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Title: Adaptive cell site selection for HSDPA

Document for: Discussion and Decision

1 Motivation

Two fast cell site selection (FCS) schemes are proposed for HSDPA: intra-Node B FCS and inter-Node B FCS [1]. In intra-node FCS, only the cells within the same Node B can be selected. With inter-Node B FCS, any cell within the active set of the UE can be selected for transmission. The currently proposed FCS schemes pose the following problems:

?? The retransmissions at the new cell have to be performed at the MCS used for the original transmission. This could result in aborting transmission if the old cell/sector MCS cannot be supported at the new cell due to lack of resources e.g., available power, codes etc.

?? The retransmission at the same MCS as the original transmission can also result in under-utilisation of resources if the rate that can be supported in the new cell is higher than the rate in the old cell/sector and the retransmission is performed at the old-cell rate.

?? In case of inter-Node B FCS, the information about the MCS and number of codes used for previous transmission have to be made available to the new cell. This will result in significant signalling overhead.

?? The FCS is performed based purely on C/I i.e. resources available (power and codes) in the new cell are not taken into account. This can result in sub-optimal performance when the newly selected cell lacks resources (low data rate) and some other cell with comparatively low C/I but plenty of resources (providing higher data rate) could have been selected.

This paper describes an adaptive cell site selection approach wherein the retransmissions in the new cell/sector can be performed at any supportable rate (MCS) thus optimising the performance and reducing the signalling overhead. Moreover, in adaptive FCS, the cell with the highest rate (compared to the scheme with highest C/I) can be selected by taking into account the loading in different cells. This is enabled by the fact that the retransmissions can be performed at any rate (MCS providing higher rate) in the new cell with the adaptive FCS scheme.

2 Adaptive cell site selection

The power available for HS-DSCH is continuously changing (on a slot-by-slot basis) due to variations in the power used by power-controlled circuit switched users. The C/I seen by a user is also changing due to varying interference from neighboring cells and/or large changes in channel quality due to fading etc. Furthermore, with asynchronous IR operation, the time between the transmissions/retransmissions could be longer because a retransmission to a user can be preempted by a transmission/retransmission to another user. Therefore, with fast cell site selection (intra-Node B or inter-Node B), the channel conditions, available power and the code space can be different in the new cell. With N-channel HARQ, it is highly likely that some of the code blocks will have pending recovery while FCS is performed. Therefore, it is highly likely that the channel conditions, available power and code space are different between transmissions/retransmissions that need to be HARQ combined across different cells.

This contribution presents a HARQ scheme that allows IR/combining across transmissions/retransmissions at different MCS (within the same Node B or across Node B).

Figure 1 [3] shows an example of HARQ operation where the sub-blocks from the same code block of size 5120 bits are transmitted at different modulation and coding schemes from 4 different cells.

