TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) ***TSGR2#4(99)433***

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Agenda Item:

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Title: The CPCH compared with DCH allocation using the RACH

Document for: Information

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1. Summary

This document analyses the Golden Bridge USCH proposal as explained in [2]. The analysis results in the observation that the proposal is very close to allocating a DCH using the RACH. The differences are out-lined.

2. Recap of the Golden Bridge proposal as described in [2]

[2] describes several phases in which the UE tries to access the CPCH, see also Fig. 1.

The first to third phases aim at allowing node B to power-control the UE. In these phases, the UE sends at low initial power a preamble, which is so far only used for the RACH or the FAUSCH and attached to this preamble power control symbols and pilot symbols at a power that is by a factor $a < 1$ smaller than the preamble power. Preamble, power-control symbols, and pilot symbols are transmitted at increased power ("power-ramping") until the UE receives the BS-preamble pilot signal, the power of which is adjusted by the UE by sending power control commands in the power-control symbols attached to the preamble. In the third phase the node B starts power-controlling the UE[1].

If possible the node B acknowledges the access to the CPCH, and if the acknowledgement is received by the UE, it transmits – in a fourth phase -- a UE-collision-detection field, which contains a random number and is reflected by the node B to the UE in order to provide a means for contention resolution (since it is possible that two UEs at the same time try to access the CPCH using the same preamble).

If the same random number is received as the one that was sent, the UE is allowed to transmit data on the CPCH, which uses in subsequent frames the same channelisation as in the first frame. Due to this fact, it is possible that UEs accessing the RACH in subsequent frames will disturb packets sent on the CPCH, if these UEs use the same preamble and time-offset as the UE that had received access to the CPCH.

Golden Bridge claims closed loop power control on the CPCH due to the downlink DPCCH allocated for the UE.

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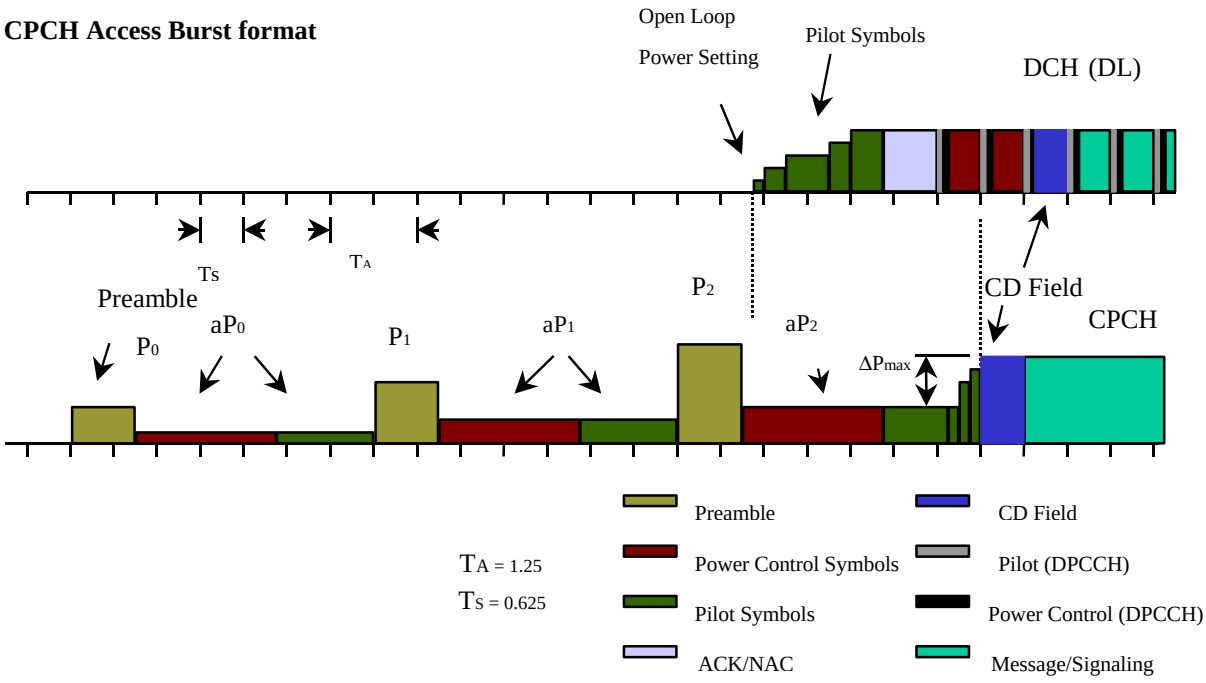
[1] Here the description of [2] is quite difficult to understand and should be refined to be convincing.

Fig. 1 CPCH Access Burst format



3. Allocating a DCH using the RACH

A very similar scheme results, if a DCH is allocated using the RACH. In this case it is even possible to allocate a DCH for both uplink and downlink, however this is not necessarily needed, while the DPCCH used for power control will always be allocated for the downlink. The scheme is extremly simple:

1. UE sends the preamble with power-ramping until it receives the node B acknowledgement at the given time-offset.
2. UE sends the RACH message (10 ms) with the same preamble and energy as used in preamble power-ramping. The RACH message contains at least a random number for contention resolution
3. If successful, the UE receives from the NW the allocation of a DCH to be used exclusively.

Investigations on the CPCH show:

1. Shared resource: the scrambling sequence of the already defined RACH.
2. Obviously no scheduling of the access to this RACH
3. It is possible that an access attempt on the RACH or on the CPCH in later frames corrupts the CPCH: this is the case if in later frames the same time-offset and the same preamble as in a previous extended RACH access is used.
4. Separate power control channel (DPCCH) on the downlink. Danger of code shortage in the DL

The following table gives a juxtaposition of the allocation of a DCH via the RACH and the CPCH:

	CPCH	DCH allocation via RACH
1. Power Control for the message part	Yes, through a separate DPCCH	Yes, per definition of DCH
2. Available bit rates on the channel used for packet transmission	The RACH transport channel bit rates: 16, 32, 64, 128 kbps	All bit rates available for DCHs: 8, 16, 32, 64, 128, 256, 384, … kbps
3. Message part subject to corruption due to other RACH users	yes	No
4. Uplink and downlink transmission possible	No, only uplink	Yes, if desired
5. Allocation of a DPCCH	Yes	Yes
6. Allocation of a DPDCH	No	Yes

Table entries 5 and 6: Due to the additional DPCCH, which has to be allocated to provide closed-loop power-control on the CPCH, there is no advantage of the CPCH over the allocation of a DCH via the RACH in the sense that packet transmission can begin faster on the CPCH. In both cases the allocation of the DPCCH has to be awaited.

According to the above table, CPCH does not provide additional functionality, which could not be achieved using techniques, which are already included in the pre-standard description. On the contrary, the CPCH shows a number of drawbacks (risk of corruption due to other RACH users, only uplink transmission possible).

4. Proposal

Golden Bridge is asked to clarify, what the benefits of the CPCH beyond what can already be achieved using the RACH for allocating a DCH.

5. References

[1] TSG-RAN-WG2 Tdoc 223/99, „Response to the Liaison letter from WG2 on the CPCH concept“ by TSG-RAN-WG1.

[2] TSG-RAN-WG2 Tdoc 281/99, „Procedures associated with Access and Operation of Uplink common Packet Channel and the associated Downlink Dedicated Control Channel“, Golden Bridge Technology.

[3] Tdoc SMG2 260/98 ”The ETSI UMTS Terrestrial Radio Access (UTRA) ITU-R RTT Candidate Submission”.