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Agenda item:	3
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Title:	Text proposals for TS 25.211 and TS.25.214
Document for:	Approval

Summary:

Several text proposals to TS 25.211 v2.4.0 and TS 25.214 v1.3.1 are made. They include:

- Update of Table 9 in chapter 5.3.1 of TS 25.211
- Update of Figure 10 in chapter 5.3.1.1.2 of TS 25.211
- Diversity antenna pilot pattern for N_{pilot}=2 case (chapter 5.3.2.1 of TS 25.211)
- Proposal to send CPICH always from the diversity antenna if any of the Tx diversity modes are used on dedicated and/or common channels (chapter 5.3.3.1 of TS 25.211)
- Correction of access slot timing description in chapter 4.4 of TS 25.214
- Correction of Figure 1 in chapter 4.5.2 of TS 25.214
- Update of the first part of chapter 8 and chapter 8.1 of TS 25.214
- Proposal to replace the chapter 8.2 (excluding 8.2.3) of TS 25.214 with the new, more rigorous text
- Proposal to replace the chapter 8.2.3 of TS 25.214 with a new, more accurate text defining the operation in compressed mode

Table 9 in chapter 5.3.1 of TS 25.211 v2.4.0 is proposed to be modified as follows:

--Start text proposal--

Table 9: Application of Tx diversity modes on downlink physical channels.

Channel	**Open loop mode**	**Closed loop mode**	**Note**
PCCPCH	X	N/A	STTD applied only to data symbols. The last odd data symbol in every radio frame ~~(10 msec.)~~ is not STTD encoded.
SCH	X	N/A	TSTD used.
SCCPCH	X	N/A	
DPCH	X	X	For the 7.5 ksps channel, the last odd data symbol in every radio frame ~~(10 msec.)~~ is not STTD encoded.
PICH	X	N/A	~~Only if closed loop Tx diversity is used in the cell and/or open loop mode is used on PCCPCH.~~
PDSCH (associated with DPCH)	X	X	
AICH	X	N/A	~~Only if closed loop Tx diversity is used in the cell and/or open loop mode is used on PCCPCH~~.

N/A = Not applied
X = Can be applied

--End text proposal--

The Figure 10 in TS 25.211 v2.4.0 chapter 5.3.1.1.2 is proposed to be modified as follows:

--Start text proposal--

5.3.1.1.2 Time Switched Transmit Diversity for SCH (TSTD)

TSTD is used optionally at the base station. Its use at the UE is mandatory. A block diagram of the transmitter using TSTD for SCH and STTD for PCCPCH is shown in Figure 10.

