1. Introduction

The issue of gated DPCCH transmission has been studied and discussed in WG1 [1~8], and the advantages which can be obtained by gated DPCCH transmission for both UTRAN and UE were agreed. Those advantages include:

- Increase of UE battery life

- Downlink capacity increase due to interference reduction

2. Discussions

Currently, in packet transmission mode, both of the UE and UTRAN stop transmission of DPDCH if there is no data to transmit while continue transmission of DPCCH in downlink and uplink.

If the gated DPCCH transmission mode is enabled, then the DPCCH shall be gated-on only in specific time slots to reduce the transmission rate of Pilot, TPC, TFCI, and FBI (uplink only) while gated-off during other time slots.

The combinations of gating parameters need to be negotiated between UTRAN and the UE are:

Table 1. Gating Parameters

Gating Rate	1	1/3	1/5

Gating Pattern	Random	Regular

Direction	Downlink Only	Uplink and Downlink

The UE shall report the capability of gating in table 1 to UTRAN when needed, then UTRAN shall determine the appropriate gating parameter values. As a result, for the UTRAN, the gated DPCCH transmission is an option in both uplink and downlink while, for the UE, it is an option in uplink and mandatory in downlink.

In the case that the gated DPCCH transmission is enabled only for the downlink, then the UE shall transmit the DPCCH in every time slot, and the UE will:
- adjust the transmit power in response to the valid downlink TPC, where the valid downlink TPC means the downlink TPC transmitted at the gated-on slots
- ignore any downlink TPC that is received during the gated off slot, and the downlink transmit power shall remain constant
- generate and transmit uplink TPC based on the downlink symbols if the time slot is associated with the downlink gate-on slot
- repeat the previous uplink TPC if the time slot is associated with the downlink gate-off slot

If the compressed mode is initiated during gated DPCCH transmission, the gated DPCCH transmission shall be disabled.

In this document, we present the proposed text for gated DPCCH transmission for the technical specification 25.214.

3. References

[1] TSGR2#9(99)g88, "Draft minutes of WG2 meeting #8" Cheju, Korea, 2-5, Nov. 1999.

[2] TSGR1#9(99)i27 (TSGR2#8(99)g67), "Response (to TSG-RAN WG1, TSG-RAN WG4) to LS on Gated DPCCH transmission," WG2, Cheju, 2-5 Nov. 1999.

[3] TSGR4#8(99)779, "Report of the 8th TSG-RAN WG4 meeting (Draft report)," Sophia Antipolis, 26-29, Oct. 1999.

[4] TSGR4#8(99)751, "Proposed Response to Liaison Statement on impact of gated DPCCH at cell boundaries," Sophia Antipolis, 26 - 29 Oct 1999.

[5] 3GPP RAN TS 25.214 v1.3.0(1999-09)

[6] TSGR1#8(99)f43, "Reducing EMC problem in uplink DPCCH Gated mode," Mitsubishi, New York, 12-15 Oct. 1999.

[7] TSGR1#8(99)g54, "Revised Random Pattern for DPCCH Gated Transmission (Rev. of R1-99f80)," Samsung, New York, 12-15, Oct. 1999.

[8] TSGR1#9(99)j51, "Random Pattern for Gated DPCCH transmission," Dresden, 30 Nov. – 3 Dec. 1999

================= START OF TEXT PROPOSAL ==================

8 Gated DPCCH Transmission in Packet Transmission Mode

8.1 General

In packet transmission mode, both of the UE and UTRAN stop transmission of DPDCH if there is no data to transmit while continue transmission of DPCCH. Gated DPCCH transmission is initiated at the specified time by higher layer. If the gated DPCCH transmission is enabled, then DPCCH shall be gated-on in specified time slots to reduce the transmission rate of Pilot, TPC, TFCI, and FBI (uplink only) while it shall be gated-off during all other time slots. During transmission of only DPCCH in gated transmission mode, the transmitter shall gate-off all the time slots other than the slots specified in 8.3.2. It is possible to transmit both DPCCH and DPDCH during gating operation, directed by higher layer. During transmission of both DPCCH and DPDCH in gated transmission mode, DPCCH shall be transmitted in all the time slots while the receiver shall ignore TPC and FBI (uplink only) in the time slots other than specified in 8.3.2.

