3GPP TSG RAN WG1 ***TSGR1#14(00)0847***

Oulu, Finland, July 4-7, 2000

Agenda item:

Source: **Philips**

Title: **Offset CPCH (rev 1)**

Document for: **Discussion**

Introduction

This document describes a possible extension to CPCH to be considered for Release 2000. Comments are invited before a CR is drafted.

Current Common Packet Channel (PCPCH)

In the current specification for CPCH the UE can transmit the access preamble at the start of one of a number of access slots (with timing defined relative to the frame boundary of the received BCH of the current cell). As shown in Figure 1 the CPCH random access transmission consists of one or several Access Preambles [A-P] of length 4096 chips, one Collision Detection Preamble (CD-P) of length 4096 chips, a DPCCH Power Control Preamble (PC-P) which is either 0 slots or 8 slots in length, and a message of variable length Nx10 ms.

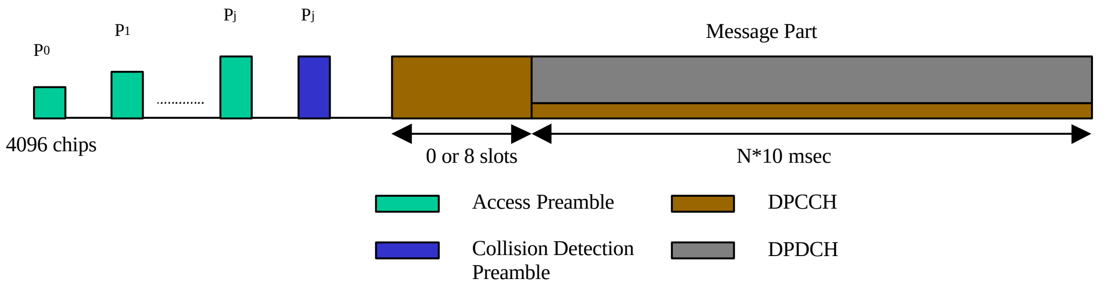

Figure 1: Structure of the CPCH random access transmission

In general the channel resource used for the message, including the bit rate, depends on the signature selected for the access preamble as well as the sub-channel. In channel assignment mode, the channel used is determined by the channel allocation message sent with the collision detection acknowledgement in the downlink. Up to 16 signatures and 12 sub-channels may be assigned.

If more combinations of signatures and sub-channels were available in the uplink transmission, then resource allocation could be more efficient. Also in some cases, particularly if signatures are shared with RACH, there may be a limited number of combinations available. This could lead to problems. For example, in the case of channel assignment the number of different bit rates available can be no more than the number of signatures. Also in the case of a limited number of signatures compared with the number of bit rates, the collision probability could be unacceptable if many of the UE’s typically request the same bit rate. Indicating message priority, e.g. by assigning different service classes to different signatures or sub-channels, requires sufficient signatures and/or sub-channels to be available.

It may also be possible to reduce the amount of higher layer information included in the message part. For example, every UE using CPCH will send its identity in the message part. If a particularly active UE was assigned the exclusive use a subset of the possible uplink signals, then whenever the node B received one of these signals the UE identity would be known and it would not need to be sent in the message part. This reduction in the overhead on packet transmission may be particularly significant for applications with small packet sizes.

Alternatively, extra information could be conveyed in the access attempt combinations, to facilitate more intelligent access control. For example, it could be possible to differentiate between CPCH access requests used for data transfer and those used to support closed loop power control on the FACH, allowing the second class of access attempt to be acknowledged with appropriate timing for the scheduled FACH transmission. Another possibility would be to use this extra information to convey the priority/required QoS of a given packet transmission attempt. This could enable the support of semi-real-time services via the CPCH (e.g. Packets which need to be transferred within a certain time, or not at all, such as those used for subjective audio/video coding, could be supported).

Proposed Solution

We propose to extend the number of combinations available in the uplink transmission by allowing the access preamble and collision detection preamble timing to be delayed with respect to the slot boundary, as indicated in Figure 2. If the offset is a multiple of 256 chips then, up to 19 different non-zero values are possible.

