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Agenda item: AH17

Title: Comments on TA-IPDL

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1 Background

In [1] simulations results are presented to compare the TA IPDL and the original IPDL method. The results differ vastly from the ones presented in [2], in which the conclusion was that the performances are quite similar. Obviously there must be some differences in how the methods are implemented. From the description in [1] it is difficult to tell what might be the cause. This paper tries to address some of the unclear points in [1]. There are a lot of comments to be made on [1] but this paper only targets the most important ones. The paper also addresses some additional drawbacks of the TA-IPDL method.

2 Comments on [1]

Simulation results

It is difficult to understand how the simulation results can differ so much between the TA and original method. The results for the TA method agrees pretty well with the results in [2] but the results for the original method is much worse. In table 3 one can see that the estimation algorithm only converges in a small number of cases. We find this strange since according to our understanding the cost-functions involved always have a global minimum, and thus non-convergence indicate an estimation algorithm problem rather than a problem with the IPDL method. In our simulation we had very few cases where the hearability sets the limit. According to our findings the main problem is the multipath propagation.

Analysis of results

It is true that the C/I of the received signal will be significantly better for the TA method. However one should also consider the fact that the original method can use a longer coherent integration time and that all ten idle periods will be non-coherently combined, whereas for the TA method only about two periods can be used on average. Furthermore in the original method the combination can be performed before the threshold detection, whereas for the TA method it is necessary to detect whether there was a signal present or not.

TOA estimators in varying C/I+N conditions

We find the results in this section difficult to understand. It is difficult to understand how the method can break down already at –20 dB. Simulations in all honour but consider the following simple reasoning. The Processing gain is 256, giving a gain of 24 dB, then there are approximately five symbols that are coherently combined, giving and additional 7 dB gain, and finally ten slots are combined giving a gain of about 7-8 dB. Taken together this will mean that after the combination there will be a C/I+N of about 18-19 dB. This is a very good value and all reasonable TOA estimators should perform well under these circumstances.

Another point is that the interference is added after the channel model. This indicates that there will be no gain from fast fading, which can be quite significant.

Multipath rejection

Ericsson has used the simple way of performing multipath rejection and to our findings this is the reason that the original method performs better than the TA method in certain multipath environments. We believe that the reason is that for the original method we collect ten slots while for the TA we can use only two on average, thus giving better diversity.

Adaptive pilot power in TA-IPDL

It is agreed that an increased pilot power can yield some extra gain in noise-limited situations. However, there is another drawback with TA-IPDL that Motorola seemingly has not considered in their simulations, and that is the effect of propagation delays. For large cells the idle periods will have smaller overlap for the idle periods. For instance in the case with 40 km cells, which is simulated at the end of the paper, the idle periods from the second tier BSs will have no overlap at all. Also for the 20-km case many remote BSs will have a small or non-existent overlap.

3 Drawbacks of the TA-IPDL method

- The UE operation is different, and slightly more complex, compared to the original OTDOA IPDL, meaning longer development times and lesser penetration, should all manufacturers choose not to implement both methods in the terminal
- Extra signalling is required for the operation of the Time-alignment of the idle periods, including Uu, Iub and Iu
- With large cells there will be a significant decrease in the overlap of the idle periods, e.g. with a 40 km BS separation the idle periods of the second tier BSs will have no overlap
- In the TA method the UE has to make a threshold detection after every idle period to determine if the BS of interest was transmitting or not
- The BS implementation is significantly more complex. The main difference is that it is much easier to idle the entire baseband signal, which can be made outside of the baseband processing. In the TA method one must idle all signals but the CPICH
- On demand positioning is complicated in two different ways. Firstly, for the original method it is enough to idle the serving BS, while in the TA method all the BSs in the vicinity must activate their idle periods. Secondly, this is especially complicated for non-synchronised networks in which the time alignment might have changed when the demand comes. In this case it is not possible to time align the idle periods without first measuring and changing the time-offsets
- Multipath rejection is better in the original method since all idle periods are used, compared to the TA method which can use only about 21%
- In the original method there is a possibility to have idle periods on only selected BSs, e.g. not on micro and pico, without sacrificing performance
- It is unclear how the alignment of the idle periods will be administered in the network for unsynchronised systems. If the IP is adjusted in one node B the surrounding ones might need to adjust its idle periods, thus causing a “chain effect” in the updating of the IP positions. Apart from the signalling this causes in the network all the UEs that are attached to these BSs need to have updated information.

References

[1] TSGR1#9(99)j09, Comparison of Time Aligned IPDL and IPDL Positioning Techniques Using Common Simulation Parameters, Motorola.

[2] TSGR1#8(99)g88, Evaluation of IPDL positioning techniques, Ericsson.