

**Agenda item:** AH 14  
**Source:** SAMSUNG Electronics Co.  
**Title:** Enhanced CPCH procedure  
**Document for:** Discussion

---

## 1. Introduction

Common Packet Channel (CPCH) has been proposed and adopted as a working assumption for the efficient packet communication over reverse common channel [1,2]. There have been many discussions related to the CPCH procedure. During the discussions, some inefficiency of the DCH/CPCH resource usage with current CPCH procedure has been pointed out. At the same time, a couple of proposals to enhance the efficiency has been proposed [2, 3].

The inefficiency mainly comes from the resource allocation scheme in current CPCH procedure, that is, the UE determines the DCH/CPCH pair number and UTRAN does not have the ability to schedule the DCH/CPCH resource. In the current scheme, UTRAN can only send ACK or NAK for the transmission of CPCH that the mobile selects. However, the proposals to enhance the efficiency still maintain the resource allocation scheme of current CPCH procedure. As a result, those proposals could not achieve much gain in terms of the efficiency.

In this paper, we propose a new CPCH procedure to enhance the resource usage efficiency in CPCH scheme. In the proposed CPCH procedure, the UTRAN decides the resource allocation for the DCH/CPCH pair and therefore achieve maximum efficiency in CPCH related resource usage.

## 2. Current CPCH procedure

### 2.1 Current CPCH Procedure

The current CPCH procedures are showed in Figure 1. According to current working assumption in [1], the characteristics of CPCH procedure can be summarised as follows.

- UE determines the DCH/CPCH pair number for burst data transmission by selecting AP and CD preamble.
- UTRAN can decide only the ACK or NAK according to its resource occupancy status for the requested DCH/CPCH pair number.
- There is no freedom for UTRAN to manage the DCH/CPCH channel resource in the present scheme.

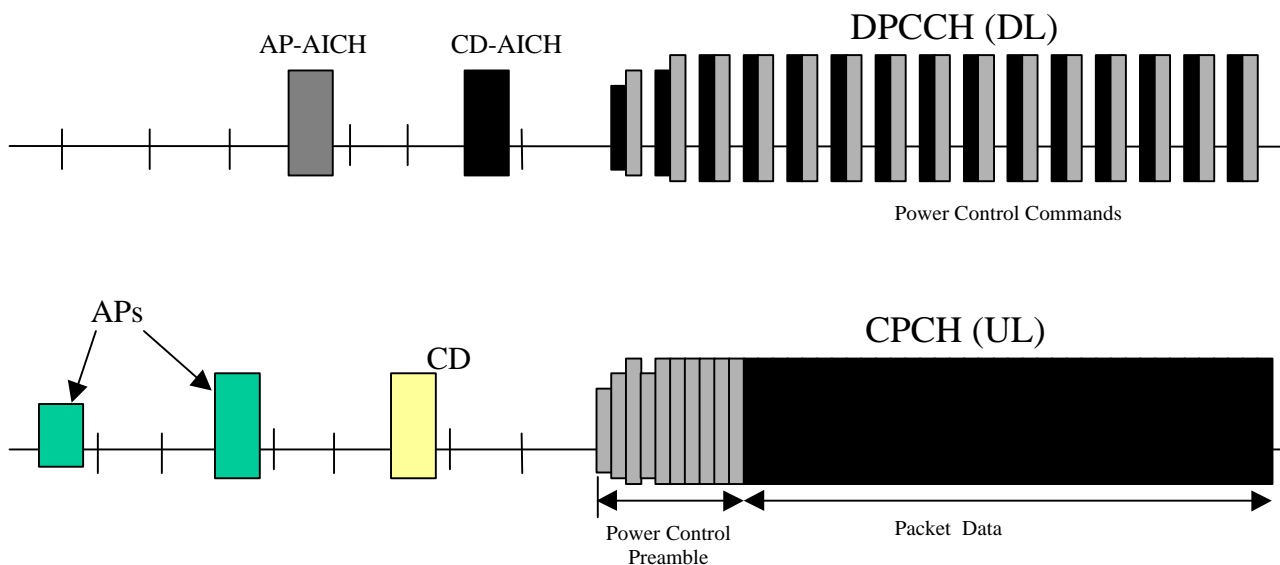


Figure 1. Current CPCH Procedure

## 2.2 Problems with present CPCH procedures

As explained in previous section, the major problem with current CPCH is the inefficiency in the resource usage. In this section, we summarise the reason of inefficiency with current CPCH procedure and other enhancement proposals.

### 2.2.1 Problems in Current CPCH Related Resource Allocation Schemes.

The reasoning of the inefficiency can be summarised as follows.

- If a UE chooses the DCH/CPCH pair randomly, the blocking probability increases when there are many occupied CPCH channels in the reverse link. If the DCH/CPCH pair that the UE chooses is already used by other UE, UTRAN cannot assign other channel resources to the UE even though there are other channel resources available. This happens more frequently as the number of used CPCH increases in the reverse link and degrades the efficiency of CPCH utilisation.
- Above problem is due to the fact that UTRAN cannot allocate the CPCH related resources to the UE's

### 2.2.2 Problems in enhancement proposals

Following procedures are proposed to enhance the CPCH related resource allocation.

