Agenda item: 3

Source: **Motorola**

Title: Text proposals for Closed loop transmit diversity mode 2 to TS.25.214

Document for: Approval

Summary:

The following text proposal to TS 25.214 v1.3.1 is made. It includes :

- Proposal to replace the chapter 8.3 of TS 25.214 describing closed loop transmit diversity mode 2 with the new, more rigorous description.
- Proposal to make corrections in the chapter 8.3.1, 8.3.2 of TS 25.214 describing closed loop transmit diversity mode 2, for end frame adjustment and normal initialisation, respectively.
- Proposal to replace the chapter 8.3.3 of TS 25.214 describing closed loop transmit diversity mode 2 in compressed mode operation , again for a clearer description.

The whole chapter 8.3 of TS 25.214 v1.3.1 is proposed to be replaced with the following text:

----------Start text proposal----------

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 1 and Table 2. 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 1. 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 2. 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 1, where, in this figure b_i (0<i<3) are the bits of the FSM (from Table 1 and Table 2) 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 1 and Table 2. 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).

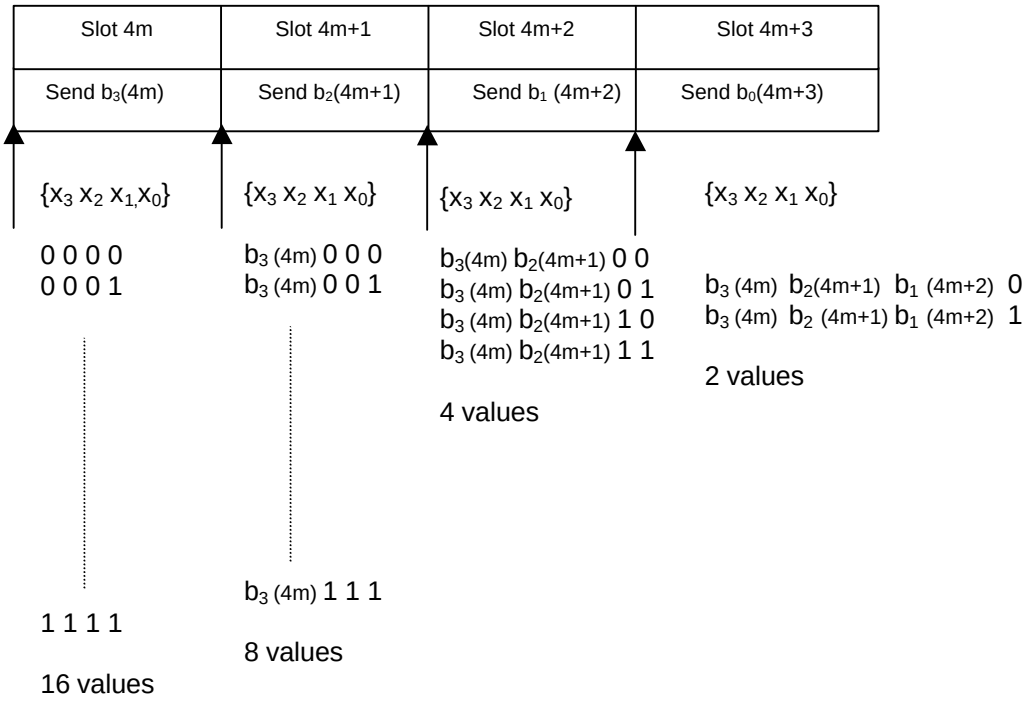

Figure 1. Progressive Refinement at the UE for closed loop mode 2.

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 1 and Table 2. More precisely, the UTRAN operation can be explained as follows. The UTRAN maintains a register **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 1 and Table 2, 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:

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

----------End text proposal----------

The following corrections are proposed for chapters 8.3.1 and 8.3.2 of TS 25.214 v1.3.1 describing end of frame adjustment and normal mode initialization, respectively:

----------Start text proposal----------

8.3.1 Mode 2 eEnd 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 UTRAN takes the amplitude bit FSM_{po} of the previous FSM.

8.3.2 Mode 2 nNormal Initialisation

For the first frame of transmission using closedinner -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 3.

Table 3.FSM_{ph} normal initialisation for closedFB loop mode 2.

FSM_{ph}	Phase difference between antennas (degrees)
- - -	180 (normal initialisation) or held from previous setting (compressed 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.

----------End text proposal----------

The whole chapter 8.3.3 of TS 25.214 v1.3.1 describing operation of Mode 2 during compressed mode is proposed to be replaced with the following text:

----------Start text proposal----------

8.3.3 Mode 2 operation during compressed mode

8.3.3.1 Downlink in compressed mode and uplink in compressed 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.

When the UE is NOT 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.

8.3.3.1 Both downlink and uplink in 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 3). Normal initialisation of FSM_{ph} (Table 3) 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 4. Initialisation then continues with the transmission by the UE of the remaining FSM_{ph} bits and the UTRAN operation according to Table 3.

Table 4: 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

----------End text proposal----------