8.2 Combination of Gating Operation Mode

The parameters related to the gating operation include:

Table 2. Gating Parameters

Gating Rate	1	1/3	1/5

Gating Pattern	Random		Regular	

Direction	Downlink Only		Uplink and Downlink	

In the case that the gated DPCCH transmission is enabled only for the downlink, then the UTRAN shall transmit the DPCCH in specified time slots while the UE shall transmit the DPCCH in every time slot. Then the UE will:
-   adjust the transmit power in response to the valid downlink TPC, where the valid downlink TPC means the downlink TPC transmitted at the gated-on slots specified in 8.3.2
-   ignore any downlink TPC that is received during the gated-off slot, and the corresponding uplink transmit power shall remain constant
-   generate and transmit uplink TPC based on the downlink symbols if the time slot is associated with the downlink gate-on slot
-   repeat the previous uplink TPC if the time slot is associated with the downlink gate-off slot

8.3 Gated DPCCH Transmission

8.3.1 DPCCH Random Gating Pattern Generation

If the gated DPCCH transmission is enabled with random gating pattern, the gating pattern shall be determined based on the parameters shown in Table 3.

Table 3. Parameters for Random Gating Pattern

Parameter	Value	
CFN	0, 1, …, 255 (8bits)	
gating rate	1/3 or 1/5	
Number of gating group(N_G)	5,	if gating rate is 1/3
	3,	if gating rate is 1/5
Gating group size (S_G)	3,	if gating rate is 1/3
	5,	if gating rate is 1/5
A=($a_0,a_1,…,a_{18}$)	1011010011011101001 (19bits)	

CFN is a frame counter ranged from 0 to 255 (8bits long). NG represents the number of gating groups in a frame and each gating group consists of SG (gating group size) consecutive time slots. Let i be the CFN of the frame (i=0,1,…,255) and j be the jth gating group, then the allocated time slot, s(i, j), shall be given by

$$s(i,j) = \begin{cases} (A_j \oplus C_i)_{10} \bmod (S_G - 1) + 1, & j = 0 \\ (A_j \oplus C_i)_{10} \bmod S_G, & j = 1,...,N_G - 2 \\ S_G - 1, & j = N_G - 1 \end{cases}, \quad i = 0,1,...,255$$

where $A_j=(a_j, a_{j+1},...,a_{j+15})$, j=0,1,...,$N_G$-2, is a 16bit sequence constructed from sequence A in Table 3, and C_i=((CFN)$_2$:(CFN)$_2$) is a 16bits sequence consists of repeated CFN, where $(x)_m$ represents the m-ary representation of the number x. Note that the first time slot (slot #0) shall never be allocated to s(i,j) (case of j=0), On the other hand the last time slot (slot #14) shall always be allocated to s(i,j) (case of j=N_G-1). Figure 1 describes the method of calculation s(i,j).
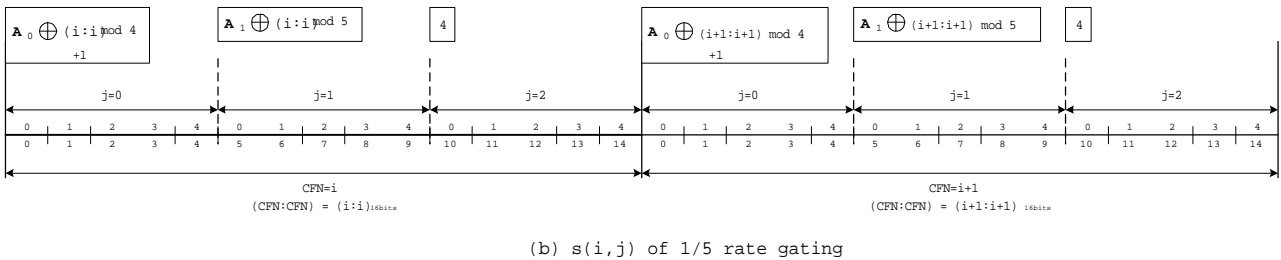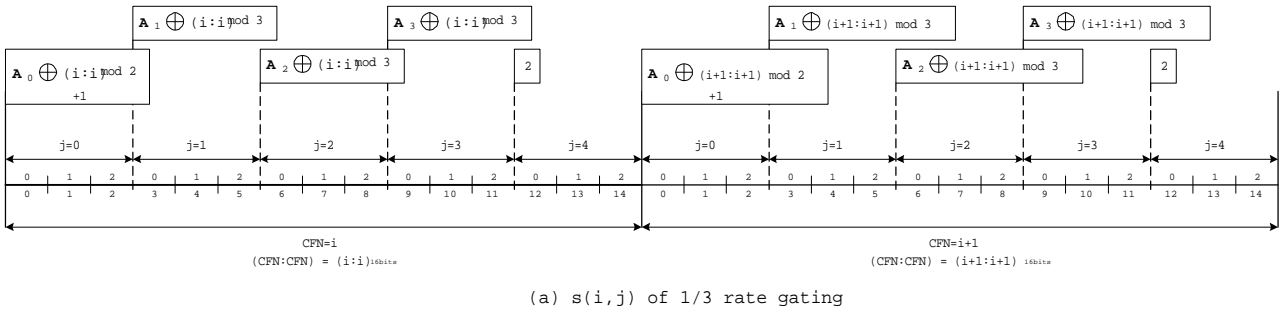