#### (1) Sending the Channel Occupancy Information in the Forward Link [2]

- Some overhead information should be transmitted in the forward common channel indicating the channel occupancy of each CPCH. The UE monitors the occupancy of each CPCH and choose a DCH/CPCH pair that is not used by other UE's.
- Disadvantage of the scheme
  - i) There should be much overhead in the forward link to inform the occupancy of the CPCH.
  - ii) The UE should monitor the indication channel before the transmission of CPCH preamble, which increases the data transmission delay.

iii) As the number of occupied CPCH's increases, the probability of preamble collision increases. This is due to the fact that if many CPCH's are occupied, then the number of available preamble decreases.

(2) Assigning two CPCH's per one Access preamble [3]

- Two CPCH channels are necessary for each preamble signature. To decrease the probability of preamble collision, using as many as signature for preamble is beneficial. But, reserving two CPCH's and forward channel for each preamble signature requires many demodulators in UTRAN and forward code resources.
- With this scheme, UTRAN cannot send NAK through the AP-AICH even when there isn't enough resources in the system.
- This scheme may solve the resource allocation problem partially but still has much rooms to be improved.

### 3. Enhanced CPCH procedure

#### 3.1 Proposed CPCH Procedure

Figure 1 shows the proposed 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.
  - 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 PA-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  $\tau_{p,p}$  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 randomly 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. After sending the CD signature in the CD-AICH, 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.
- (6) UE detects the CD-AICH and CA-AICH. If the returned CD signature is different from that of original one, UE stops transmission and begins a new CPCH procedure. If the returned CD number matches to the original one, UE receives the CA signature and starts to transmit the burst data through the assigned CPCH while controls its transmit power according to PCB from the DCH.

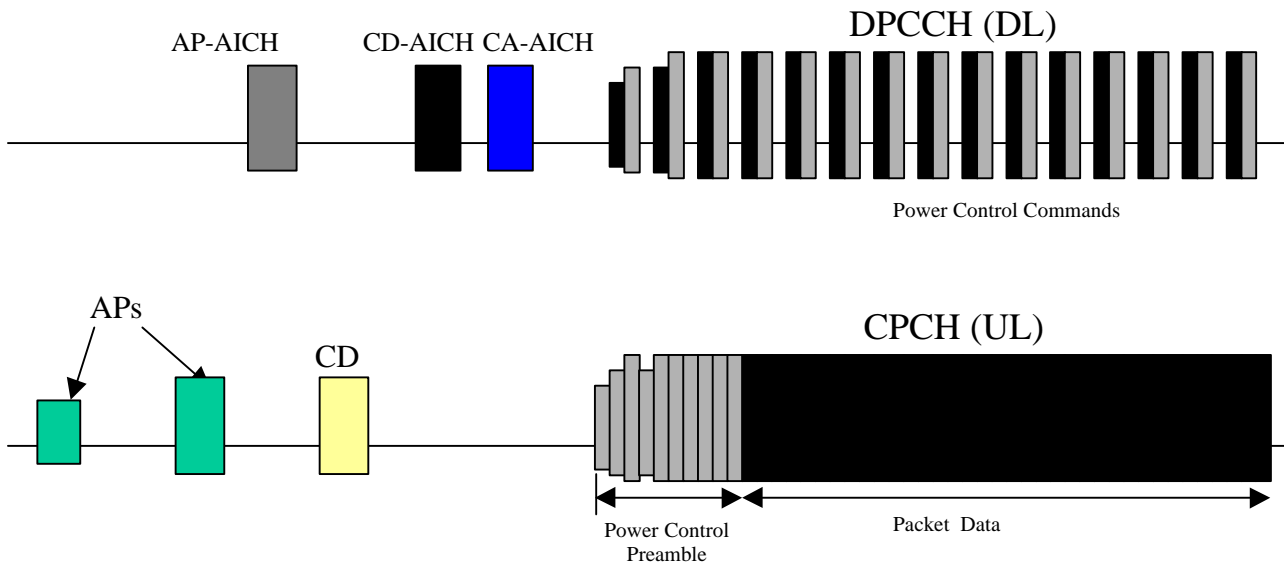


Figure 2 Proposed CPCH Procedure

### 3.2 Advantage of Proposed CPCH Procedure

- UTRAN can allocate and control the available resource for the CPCH. This scheme maximises resource usage efficiency.
- UE needs not monitor the channel occupancy of each CPCH before the CPCH transmission.

## 4. Conclusions

In this paper, we proposed a new CPCH procedure for enhanced resource allocation. A Channel Assignment AICH is transmitted after the CD-AICH. UTRAN can assign the DCH/CPCH pair to the UE by transmitting a signature that is mapped to DCH/CPCH pair. With this scheme we can maximise the efficiency of CPCH.

## 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