TSG-RAN Meeting #6 ***TSGRP#6(99)685***
Nice, France, 13 – 15 December 1999

Title: **Agreed CRs of category "D" (Editorial) to TS 25.214**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc
25.214	011	-	R99	Clarification of closed loop transmit diversity figure	D	3.0.0	3.1.0	R1-99i02

NOTE: The source of this document is TSG-RAN WG1. The source shown on each CR cover sheet is the originating organisation.

TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)i02**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Motorola

Title: CR 25.214-011 : Clarification of Closed Loop Transmit Diversity diagram and editorial changes in compressed mode operation of closed loop transmit diversity mode 2 in TS 25.214 V3.0.0

Document for: Decision

The current section 8 of TS 25.214, Figure 6 explains the general transmitter structure to support closed loop transmit diversity for DPCH.

It was agreed in ADHOC 6 meeting #8 in New York that the figure should be clarified. It was also decided that some editorial changes should be done for the compressed mode operation for mode 2.

In the following CR, a clarified diagram for figure 6 is proposed. It is also clarified that orthogonal dedicated pilots in DPCCH is transmitted for mode 1 on the different antennas and the same dedicated pilots are transmitted for mode 2 on both antennas.

Some editorial changes in the text of section 8.3 for the operation in compressed mode of mode 2 is also included in this CR.

Finally, the statement "When Npo=0, equal power is applied to each antenna" is removed from 8.3

***Document* R1-99i02**
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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25.214	**CR**	**011**	Current Version:	3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑　　*↑ CR number as allocated by MCC support team*

For submission to:	TSG-RAN #9	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG　The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME		UTRAN / Radio	X	Core Network	

Source:	Motorola	**Date:**	1999-11-17

Subject: Clarification of closed loop transmit diversity figure in section 8 and closed loop operation in compressed mode for mode 2 in section 8.3 of TS 25.214

Work item:

Category:	F	Correction		**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change: Clarifies the general functionning of the closed loop transmit diversity scheme and the operation in compressed mode for closed loop transmit diversity mode 2.

Clauses affected: 8 and 8.3

Other specs affected:	Other 3G core specifications		→ List of CRs:
	Other GSM core specifications		→ List of CRs:
	MS test specifications		→ List of CRs:
	BSS test specifications		→ List of CRs:
	O&M specifications		→ List of CRs:

Other comments:

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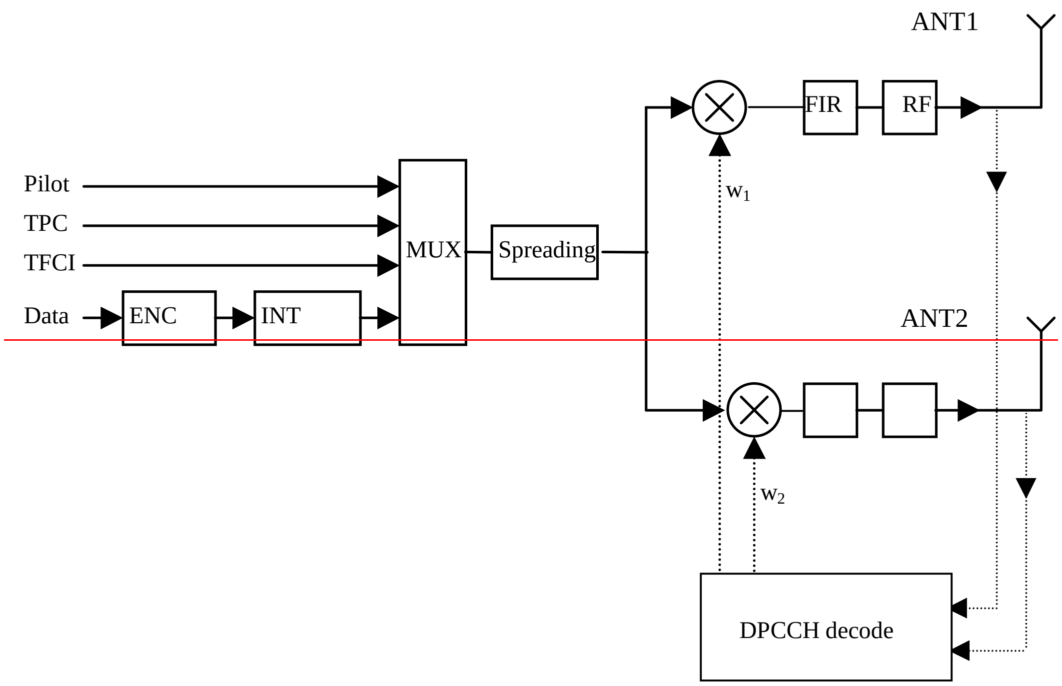
8 Closed loop mode transmit diversity