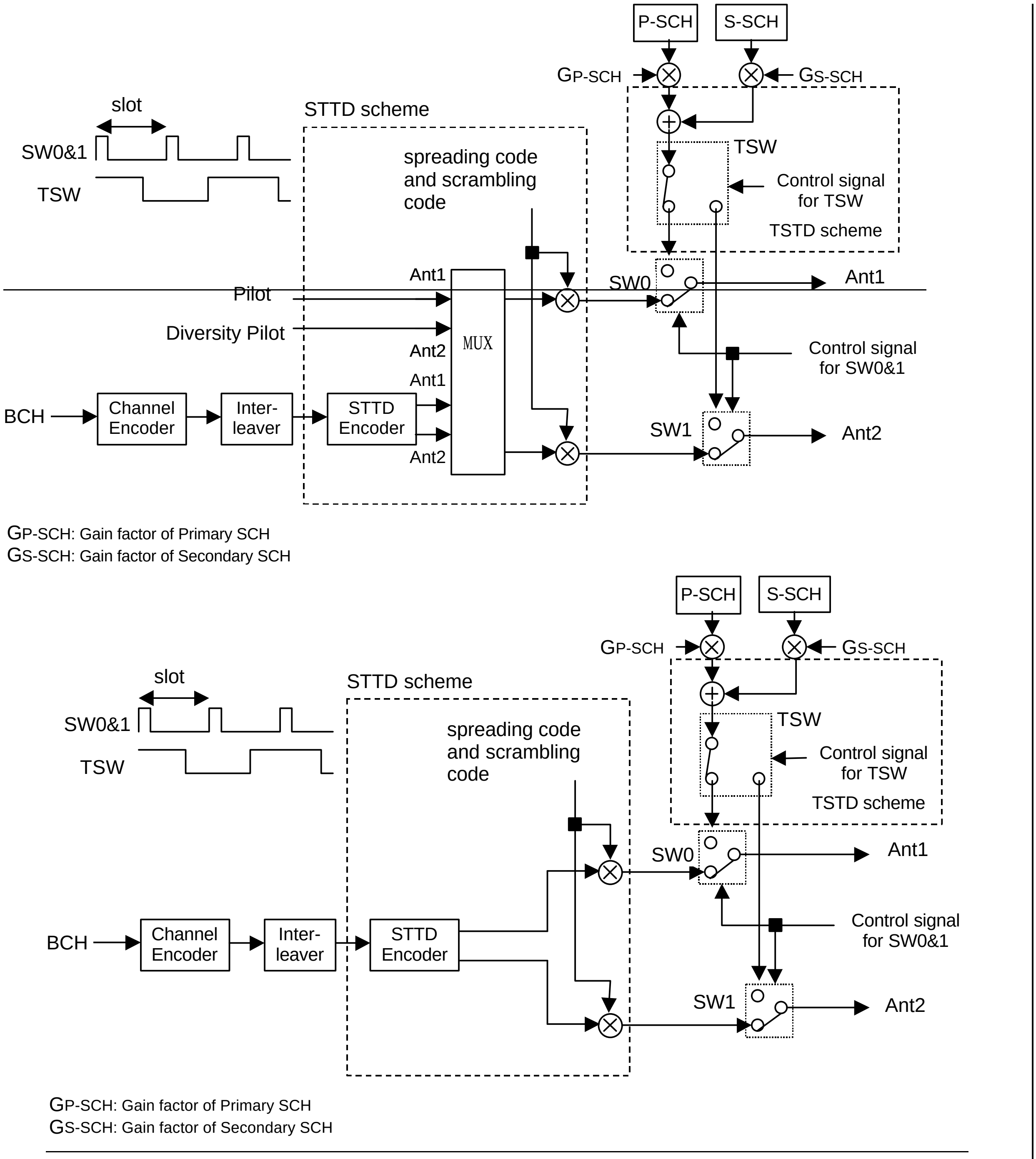


Figure 10: Multiplexing scheme of SCH (TSTD) and PCCPCH (STTD)

--**End text proposal**--

The chapter 5.3.2.1 of TS 25.211 v2.4.0 is proposed to be modified as follows:

--**Start text proposal**--

5.3.2.1 STTD for DPCH

The block diagrams shown in Figure 8 and Figure 9 are used to STTD encode the DPDCH, TPC and TFCI symbols. The pilot symbol pattern for the DPCH channel transmitted on the diversity antenna is given in Table 13. In SF=256 channel, if there is only one dedicated pilot symbol, it is STTD encoded together with the last symbol (data or DTX) of the data$_2$ field of the slot. For the 7.5 ksps DPCH the last odd data symbol in every radio frame ~~(10 msec.)~~ is not STTD encoded and the same symbol is transmitted with equal power from the two antennas.

Table 13: Pilot pattern of the DPCH channel for the diversity antenna using STTD.