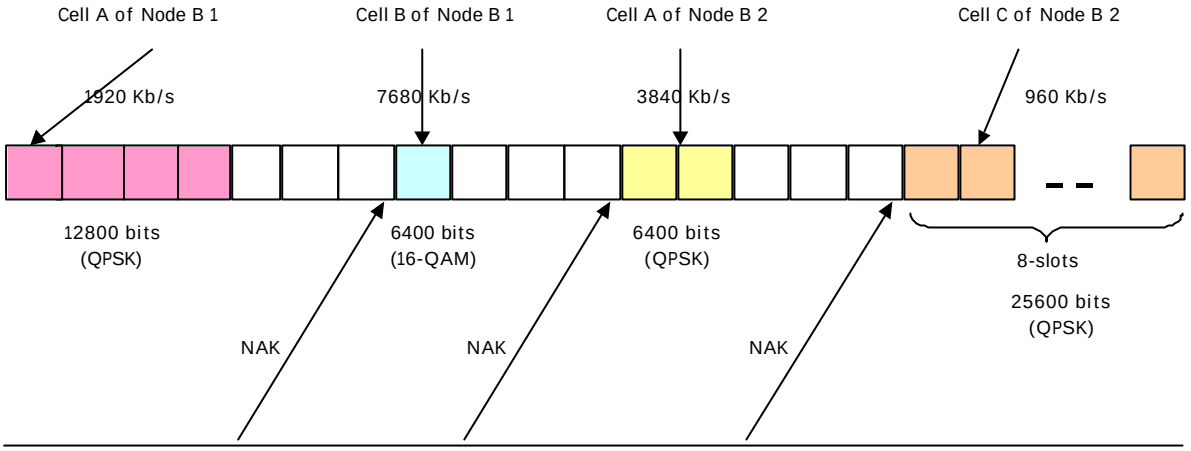

Figure 1. Sub-blocks from the same code block are transmitted at 4 different MCS from 4 different cells.

The fact that all sub-blocks are derived from the same coded sequence of 25600 bits [3] makes it possible to perform HARQ across these sub-blocks in order to recover the original code block as depicted in Figure 2 [3]. The first sub-block contains half of the coded bits i.e., 12800 provides a coding rate of 0.4. The second sub-block contains 6400 bits that are complementary to 12800 bits received in the first sub-block. The first and second sub-blocks jointly provide a coding rate of 0.266. The third sub-block contains 6400 bits that are complementary to 12800 bits received in the first sub-block and 6400 bits received in the second sub-block. The fourth sub-block transmission at 960 Kb/s provides all the 25600 coded bits. The bits from first, second and third sub-blocks also provide the entire sequence of 25600 coded bits. Therefore, the first three transmissions can be Maximal ratio combined with the 4th sub-block transmission.

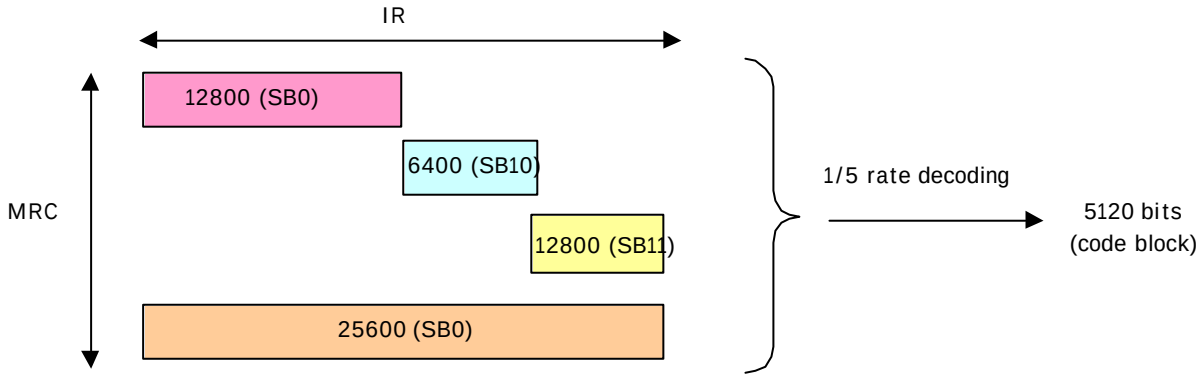

Figure 2. IR/MRC of sub-blocks received at different MCS from different cells.

3 Signalling for Adaptive FCS

The adaptive FCS scheme needs less signalling overhead compared to a non-adaptive FCS scheme because the retransmissions in the new cell can be performed at any MCS thus eliminating the need to make the MCS and code information available to the new cell in case of inter-Node B FCS.

4 Conclusion

An adaptive cell site selection approach for HSDPA is discussed. The scheme provide enhanced flexibility in retransmissions in the new cell and needs minimum signalling overhead. Therefore, it is recommended that adaptive cell site selection operation be considered for HSDPA.

5 References

[1] “Fast cell selection and Handovers in HSDPA”, TSG-RAN WG2#18, R2-A010017, Motorola.

[2] “Variable TTI for HSDPA”, TSG-RAN #18(01) 0079, Lucent Technologies.

[3] “Adaptive HARQ proposal for HSDPA”, TSG-RAN WG1#19, R1-01-384, Lucent Technologies.