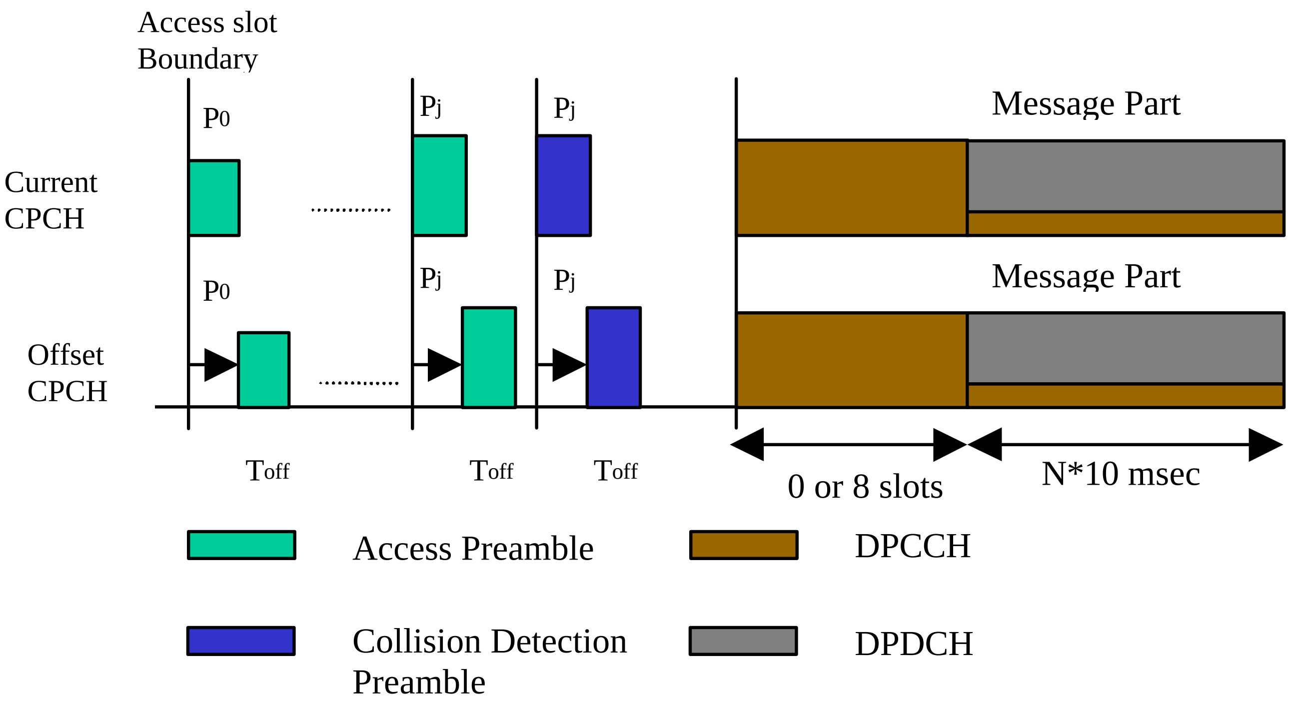

Figure 2: Structure of the CPCH random access transmission

The downlink transmissions (e.g. on AICH) have no time shift.

The operation of CPCH with no offset is unchanged.

With an offset (i.e. "OPCPCH" or "OCPCH") the use of each signature, access sub-channel and (non-zero) time offset, can be assigned in one or more of the following ways:

- (1) as a request for a particular bit rate

- (2) as a request for a particular access class (with associated priority)
- (3) for indicating the length (or maximum length) of the packet to be sent
- (4) for use by a specific UE
- (5) to request some additional resources (e.g. downlink shared channel)
- (6) for use by UE's using one of a set of common higher layer messages
- (7) to indicate a request for an alternative CPCH used (e.g. FACH close loop power control)
- (8) some combination of the above

The total number of degrees of freedom within 20ms, assuming 16 access signatures, 12 sub channels and 19 additional time offsets, is 16x12=192 for CPCH and 16x12x19=3648 for OCPCH (in addition to those for CPCH).
In order to ensure that there is sufficient time to process uplink transmissions prior to transmission of downlink acknowledgements, it may be necessary to choose the larger time between access preamble and AP-AICH ($\tau_{p\text{-}a1}$ in 25.211 v3.2.0 section 7.4 PCPCH/AICH Timing Relation) in medium sized cells, or to limit the use of larger valued offsets. These decisions require no changes to the standards, but would be made on a cell specific basis by operators.

Further discussion points

It is proposed that the Collision Detection preamble timing is offset by the same amount as the access preamble. Furthermore the timing of the downlink channels is the same for CPCH with and without offset. Therefore the acknowledgement to an access preamble is the same whether it had an offset or not. This means that collisions between offset and non-offset transmissions can be resolved during the collision resolution phase.

Signatures can be shared between access and collision detection as well as with PRACH. Although it may not be essential, system design seems simpler if we apply the restriction that for a given signature and sub-channel the time-offset signatures should not be mixed between RACH and CPCH.

In some deployment/implementation scenarios OCPCH could be supported without requiring additional Node B resources. For example, we consider that specific hardware might be designed to detect access preambles received with the large delays which might arise from the round trip delay in large cells. If used in a small cell there would be no large round trip delays, so this ability could be used to detect which time offset was transmitted instead.

There is no problem foreseen in mixing UE's with and without OCPCH capability. Those without OCPCH use CPCH as currently specified. OCPCH can be considered an optional overlay.

Conclusions

The proposals here should be considered within Feasibility Study for Improved Common DL Channel for Cell-FACH State as potential improvements to packet transmission in Release 2000.