	N_{pilot}=2	N_{pilot} = 4		N_{pilot} = 8				N_{pilot} = 16							
Symbol #	0	0	1	0	1	2	3	0	1	2	3	4	5	6	7
Slot #~~1~~0	01	01	10	11	00	00	10	11	00	00	10	11	00	00	10
~~2~~1	10	10	10	11	00	00	01	11	00	00	01	11	10	00	10
~~3~~2	11	11	10	11	11	00	00	11	11	00	00	11	10	00	11
~~4~~3	10	10	10	11	10	00	01	11	10	00	01	11	00	00	00
~~5~~4	00	00	10	11	11	00	11	11	11	00	11	11	01	00	10
~~6~~5	01	01	10	11	00	00	10	11	00	00	10	11	11	00	00
~~7~~6	01	01	10	11	10	00	10	11	10	00	10	11	01	00	11
~~8~~7	00	00	10	11	10	00	11	11	10	00	11	11	10	00	11
~~9~~8	11	11	10	11	00	00	00	11	00	00	00	11	01	00	01
~~10~~9	01	01	10	11	01	00	10	11	01	00	10	11	01	00	01
~~11~~10	11	11	10	11	11	00	00	11	11	00	00	11	00	00	10
~~12~~11	00	00	10	11	01	00	11	11	01	00	11	11	00	00	01
~~13~~12	00	00	10	11	10	00	11	11	10	00	11	11	11	00	00
~~14~~13	10	10	10	11	01	00	01	11	01	00	01	11	10	00	01
~~15~~14	10	10	10	11	01	00	01	11	01	00	01	11	11	00	11

~~At call setup phase the UE is informed if Transmit diversity will be used on DPCH or not. If the base station allows diversity mode, the base station starts the transmission of dedicated physical channel(s) using open loop diversity mode by default. As soon as the reverse link transmission has started, the base station can command the UE to either use open loop diversity mode or feedback mode by using higher level signalling. During hand over between cells and sectors open loop antenna diversity is used on dedicated physical channels.~~

--End text proposal--

The following modification is proposed to chapter 5.3.3.1 of TS 25.211 v2.4.0:

--Start text proposal--

5.3.3.1 Common Pilot Channel (CPICH)

This physical channel consists of two parts:

- Antenna 1 common pilot (always present) and
- Antenna 2 common pilot (~~in the case of~~ always present if open and/or closed loop Tx diversity is used on common and/or dedicated channels)

These are continuous channels with the same spreading and scrambling codes transmitted on the different antennas in the case of downlink transmit diversity. The spreading factor is always 256. They differ only in the modulation pattern used. The modulation patterns are shown in Figure 14.

--End text proposal---

The following modification is proposed to chapter 4.4 of TS 25.214 v 1.3.1:

