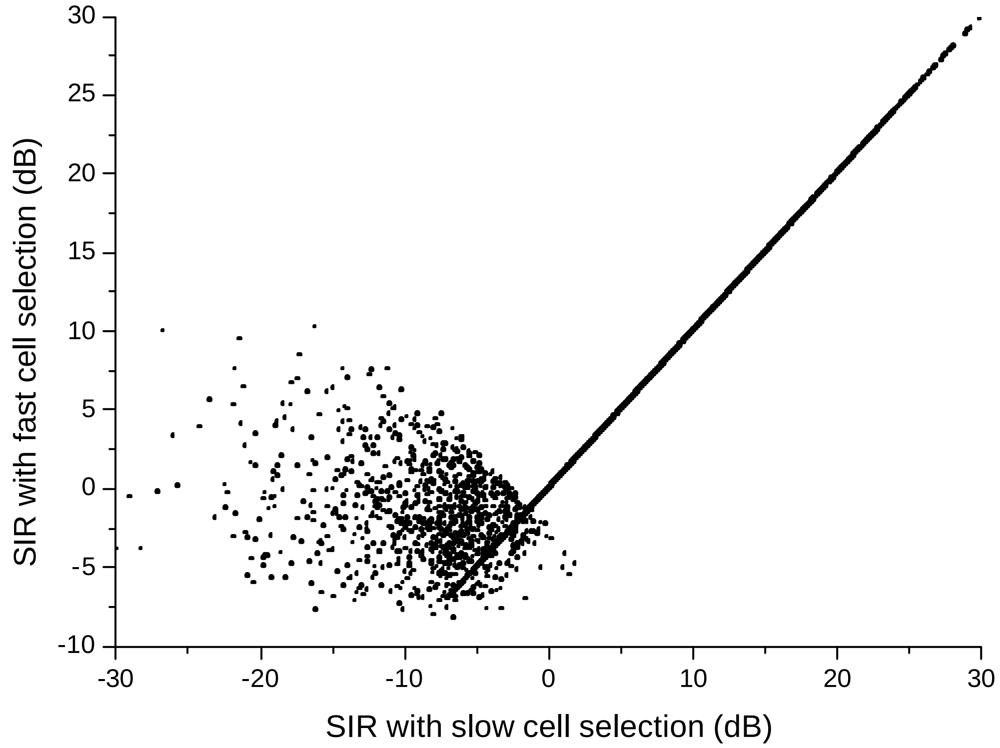

Figure 1 – SIR with fast cell selection vs SIR with slow cell selection
(alpha =3.76, sigma=8dB)

Figure 1 shows that fast cell selection can give improvements in SIR for low SIR values (less than about 0dB). In some cases a small degradation is produced. This arises from the CPICH measurement errors which can result in the selection of a sub-optimum site.

The distribution of the points can be explained as follows: The straight-line portion results from those instances where the fast and slow methods both select the same cell. The scattered region is where the fast method can give some gain. However, such a gain can only be obtained if the slow method has selected the wrong cell. For two equal strength signals this could only happen if the SIR obtained by slow cell selection was less than 0dB. Therefore we would only expect to see possible improvements below 0dB. More precisely, in this case the wanted signal can only have 80% of the cell power, so this "cross over point" is shifted to about –1dB.