The general transmitter structure to support closed loop mode transmit diversity for DPCH transmission is shown in figure 6. Channel coding, interleaving and spreading are done as in non-diversity mode. The spread complex valued signal is fed to both TX antenna branches, and weighted with antenna specific weight factors w_1 and w_2. The weight factors are complex valued signals (i.e., $w_i = a_i + jb_i$), in general.

The weight factors (actually the corresponding phase adjustments in closed loop mode 1 and phase/amplitude adjustments in closed loop mode 2) are determined by the UE, and signalled to the UTRAN access point (=cell transceiver) using the D-bits of the FBI field of uplink DPCCH.

For the closed loop mode 1 different (orthogonal) dedicated pilots symbols in the DPCCH are sent on the 2 different antennas. For closed loop mode 2 the same dedicated pilot symbols in the DPCCH are sent on both antennas.



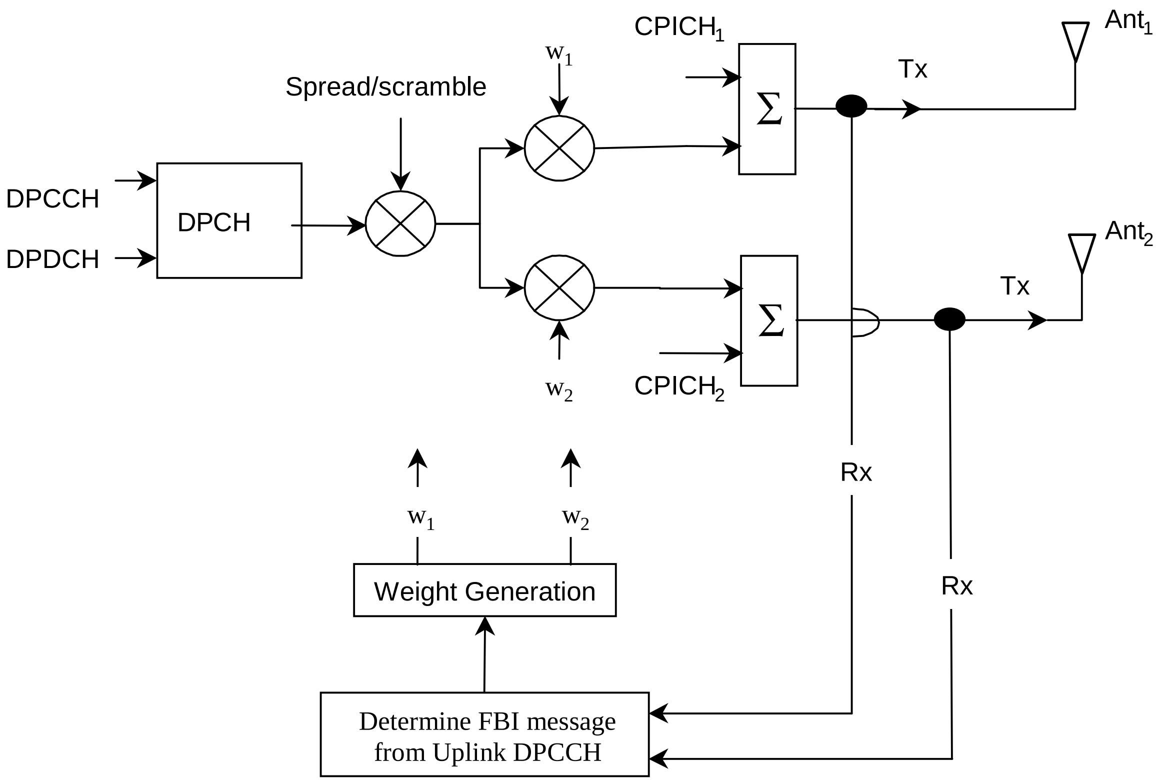


Figure 6: The generic downlink transmitter structure to support closed loop mode transmit diversity for DPCH transmission (UTRAN Access Point)

There are two closed loop modes whose characteristics are summarized in the table 8. The use of the modes is controlled by the UTRAN access point. The use of the modes is controlled via higher layer signalling.

8.3 Closed loop mode 2

In closed loop mode 2 there are 16 possible combinations of phase and amplitude adjustment from which the UE selects and transmits the FSM according to table 10 and table 11. As opposed to closed loop Mode 1, no constellation rotation is done at UE and no filtering of the received weights is performed at the UTRAN.

Table 10: FSM_{po} subfield of closed loop mode 2 signalling message

FSM_{po}	Power_ant1	Power_ant2
0	0.2	0.8
1	0.8	0.2

Table 11: FSM_{ph} subfield of closed loop mode 2 signalling message

FSM_{ph}	Phase difference between antennas (degrees)
000	180
001	-135
011	-90
010	-45
110	0
111	45
101	90
100	135

~~When N_{po}=0, equal power is applied to each antenna.~~