(a) s(i,j) of 1/3 rate gating

(b) s(i,j) of 1/5 rate gating

Figure 1. Calculation of s(i, j): (a) 1/3 rate (b) 1/5 rate

8.3.2   Gated-on Slot Allocation in Gated DPCCH Transmission

When the gated transmission is enabled in the downlink, UTRAN shall transmit the DPCCH in the time slots specified in Table 4. In case of uplink gated transmission, the UE shall transmit the DPCCH in time slots specified in Table 5. Only one time slot per each gating group shall be gated-on.

Table 4. Downlink DPCCH gate on time slot allocations during gated transmission

Gating Pattern	Gating Rate	Downlink DPCCH gate on time slot allocation	
		Pilot	**TPC, TFCI**
Regular Pattern	1	every time slots (0~14)	every time slots (0~14)
Regular Pattern	1/3	$j \times 3$	$1 + j \times 3$
	1/5	$1 + j \times 5$	$2 + j \times 5$

3

Random Pattern	1/3	$j \times S_G + s(i,j) - 1$ (defined in 8.3.2)	$j \times S_G + s(i,j)$ (defined in 8.3.2)
	1/5		

* Note: i=0,1,...,255 denotes the CFN and j=0,1,2,3,4 if gating rate is 1/3, j=0,1,2 if gating rate is 1/5 denotes the gating group number. (defined in 8.3.2)

Table 5. Uplink DPCCH gate on time slot allocations during gated transmission

Gating Pattern	Gating Rate	Uplink DPCCH gate on time slot allocation
		Pilot, TFCI, FBI, TPC
Regular Pattern	1	every time slots (0~14)
Regular Pattern	1/3	$2 + j \times S_G$
	1/5	$4 + j \times S_G$
Random Pattern	1/3	$j \times S_G + s(i,j)$ (defined in 8.3.2)
	1/5	

* Note: i=0,1,...,255 denotes the CFN and j=0,1,2,3,4 if gating rate is 1/3, j=0,1,2 if gating rate is 1/5 denotes the gating group number. (defined in 8.3.2)

The relative timings of the downlink and uplink DPCCH transmission with random and regular gating pattern which are summarised in Table 2 and Table 3 are depicted in Figure 2, Figure 3, respectively.
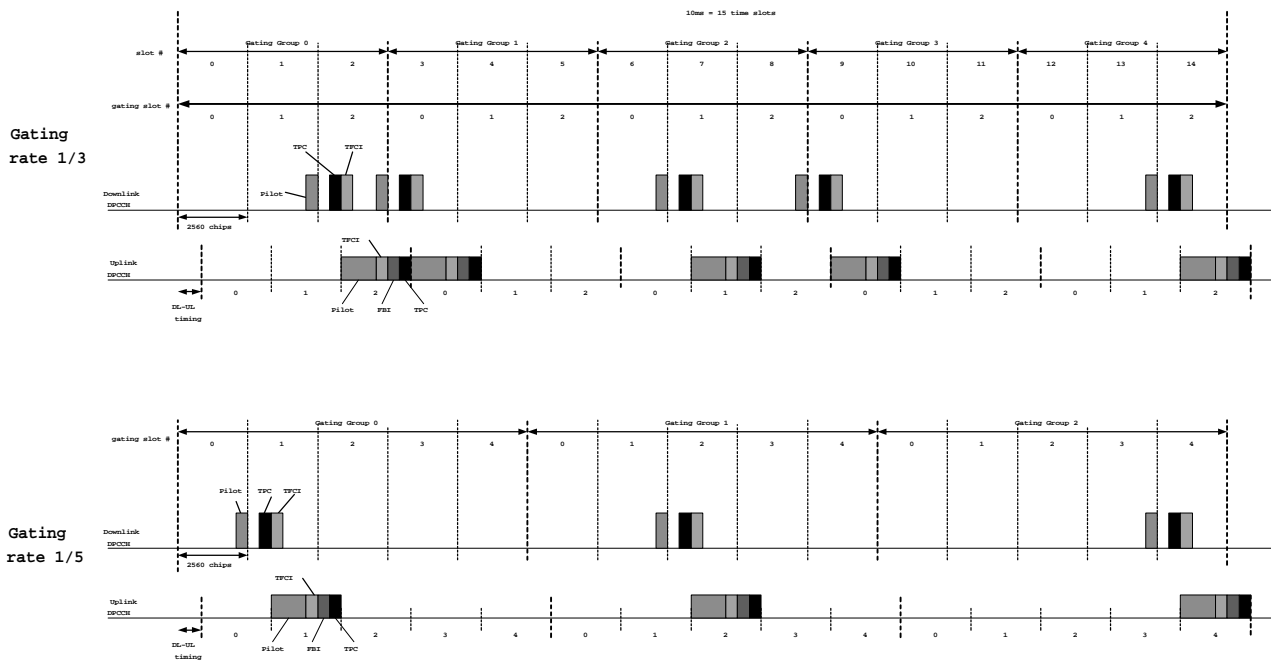