--Start text proposal---

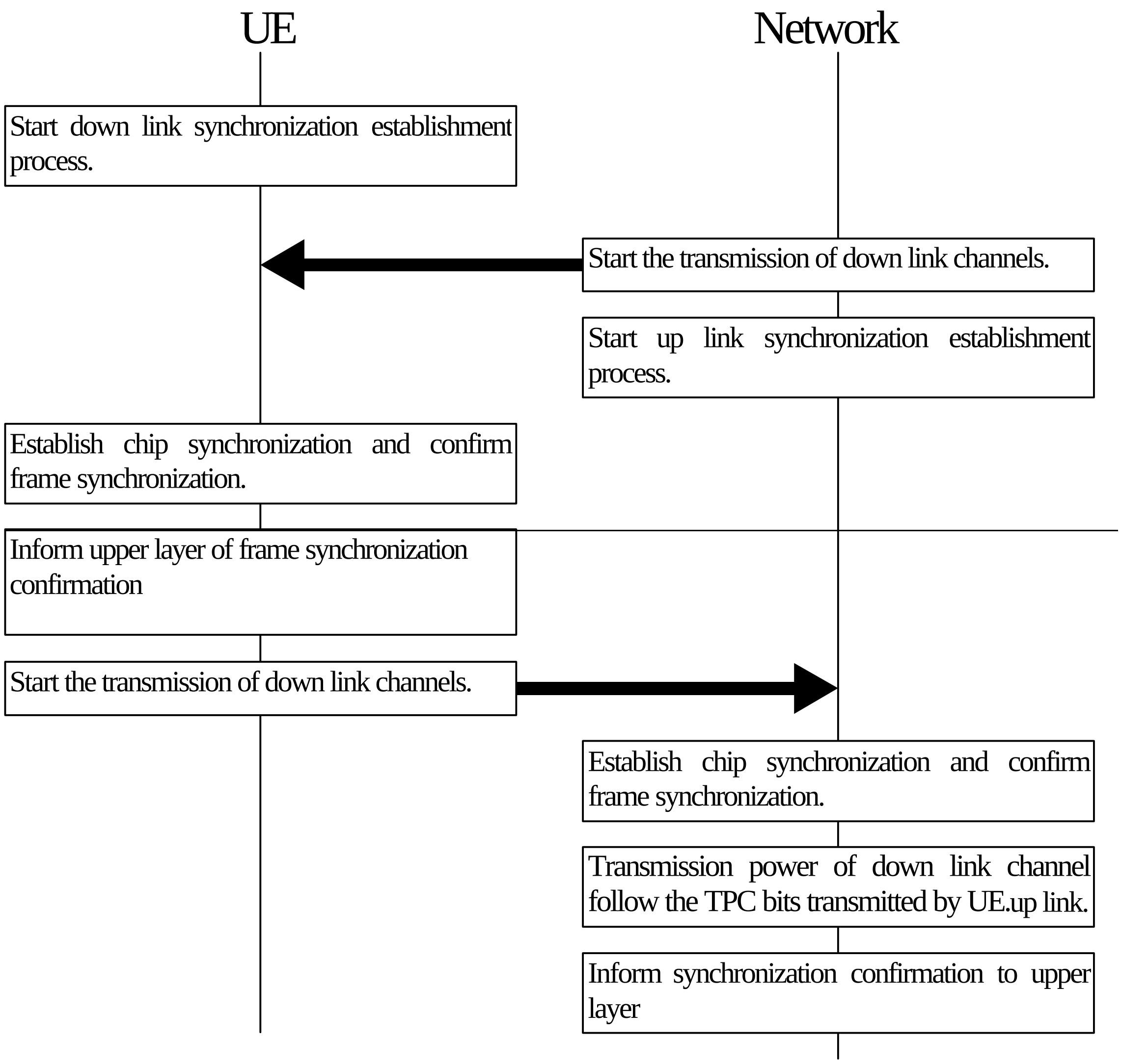
4.4 PRACH synchronisation

Transmission of random access bursts on the PRACH is done aligned with access slot times. The timing of the access slots is derived from the received Primary CCPCH timing. The transmit timing of access slots is described in TS 25.211 chapter 5.2.2.1.1. ~~n starts n×10/N ms after the frame boundary of the received Primary CCPCH, where n = 0, 1, …, N-1, and N is the number of access slots per 10 ms.~~

--End text proposal---

The Figure 1 in chapter 4.5.2 of TS 25.214 v 1.3.1 is proposed to be corrected as follows:

--Start text proposal---


UE
Network
Start down link synchronization establishment process.
Start the transmission of down link channels.
Start up link synchronization establishment process.
Establish chip synchronization and confirm frame synchronization.
Inform upper layer of frame synchronization confirmation
Start the transmission of down link channels.
Establish chip synchronization and confirm frame synchronization.
Transmission power of down link channel follow the TPC bits transmitted by UE.up link.
Inform synchronization confirmation to upper layer