To obtain the best performance, progressive updating is performed at both the UE and the UTRAN Access point. Every slot time, the UE refines its choice of FSM, from the set of weights allowed given the previously transmitted bits of the FSM. This is shown in figure 8, where, in this figure b_i (0<i<3) are the bits of the FSM (from table 10 and table 11) from the MSB to the LSB and m=0, 1, 2, 3 (the end of frame adjustment given section 8.3.1 is not shown here).

At the beginning of a FSM to be transmitted, the UE chooses the best FSM out of the 16 possibilities. Then the UE starts sending the FSM bits from the MSB to the LSB in the portion of FBI field of the uplink DPCCH during 4 (FSM message length) slots. Within the transmission of the FSM the UE refines its choice of FSM. This is defined in the following. :

Define the 4 bits of FSM, which are transmitted from slot number k to k+3, as $\{b_3(k)\ b_2(k+1)\ b_1(k+2)\ b_0(k+3)\}$, where k=0, 4, 8, 12. Define also the estimated received power criteria defined in Equation 1 for a given FSM as $p(\{x_3, x_2\ x_1\ x_0\})$, where $\{ x_3\ x_2\ x_1\ x_0 \}$ is one of the 16 possible FSMs which defines an applied phase and amplitude offset according to table 10 and table 11. The $b_i()$ and x_i are 0 or 1.

The bits transmitted during the m'th FSM of the frame, where m=0,1,2,3, are then given by

$b_3(4m)=X_3$ from the $\{X_3\ X_2\ X_1\ X_0\}$ which maximises $p(\{x_3\ x_2\ x_1\ x_0\})$ over all x_3,x_2,x_1,x_0 (16 possible combinations);

$b_2(4m+1)=X_2$ from the $\{b_3(4m)\ X_2\ X_1\ X_0\}$ which maximises $p(\{b_3(4m)\ x_2\ x_1\ x_0\})$ over all x_2,x_1,x_0 (8 possible combinations);

$b_1(4m+2)=X_1$ from the $\{b_3(4m)\ b_2(4m+1)\ X_1\ X_0\}$ which maximises $p(\{b_3(4m)\ b_2(4m+1)\ x_1\ x_0\})$ over all x1,x0 (4 possible combinations);

$b_0(4m+3)=X_0$ from the $\{b_3(4m)\ b_2(4m+1)\ b_1(4m+2)\ X_0\}$ which maximises $p(\{b_3(4m)\ b_2(4m+1)\ b_1(4m+2)\ x_0\})$ over x_0 (2 possible combinations).