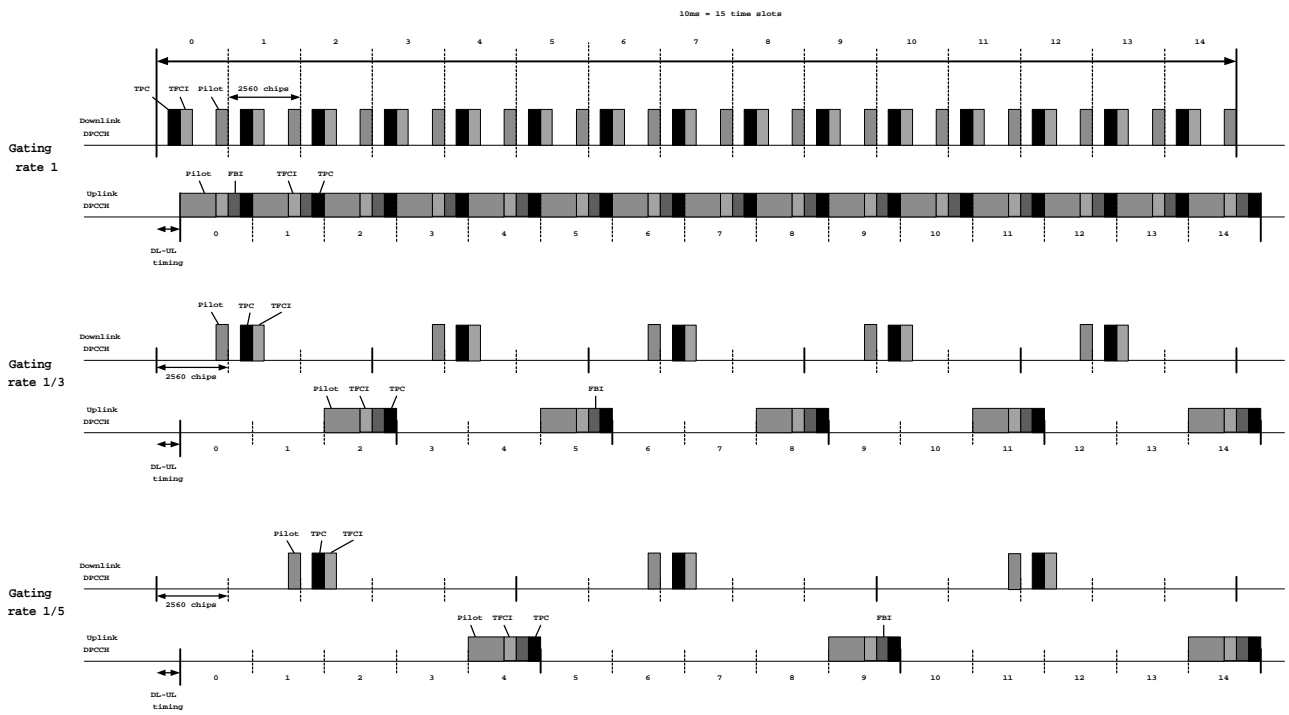**Figure 2. Downlink and uplink DPCCH transmission with random gating pattern (example)**

Figure 3. Downlink and uplink DPCCH transmission timing with regular gating pattern

================== END OF TEXT PROPOSAL ==================