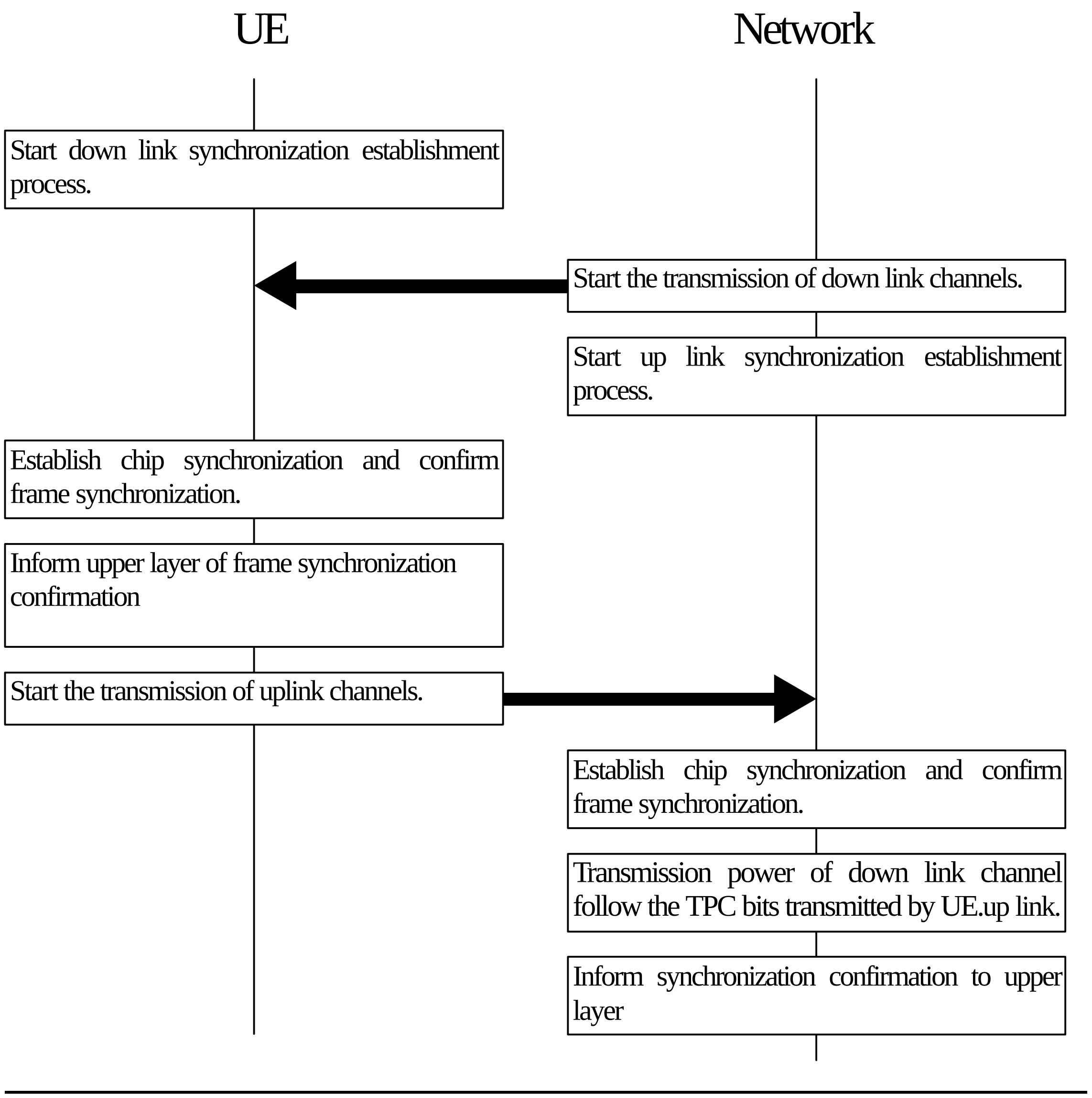


Figure 1: Synchronization establishment flow of dedicated channels

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

The following modifications are proposed to first part of chapter 8 and chapter 8.1 of TS 25.214 v1.3.1:

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

8 ~~Feedback~~ Closed loop mode transmit diversity

The general transmitter structure to support ~~Feedback (FB)~~closed loop mode transmit diversity for DPCH transmission is shown in Figure 2. 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 signaled to the UTRAN access point (=cell transceiver) using the D-bits of the FBI field of uplink DPCCH.

