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Agenda item: **AH 14**

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Title: **CPCH with Multiple Channel Assignment**

Document for: **Discussion**

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1. Introduction

Common Packet Channel (CPCH) has been proposed and adopted as a working assumption for the efficient packet communication over uplink common channels [1, 2]. Problems regarding the channel allocation are pointed out and some possible solutions are proposed to enhance the CPCH related channel allocation [3,4, 5,6].

In case of RACH, UTRAN is allowed to send multiple AP-AICH's at one time for the case when multiple UE's send preamble simultaneously. This can reduce the RACH transmission time delay. But, there is no scheme that can allow multiple CPCH acknowledge at one time slot.

In this paper, we propose a channel assignment scheme to allow multiple CPCH assignment at one time slot. UTRAN decides the channel allocation for the CPCH and can send multiple CD/CA-AICH's at one time slot. With this scheme, more flexible CPCH allocation can be possible and the time delay for CPCH transmission can be reduced.

2. Proposed CPCH procedure

3.1 Proposed CPCH Procedure

Figure 1 shows the proposed CPCH procedure with multiple allocation. This is described here in outline. It is assumed that UTRAN decide the maximum number of CD/CA-AICH allowed at one time slot and send this information to UE's over the BCH. So, UE's know the maximum number of CD/CA-AICH before the CPCH procedure.

(1) UE sends the acquisition preamble that is similar to RACH preamble.

(2) Detecting the acquisition preamble that UE sent, UTRAN decides the ACK or NAK according to the loading condition of reverse link and the UTRAN resource occupancy status of DCH/CPCH pairs. Then, UTRAN sends the ACK/NAK through AP-AICH. In this stage, UTRAN can send multiple ACK's by sending multiple AP-AICH. This scheme is consistent with the AP-AICH transmission for RACH.

- ACK : one or more DCH/CPCH pairs are available and can be assigned to the UE
- NAK : currently no DCH/CPCH pair is available for the UE

(3) UE detects the AP-AICH and does as follows depending on the detected AP-AICH.

- If no signal is detected in the AP-AICH, UE waits a time period $\tau_{P\text{-}P}$ and send the AP with increased power.
- If NAK is received from the AP-AICH, UE stops transmission and waits some time periods and begins new CPCH procedure from (1).
- If ACK is received from the AP-AICH, UE continue the CPCH procedure of (4).

(4) UE selects a CD signature and transmit the CD preamble to the base station.

(5) UTRAN detects the CD preamble and sends back the CD signature in CD-AICH. At the same time, UTRAN sends the DCH/CPCH pair number through Channel Assignment AICH (CA-AICH) to indicate the channel number to be used for CPCH. The channel assignment is sent in the signature form as used in AICH. Up-link CPCH and DCH for the CPCH are one-to-one mapped and can be assigned by assigning only DCH.

In this stage, UTRAN can send multiple CD/CA-AICH's up to MAX_CDCA, where NUM_CDCA is the maximum number of CD/CA-AICH's that can be transmitted simultaneously. Multiple CD/CA-AICH's shall be transmitted over multiple channelization codes. So, UTRAN should reserve multiple channelization codes to support multiple CPCH assignment. The NUM_CDCA parameter will be broadcasted in the BCH so that UE can know the information before the CPCH procedure.

(6) UE detects the CD-AICH and CA-AICH. It is necessary for UE to detect possible CD/CA-AICH's transmitted over the multiple CD/CA-AICH channels. If UE can't detect a CD signature that does matches to the original one, UE stops transmission and begins a new CPCH procedure. If UE detect a CD number that matches to the signature that UE sent in the CD preamble, UE receives the CA signature that was transmitted in the CD/CA-AICH channel.

(7) With the channel assignment information, UE starts to transmit the burst data through the assigned CPCH while controls its transmit power according to PCB from the DCH. UTRAN sends the power control command for the CPCH over the DCH.

