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Title: Cycling of cell parameters to improve path estimation

Document for: Discussion

1.0 SUMMARY

The midambles used for channel estimation have been designed to have good autocorrelation properties, but not necessarily good crosscorrelation properties. Thus in case of crosscorrelations with midambles from neighboring cells false paths may appear during channel estimation, which will add additional noise during maximal ratio combining (MRC) and lower the system capacity. In order to find which paths actually exist, the midambles in each cell can be changed from frame to frame. Actual paths will appear in the same position with different midambles, while false paths generated by crosscorrelations will only appear with a specific midamble. The receiver can perform a delay profile estimation to determine which paths actually exist and only include these paths in the MRC.

A significant reduction in the number of false paths is obtained when the cell parameters are cycled through four frames. Each cell will cycle through the four codes in one cell-code-group. This paper analyzes the crosscorrelations between midambles and then shows the benefits of cycling the midambles.

2.0 CROSSCORRELATIONS BETWEEN MIDAMBLES

The parameters that were used to find the crosscorrelations between midambles are:
1) 16 users per cell
2) 512 chip midambles are used (56 chip cyclic prefix + 456 chip basic sequence)
3) midambles are normalized to have equal power
4) 2 base stations are received with equal power
5) user receives two equal power paths (1 chip apart) from each base station
6) no noise or fading

The strongest false path for a particular user is compared to the strongest actual path from the desired base station to find the intercell interference rejection. An intercell interference rejection of 6 dB means that the strongest false path caused by crosscorrelation with the interfering base station is 6 dB lower in power than the strongest path of the desired base station. If the strongest path from the desired base station has amplitude 1 (power of 0 dB), then the strongest false path has amplitude 0.5 (power of –6 dB). Figure 1 shows the distribution of intercell interference rejection computed using the parameters given above. In over 90% of the cases the strongest false path will have an amplitude of 0.5 or above and will significantly contribute extra noise to the MRC.

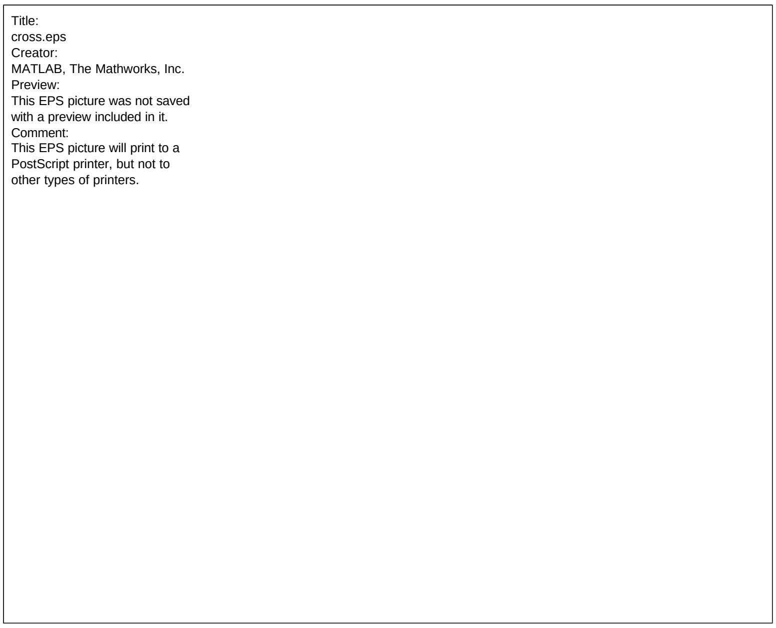

Figure 1: Intercell interference rejection with 16 users per cell. Over 90% of the time the strongest false path will be within 6 dB of the strongest actual path.

3.0 CELL PARAMETER CYCLING

If the cell parameters are changed every frame, then the receiver can perform a delay profile estimation to determine which paths are actually present. Figure 2 shows a conceptual drawing of how the delay profile estimation can be performed. Assume that the cell parameters are cycled every frame and that the cycle length is 4 frames. Thus, the parameters for the fifth frame would be the same as those for the first frame. In every frame the receiver can store all the positions where the measured channel estimate passes a threshold. In Figure 2 for the first frame with midamble 1, the paths that cross the threshold are located at chip positions 10, 12, 14,16, 20, and 22. In the other three frames the positions that pass the threshold can also be stored. If a path is present for all four midambles, then it is likely that this path is really present and is not a result of crosscorrelations with interfering midambles. The paths at positions 14 and 16 are present for all four midambles, so the receiver would only include these two paths in the MRC. Since the paths positions vary slowly, the receiver can average the received power at each position for each of the four midambles to average over the fading and noise.