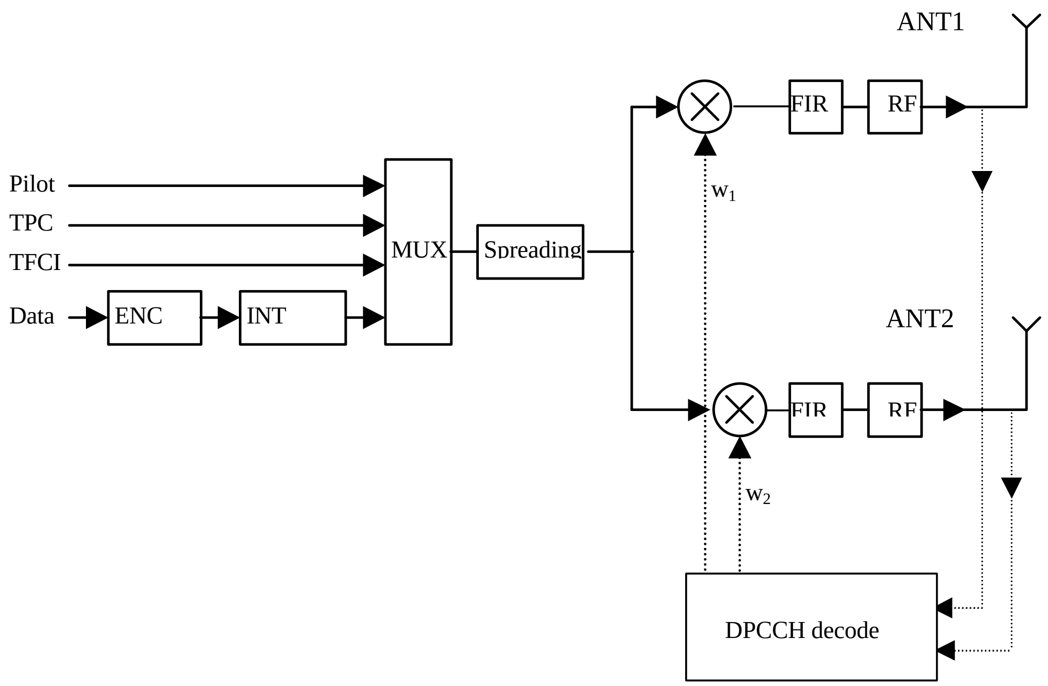


Figure 2. The generic downlink transmitter structure to support ~~FB Mode~~closed loop mode t~~T~~ransmit d~~D~~iversity for DPCH transmission (UTRAN Access Point)

There are two ~~feedback~~ closed loop modes whose characteristics are summarized in the Table 1. The use of the modes is controlled by the UTRAN access point.

Table 1: Summary of number of feedback information bits per slot, N_{FBD}, feedback command length in slots, N_W, feedback command rate, feedback bit rate, number of phase bits, N_{ph}, per signalling word, number of amplitude bits, N_{po}, per signalling word and amount of constellation rotation at UE for the two ~~feedback~~ closed loop modes.

Closed loop~~FB~~ mode	N_{FBD}	N_W	Update rate	Feedback bit rate	N_{po}	N_{ph}	Constellation rotation
1	1	1	1500 Hz	1500 bps	0	1	$\pi/2$
2	1	4	1500 Hz	1500 bps	1	3	N/A

8.1 Determination of feedback information

The UE uses the Common PIlot CHannel (CPICH) to separately estimate the channels seen from each antenna.

Once every slot, the UE computes the phase adjustment, f, and for mode 2 the amplitude adjustment that should be applied at the UTRAN access point to maximize the UE received power. In ~~a generic sense for the~~ non-soft handover case, ~~UE~~ that can be accomplished by e.g. solvinges~~es~~ for weight vector, $\underline{w}$, that maximizes

$$P=\underline{w}^H H^H H \underline{w} \qquad (1)$$

where

$$H=[h_1\ \ h_2\ \cancel{\ldots}]$$

and where the column vectors h_1 and h_2 ~~h_i~~ represent~~s~~ the estimated channel impulse responses for the ~~i'th~~ transmission antennas 1 and 2, of length equal to the length of the channel impulse response. The elements of w correspond to the phase and amplitude adjustments computed by the UE.

During soft handover or SSDT power control, the antenna weight vector, w ~~is~~ can be, for example, determined so as to maximize the criteria function,

$$P=w^H(H_1^H H_1+H_2^H H_2+\cdots)w \qquad (2)$$

where H_i is an estimated channel impulse response for BS#i. In regular SHO, the set of BS#i corresponds to the active set. With SSDT, the set of BS#i corresponds to the primary base station(s).