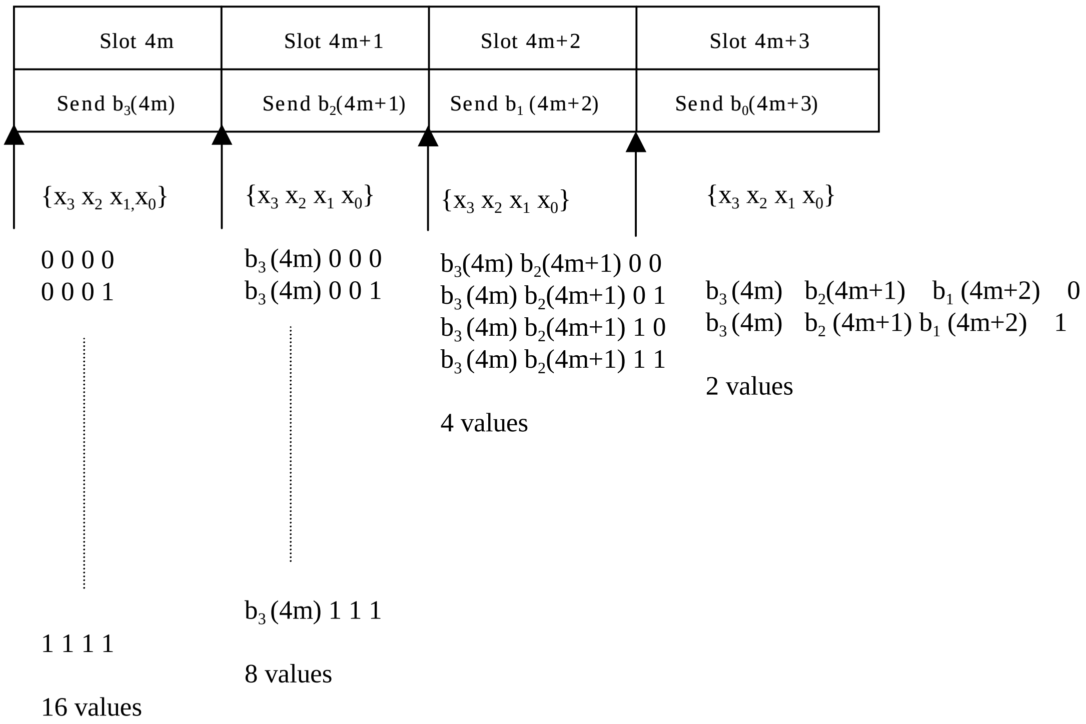


Figure 8: Progressive Refinement at the UE for closed loop mode 2

Every slot time the UTRAN constructs the FSM from the most recently received bits for each position in the word and applies the phase and amplitude as defined by table 10 and table 11. More precisely, the UTRAN operation can be explained as follows. The UTRAN maintains a register $\mathbf{z}=\{z_3\ z_2\ z_1\ z_0\}$, which is updated every slot time according to $z_i=b_i(ns)$ (i=0:3,ns=0:14). Every slot time the contents of register **z** are used to determine the phase and amplitude adjustments as defined by table 10 and table 11, with $FSM_{ph} =\{z_3\ z_2\ z_1\}$ and $FSM_{po}=z_0$.

Special procedures for initialisation and end of frame processing are described below.

The weight vector, *w*, is then calculated as:

$$\underline{w} = \begin{bmatrix} \sqrt{power\_ant1} \\ \sqrt{power\_ant2}.\exp(j\pi.phase\_diff\ /180) \end{bmatrix} \qquad (6)$$

8.3.1 Mode 2 end of frame adjustment

The FSM must be wholly contained within a frame. To achieve this an adjustment is made to the last FSM in the frame where the UE only sends the FSM_{ph} subfield, and the Node B takes the amplitude bit FSM_{po} of the previous FSM.

8.3.2 Mode 2 normal Initialisation

For the first frame of transmission using closed loop mode 2, the operation is as follows.