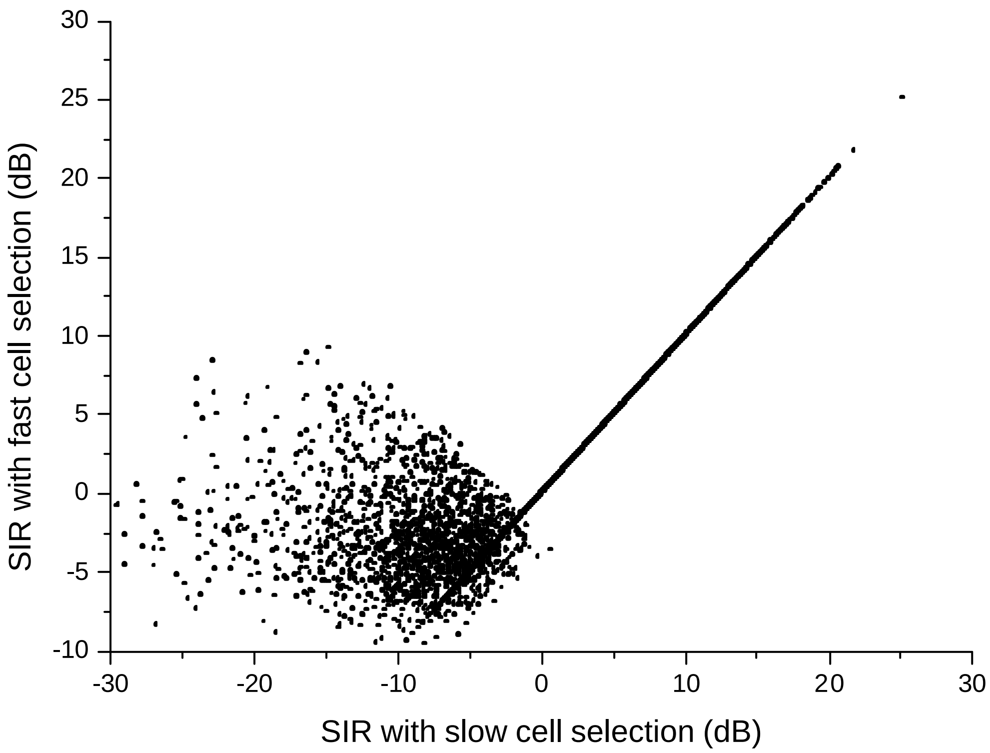

Figure 2 – SIR with fast cell selection vs SIR with slow cell selection
(alpha =2.5, sigma=10dB)

In Figure 2, we can see that the modified propagation conditions give lower values for the maximum SIR achieved and more occurrences of SIR below 0dB for slow cell selection.

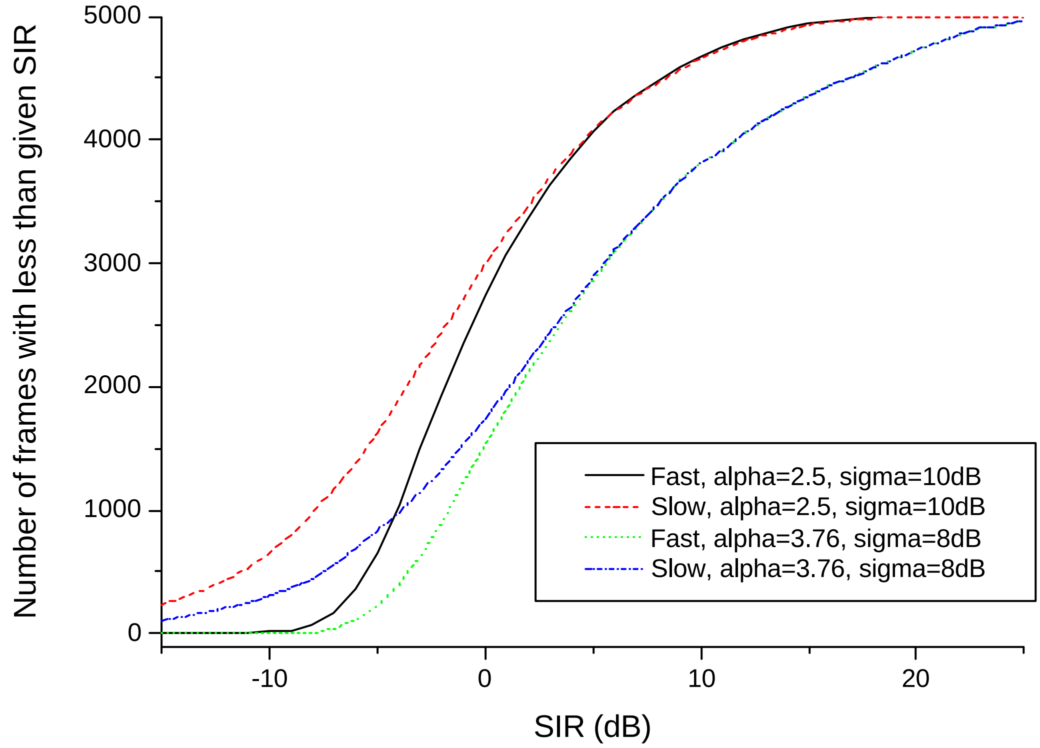

Figure 3 – Cumulative distributions of SIR with fast cell selection vs SIR with slow cell selection

In Figure 3 we can see that the lower tail of the cumulative distribution of SIR is significantly improved by fast cell selection, particularly in the case of adverse propagation conditions.

Conclusions

The gains in SIR from fast cell selection (compared with slow cell selection) appear to become worthwhile for SIR values significantly below about 5dB. Therefore it is worth considering the situations in which this benefit could be obtained:-

(1) Fair scheduler: If the packet scheduling does not take into account the SIR (e.g. for time critical services where it is desirable to minimise scheduling delays), then packets may be scheduled for transmission during frames with low SIR. In such cases fast cell selection is likely to give a benefit. In contrast, a SIR based scheduler may be able to ensure that transmission only occurs during frames with good SIR at the destination UE.

(2) Maximum Coverage Required: In order to provide service over the whole cell area, it may be necessary to serve UE's with low SIR, in which case the benefit of fast cell selection would be welcome.

(3) Poor propagation conditions: The prevailing path loss and shadowing model may result in an increased occurrence of low SIR conditions. In such a case this could be offset by fast cell selection.

It is also clear that in order to obtain maximum benefit from fast cell selection, it is desirable to minimise effects of errors (e.g. due to SIR measurement errors, signalling errors and insufficient update rate for cell site and SIR information).