The UE feeds back to the UTRAN access point the information on which phase/power settings to use. Feedback Signaling Message (FSM) bits are transmitted in the portion of FBI field of uplink DPCCH slot(s) assigned to FB Mode Transmit Diversity, the FBI D field (see 25.211). Each message is of length $N_W = N_{po}+N_{ph}$ bits and its format is shown in the Figure 3. The transmission order of bits is from MSB to LSB, i.e. MSB is transmitted first. FSM_{po} and FSM_{ph} subfields are used to transmit the power and phase settings, respectively.

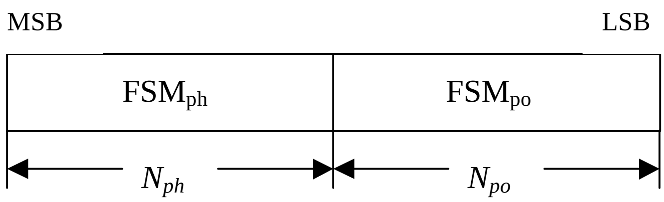


Figure 3:Format of feedback signalling message. FSM_{po} transmits the power setting and FSM_{ph} the phase setting.

The adjustments are made by the UTRAN Access Point at the beginning of the downlink DPCCH pilot field.

--End text proposal--

The chapter 8.2 (excluding 8.2.3) of TS 25.214 v1.3.1 is proposed to be replaced with the following text:

--Start text proposal--

8.2 Closed loop mode 1

UE uses the CPICH transmitted both from antenna 1 and antenna 2 to calculate the phase adjustment to be applied at UTRAN access point to maximize the UE received power. The received CPICH can be denoted as:

$$S^1_{CPICH}(t) = a_1(t)e^{jf_1(t)} \tag{2}$$

$$S^2_{CPICH}(t) = a_2(t)e^{jf_2(t)} \tag{3}$$

where,

$S^1_{CPICH}(t)$ = common pilot signal from antenna 1
$a_1(t)$ = time varying amplitude of the $S^1_{CPICH}(t)$
f_1(t) = time varying phase of the $S^1_{CPICH}(t)$
$S^2_{CPICH}(t)$ = common pilot signal from antenna 2 (diversity antenna)
$a_2(t)$ = time varying amplitude of the $S^2_{CPICH}(t)$
$f_2(t)$ = time varying phase of the $S^2_{CPICH}(t)$

Before solving for the optimum phase adjustment, the S^2_{CPICH} is rotated as follows:

$$S^2_{CPICH}(t) = a_2(t)e^{jf_2(t)}e^{jf_r(t)} \tag{4}$$

The rotation angle, $f_r(t)$, which is applied before solving for phase adjustment to be signaled in uplink slot i, is defined as:

$$f_r(t) = \begin{cases} 0, & i = 0,2,4,6,8,10,12,14 \\ \frac{p}{2}, & i = 1,3,5,7,9,11,13 \end{cases} \tag{5}$$

After rotation of the S^2_{CPICH} by $f_r(t)$, UE calculates the optimum phase adjustment, f, which is then quantized into f_Q having two possible values as follows:

$$\begin{aligned} \frac{-p}{2} < f \le \frac{p}{2} \quad &\Rightarrow \quad f_Q = 0 \\ \frac{p}{2} < f \le \frac{3p}{2} \quad &\Rightarrow \quad f_Q = p \end{aligned} \tag{6}$$

If f_Q = 0, a command '0' is send to UTRAN using the FSM_{ph} field. Correspondingly, if f_Q = π, command '1' is send to UTRAN using the FSM_{ph} field.

Due to rotation of the constellation at UE the UTRAN interprets the received commands according to Table 12 which shows the mapping between phase adjustment, f_i ,, and received feedback command for each UL slot.

Table 12. Feedback commands and corresponding phase adjustments, f_i, for the slots i of the UL radio frame.