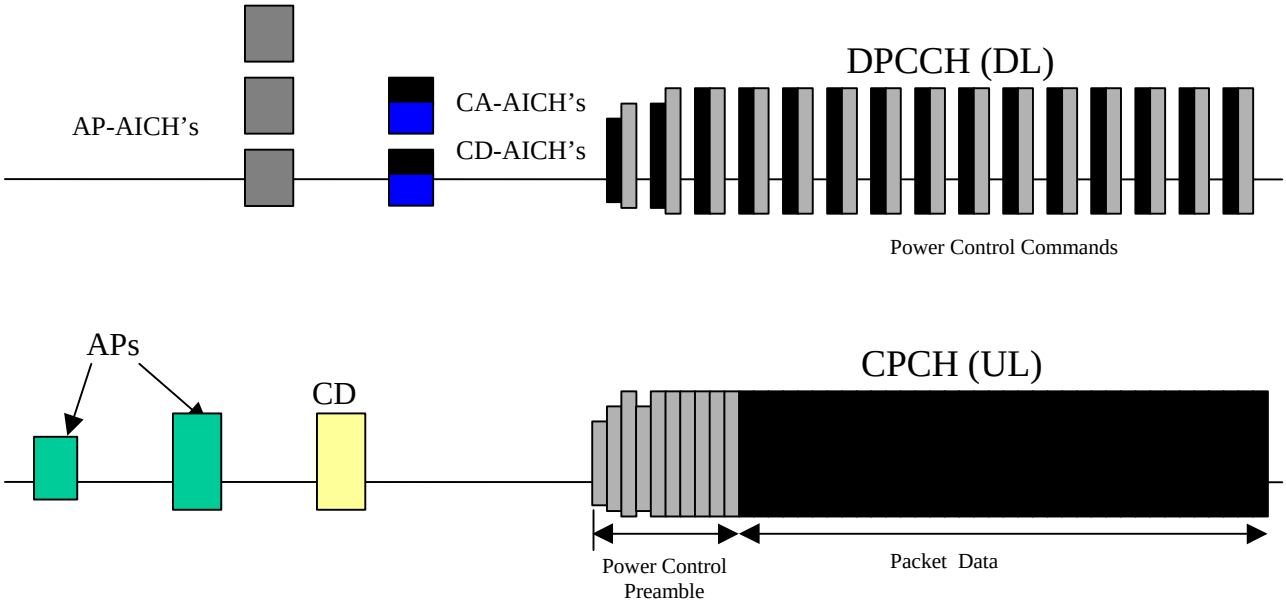

Figure 2 Proposed CPCH Procedure

3.2 Code Assignment for Multiple CD/CA-AICH

In this paper, we proposed a scheme allowing multiple CPCH assignment in one slot. UTRAN send the CD/CA-AICH's in multiple code channels. UTRAN chooses the number of CD/CA-AICH that can be transmitted simultaneously and informs this information to UE's over BCH. UE should detect all the CD/CA-AICH's to see the allocation indication. We also propose a well-designed channelization code structure that enables multiple AICH detection with low complexity.

If UTRAN is allowed to send two CD/CA-AICH's simultaneously, a channelization code W_i with 128 chip length will be allocated for CD/CA-AICH. Assign [W_l W_i] code for first CD/CA-AICH and [W_i $-W_l$] code for second CD/CA-AICH. UE despread the input signal with a channelization code W_i with 128 chip length and can get two CD/CA-AICH symbols by adding and subtracting two consecutive odd and even depread outputs.

If UTRAN is allowed to send four CD/CA-AICH's simultaneously, a channelization code W_k with 64 chip length will be allocated for CD/CA-AICH. Assign following channelization codes for the CD/CA-AICH's

[W_k W_k W_k W_k] => For 1st CA/CA-AICH

[W_k $-W_k$ W_k $-W_k$] => For 2nd CA/CA-AICH

[W_k W_k $-W_k$ $-W_k$] => For 3rd CA/CA-AICH

[W_k $-W_k$ $-W_k$ W_k] => For 4th CA/CA-AICH

UE despread the input signal with a channelization code W_k with 64 chip length and can get four CD/CA-AICH symbols by linear combination of four consecutive despread outputs.

3.3 Advantage of Proposed CPCH Procedure

- UTRAN can allocate multiple CPCH's at one time slot. This scheme can enhance the resource allocation further and reduce the transmission delay.
- Multiple CPCH assignment can provide flexible CPCH design. That is, UTRAN can choose the number of CD/CA-AICH that will be sent simultaneously and inform this number to UE's. This concept is consistent with the multiple AP-AICH's for RACH.

4. Conclusions

In this paper, we proposed a CPCH procedure for enhanced channel allocation. Multiple Channel Assignment AICH (CA-AICH) can be transmitted at one time slot. With this scheme, we can maximise the efficiency of CPCH can design CPCH more flexibly.

References

[1] GBT/ Tdoc 592: CPCH physical layer procedures

[2] GBT/Tdoc 594: Overview of System-wide CPCH Access procedures

[3] Interdigital Comm. Corp./Tdoc816: CPCH Channel Allocation

[4] Samsung Electronics Co./Tdoc906: Enhanced CPCH Procedure

[5] Philips/TdocABC: Enhanced CPCH with status monitoring and code assignment

[6] Samsung, Philips/TdocB13: Enhanced CPCH with Channel Assignment

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