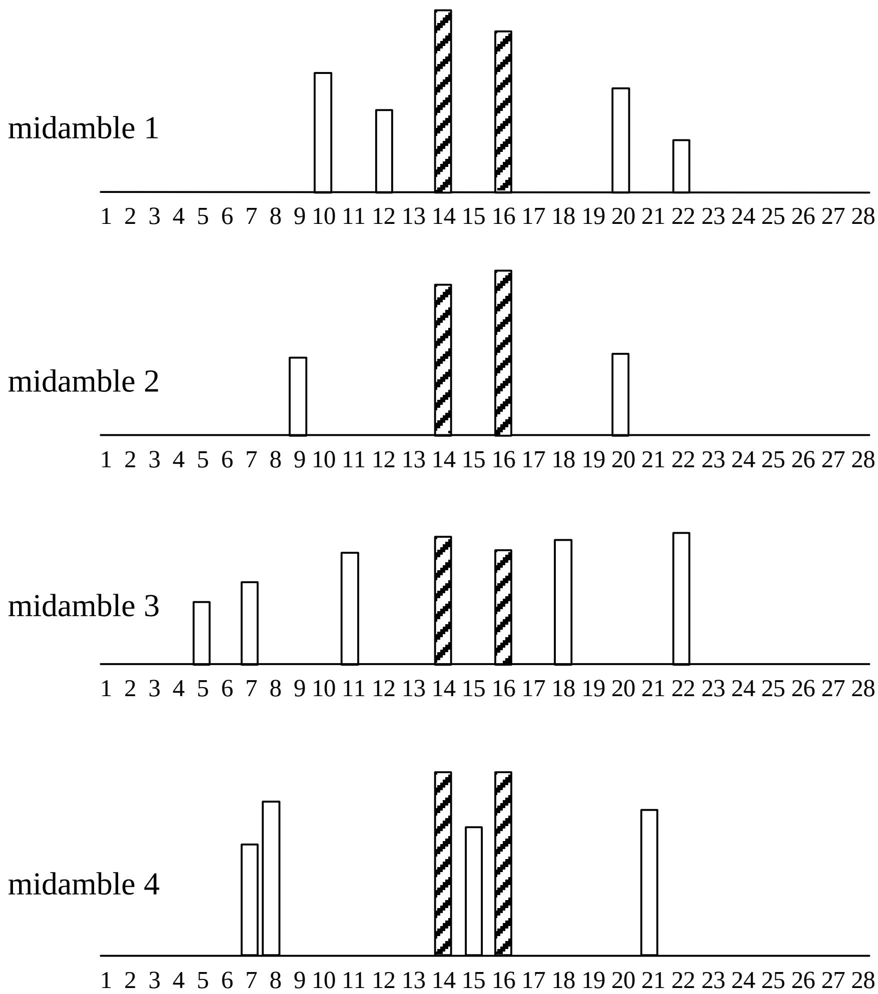

Figure 2: Conceptual drawing of how midamble cycling can be used to aid delay profile estimation. The two shaded paths are present for all four midambles and are likely actual paths. All the other paths are likely false paths caused by crosscorrelations with interfering midambles.

TS 25.223 [1] gives a list of the cell parameters, which include the scrambling code, long basic midamble code, and the short basic midamble code. There are 32 groups with 4 sets of cell parameters each. It is proposed that the when a cell is assigned to a group, it will cycle through the 4 sets of cell parameters in that group, using 1 set in each frame. The super frame number ranges from 0 to 71 and is used to determine which set of cell parameters is used in each frame.

Table 1: Alignment of cell parameter cycling and super frame number.

Set assignment	SFN mod 4 = 0	SFN mod 4 = 1	SFN mod 4 = 2	SFN mod 4 = 3
Set 0	Set 0	Set 1	Set 2	Set 3
Set 1	Set 1	Set 2	Set 3	Set 0
Set 2	Set 2	Set 3	Set 0	Set 1
Set 3	Set 3	Set 0	Set 1	Set 2

Table 1 shows how the cell parameters are cycled from frame to frame. Each cell is assigned a set of parameters as currently is done, but the cell will also cycle through the other 3 sets of cell parameters. Simulations were performed to find how cell parameter cycling can be used to aid delay profile estimation and reduce the number of false paths included in the MRC. The same parameters as those in Section 2.0 were used.

Figure 3 shows the number of false paths that are present with no cell parameter cycling, cycling through 2 frames, and cycling through 4 frames. Only paths that were –10 dB or greater were counted [the strongest actual path was 0 dB]. If no cell parameter cycling is performed, then 50% of the time there are 8 or more false paths which are –10 dB or stronger. With cell parameter cycling through 4 frames, more than 85% of the time there are no false paths.

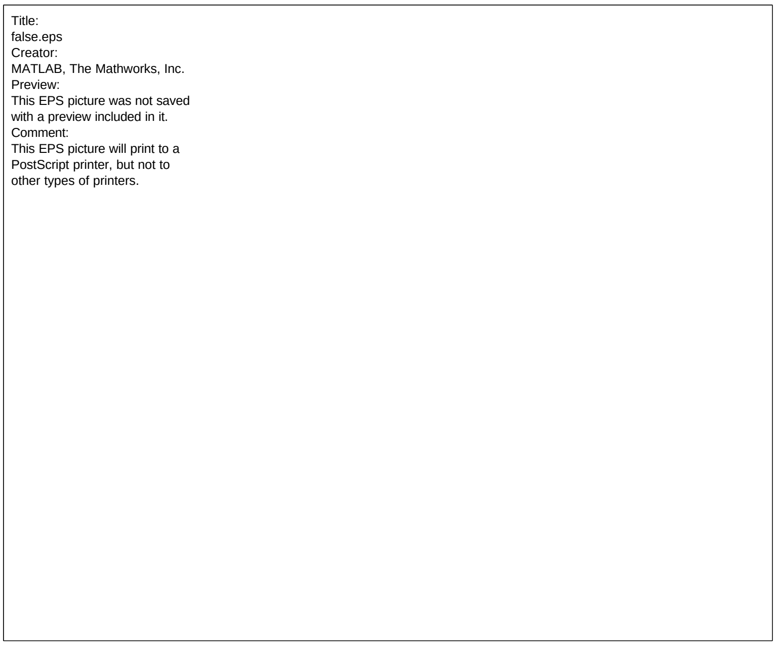

Figure 3: Distribution of the number of false paths (-10 dB or greater) with no cycling, cycling through 2 frames, and cycling through 4 frames.

REFERENCES

[1] 3GPP, TS 25.223, V2.1.2, (1999-08).