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Title: DL control channel structures for parameters sent before HS-DSCH TTI

Document for: Discussion

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1. Introduction

In this paper it is analysed what kind of control channel structure could carry the HS-DSCH related parameters that should be sent before the corresponding HS-DSCH TTI.

This paper was available already in HSDPA adhoc meeting in Sophia Antipolis, as tdoc 12A010006. The only modification made to that , is that the table 1 is partly modified according to [1]. However, since the modifications are done only for parameters to be sent simultaneously with HS-DSCH TTI, those modifications do not affect any chapters in this paper. Thus the contents of this paper is exactly the same as 12A010006, distributed in HSDPA adhoc.

2. Signaling parameters needed in downlink

Table 1 below was introduced in [1]. It contains a summary of the draft analysis of the HS-DSCH related parameters needed in downlink. See [1] for further details of each parameter.

Parameter	**Before the HSDSCH data packet**			**Simultaneously with HSDSCH data packet**		
	Min	**Prop**	**Max**	**Min**	**Prop**	**Max**
UE identification	1	1	16	-	-	-
MCS	2	2	3	-	-	-
HS-DSCH power level	0	0	n	-	-	-
Code channels	0	2	8	-	4	-
FHARQ process #	-	-	-	0	0	3
FHARQ redundancy version	-	-	-	0	0	2
FHARQ packet number	-	-	-	2	5	5
Power offset for uplink	-	-	-	0	2	4
Total	3	5	27+n	2	11	14

Table 1. Summary of HS-DSCH related parameters in downlink.

3. Basic assumptions

The control channel structure carrying those parameters to the UE, which have to be signaled before the corresponding HS-DSCH TTI, depends on the assumptions. There are two different possible solutions:

- solution1: There is dedicated channel, DPCH, for each UE carrying also TPC and Pilot bits, in order to be able to use closed loop power control for uplink transmission.
- solution2: There is not a dedicated channel, DPCH, for each UE. In this case it is not possible to use closed loop power control for uplink transmission.

In this paper it is assumed that solution1 is the basic assumption, since it is seen important that the uplink signaling will have good enough performance.

Thus the assumption in this paper is that the HSDPA related parameters which are signaled before the corresponding HS-DSCH TTI, are put to the already existing associated DPCH, which means that it is then serving as a sort of "dedicated control channel" for HSDPA.

This means that we need to e.g. define some new rules in the 25.212, that in case there is a CCTrCH of DCH type to be mapped to this associated DPCH, in some of the slots there are certain fields to which the physical channel mapping block should not map the CCTrCH bits, since they are already reserved for HSDPA control information.

One other thing to be noted is that there is a clear need to send this control channel with as small time period as possible, in order to allow enough time for UE and Node B processing , since that will anyway be quite demanding, see [2]. On the other hand the spreading factor of the dedicated channel should be as large as possible, so that downlink code tree is not wasted.

4. Possible signaling structures with Dedicated control channel

Based on the table 1 above, the parameters that are thought to be signaled before the HS-DSCH data packet are UE identification, MCS, and code channel information (starting point of the code tree) for code multiplexing purposes.

4.1. Number of bits available

Table 2 below shows how many bits there are available for the control channel in different cases, when TPC and pilot bits are excluded. Slot format 0 (Npilot=4, Ntpc=2, Ntfci=0) is assumed for SF=512, and slot format 4 (Npilot=4, Ntpc=2, Ntfci=0) for SF=256.

Case	SF	HSDPA control signaling duration/slots	Ndata
a)	512	1	4
b)	512	2	8
c)	256	1	14
d)	256	2	28

Table 2. Number of bits available in different scenarios.

4.2. Possible cases

In this chapter it is analysed what kind of SF and time duration pair is needed for transmitting the HSDPA related parameters on the associated DPCH.

a) SF=512, TTI=1 slot: 4 bits available

Parameter	Info bits	Encoded bits	Coding rate, without CRC	Comments
UE identification	1			
MCS	-			
Code channels	2			Alternatively, this could be only 1bit.
Total	**3**	**4**	**3/4**	

b) SF=512, TTI=2 slot: 8 bits available

Parameter	Info bits	Encoded bits	Coding rate, without CRC	Comments
UE identification	1			
MCS	2			
Code channels	2			Alternatively, this could be only 1 bit.
Total	**5**	**8**	**5/8**	

c) SF=256, TTI=1 slot: 14 bits available

Parameter	Info bits	Encoded bits	Coding rate, without CRC	Comments
UE identification	1			
MCS	2			
Code channels	2			
Total	**5**	**14**	**5/14 (~1/3)**	Here it might be possible to use the existing TFCI coding, if two bits would be punctured.

d) SF=256, TTI=2 slots: 28 bits available

Parameter	Info bits	Encoded bits, e.g.	Coding rate, without CRC	Comments
UE identification	1			
MCS	2			
Code channels	2			
Total	**5**	**28**	**5/28 (~1/6)**	Probably as small coding rate as this is not needed.

5. Conclusions

Based on this draft analysis, we can make following basic findings:

- There is no room for CRC for any of the parameters, if we try to squeeze this to SF=512 or 256, and to 1 or 2 timeslots. On the other hand we should not use at least smaller SF than SF=256, since then there are not enough codes in the downlink code tree. Also, we should not use more than 1 or 2 timeslots for transmitting this information, since otherwise there is not enough processing time available for NodeB and UE [2]. Thus we should define a coding that has good enough performance, so that we can cope without CRC check. Especially , receiving the UE identification correctly is important.

- The coding for these parameters could be either some new block code or the existing (5,15) TFCI coding with puncturing, depending on what case will be selected.

6. Open issues and way forward

If it can be agreed, that this approach is selected , where certain parameters are sent before the HSDSCH TTI, then a selection should be made in the end, what SF and time duration pair is selected for sending these parameters.

Table 3 below lists the benefits and drawbacks for each case. Our one big concern is processing times for UE and NodeB, and for this reason we see a strong push for using only 1 timeslot for sending these parameters. Taking that as a guideline, then the most flexible solution would be case c) : SF=256 and time duration = 1 slot. It allows us to send RRC signaling on the associated DPCH, and all the proposed parameters would fit there.

Case	SF	duration/ slots	Benefits	Drawbacks
a)	512	1	• Saves the downlink codetree • Maximises processing times	• RRC signaling does not fit there, thus it needs to be sent on HSDSCH • No room for MCS
b)	512	2	• Saves the downlink codetree	• RRC signaling does not fit there, thus it needs to be sent on HSDSCH • Reduces processing times
c)	256	1	• Maximises processing times • All the proposed parameters fit here • RRC signaling fits here in time muxed manner	• Reserves more downlink codetree
d)	256	2	• RRC signaling fits here in time muxed manner	• Reserves more downlink codetree • Reduces processing times

Table 3. Number of bits available in different scenarios.

REFERENCES

[1] RAN WG2 #21 meeting, Tdoc R2-01-1177, "HSDPA related signaling parameters in downlink, version 2", Nokia.

[2] RAN WG1 #20 meeting, Tdoc R1-01-0553, "Further buffer complexity and processing time considerations on HARQ", Nokia