The UE starts sending the FSM message in slot 0 in the normal way, refining its choice of FSM in slots 1 to 3 from the set of weights allowed given the previously transmitted bits of the FSM.

During the reception of the first three FSM bits (that is before the full four bits are received), the UTRAN Access Point initialises its transmissions as follows. The power in both antennas is set to 0.5. The phase offset applied between the antennas is updated according to the number and value of FSM_{ph} bits received as given in table 12.

Table 12: FSM_{ph} normal initialisation for closed mode 2

FSM_{ph}	Phase difference between antennas (degrees)
- - -	180 (normal initialisation) or held from previous setting (slotted mode recovery)
0 - -	180
1 - -	0
0 0 -	180
0 1 -	-90
1 1 -	0
1 0 -	90
0 0 0	180
0 0 1	-135
0 1 1	-90
0 1 0	-45
1 1 0	0
1 1 1	45
1 0 1	90
1 0 0	135

This operation applies in both the soft handover and non soft handover cases.

8.3.3 Mode 2 operation during compressed mode

8.3.3.1 Downlink in compressed mode and uplink in normalcompressed mode

When the downlink is in compressed mode and the uplink is in normal mode, the closed loop mode 2 functions are described in 8.3.3.1 below.

If UE continues to calculate the phase adjustments based on the received CPICH from antennas 1 and 2 during the idle downlink slots there is no difference in UE operation when compared to non-compressed downlink operation.

When the UE is notNOT listening to the CPICH from antennas 1 and 2 during the idle downlink slots, the UE sends the last FSM bits calculated before entering in the uplink compressed mode.

- For recovery after compressed mode, UTRAN Access Point sets the power in both antennas to 0.5 until a FSM_{po} bit is received. Until the first FSM_{ph} bit is received and acted upon, UTRAN uses the phase offset, which was applied before the transmission interruption (table 12).

- Normal initialisation of FSM_{ph} (table 12) occurs if the uplink signalling information resumes at the beginning of a FSM period (that is if signalling resumes in slots 0,4,8,12).

- If the uplink signalling does not resume at the beginning of a FSM period, the following operation is performed. In each of the remaining slots of the partial FSM period, and for the first slot of the next full FSM period, the UE sends the first (i.e. MSB) bit of the FSM_{ph} message, and at the UTRAN access point the phase offset applied between the antennas is updated according to the number and value of FSM_{ph} bits received as given in table 13. Initialisation then continues with the transmission by the UE of the remaining FSM_{ph} bits and the UTRAN operation according to table 12.

Table 13: FSMph subfield of FB mode 2 compressed mode recovery period

FSM_{ph}	Phase difference between antennas (degrees)
-	held from previous setting
0	180
1	0

8.3.3.2 Both downlink and uplink in compressed mode

During both downlink and uplink compressed mode, the UTRAN and the UE performs the functions of recovery after compressed mode as described in the previous section 8.3.3.1

For recovery after compressed mode, UTRAN Access Point sets the power in both antennas to 0.5 until a FSM_{po} bit is received. Until the first FSM_{ph} bit is received and acted upon, UTRAN uses the phase offset, which was applied before the transmission interruption (table 12). Normal initialisation of FSM_{ph} (table 12) occurs if the uplink signalling information resumes at the beginning of a FSM period (that is if signalling resumes in slots 0,4,8,12). If the uplink signalling does not resume at the beginning of a FSM period, the following operation is performed.

In each of the remaining slots of the partial FSM period, and for the first slot of the next full FSM period, the UE sends the first (i.e. MSB) bit of the FSM_{ph} message, and at the UTRAN access point the phase offset applied between the antennas is updated according to the number and value of FSM_{ph} bits received as given in table 13. Initialisation then continues with the transmission by the UE of the remaining FSM_{ph} bits and the UTRAN operation according to table 12.

Table 13: FSMph subfield of FB mode 2 compressed mode recovery period

FSM_{ph}	Phase difference between antennas (degrees)
-	held from previous setting
0	180
1	0