FSM_{ph}	f_i														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	0	π/2	0	π/2	0	π/2	0	π/2	0	π/2	0	π/2	0	π/2	0
1	π	-π/2	π	-π/2	π	-π/2	π	-π/2	π	-π/2	π	-π/2	π	-π/2	π

The weight vector, w_2, is then calculated by sliding window averaging the received phases over 2 consequtive slots. Algorithmically, w_2 is calculated as follows:

$$w_2 = \frac{\sum_{i=n-1}^{n} \cos(f_i)}{\sqrt{2}} + j\frac{\sum_{i=n-1}^{n} \sin(f_i)}{\sqrt{2}} \qquad (7)$$

where,

$$f_i \in \{0, p, p/2, -p/2\} \qquad (8)$$

For antenna 1, the weight vector, w_1, is always:

$$w_1 = 1 \qquad (9)$$

8.2.1 Mode 1 end of frame adjustment

In closed loop mode 1 at frame borders the sliding window averaging operation is slightly modified. Upon reception of the FB command for slot 0 of the next frame, the average is calculated based on the command for slot 13 of the previous frame and the command for slot 0 of the next frame, i.e. f_i from slot 14 is not used:

$$w_2 = \frac{\cos(f_{13}^{j-1}) + \cos(f_0^{j})}{\sqrt{2}} + j\frac{\sin(f_{13}^{j-1}) + \sin(f_0^{j})}{\sqrt{2}} \qquad (10)$$

where,

f_{13}^{j-1} = phase adjustment from frame j-1, slot 13

f_0^{j} = phase adjustment from frame j, slot 0

8.2.2 Mode 1 normal initialization

For the first frame of transmission UE determines the feedback commands in a normal way and sends them to UTRAN.

Having received the first FB command the UTRAN calculates the w_2 as follows:

$$w_2 = \frac{\cos(p/2) + \cos(f_0)}{\sqrt{2}} + j\frac{\sin(p/2) + \sin(f_0)}{\sqrt{2}} \qquad (11)$$

where,

f_0 = phase adjustment from slot 0 of the first frame

---End text proposal---

The chapter 8.2.3 of TS 25.214 v1.3.1 is proposed to be replaced with the following text:

---Start text proposal---

8.2.3 Mode 1 operation during compressed mode

8.2.3.1 Downlink in compressed mode and uplink in normal mode

When downlink is in compressed mode but uplink is operating normally (i.e. not compressed) the UTRAN continues it's Tx diversity related functions in the same way as in non-compressed downlink mode.

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.

If during the compressed downlink transmission there are uplink slots for which no new estimate of the phase adjustment has been calculated the following rules are applied in UE when determining the feedback command:

1. If no new estimate of phase adjustment, f_i, exist corresponding to the feedback command to be send in uplink slot *i*:

   If 1 < *i* < 15
      the feedback command sent in uplink slot *i*-2 is used
   else if *i* = 0
      the feedback command sent in uplink slot 14 of previous frame is used
   else if *i* = 1
      the feedback command sent in uplink slot 13 of previous frame is used
   end if

2. When transmission in downlink is started again in downlink slot N_{Last+1} the UE must resume calculating new estimates of the phase adjustment. The feedback command corresponding to the first new estimate of f_i must be send in the uplink slot which is transmitted 1024 chips in offset from the downlink slot N_{Last+1}.

8.2.3.2 Both downlink and uplink in compressed mode

During the uplink idle slots no FB commands are sent from UE to UTRAN. When transmission in downlink is started again in downlink slot N_{Last+1} the UE must resume calculating new estimates of the phase adjustment. The feedback command corresponding to the first new estimate of f_i must be send in the uplink slot which is transmitted 1024 chips in offset from the downlink slot N_{Last+1}.

The UTRAN continues to update the weight vector, w_2, until the uplink enters the compressed mode and no more FB commands are received. When the transmission in downlink resumes in slot N_{Last+1}, the value of w_2 calculated after receiving the last FB command before uplink entered the compressed mode is applied to antenna 2 signal.

After UE resumes transmission in uplink and sends the first FB command the new value of w_2 is calculated as follows:

S_1 = {0, 2, 4, 6, 8, 10, 12 14}
S_2 = {1, 3, 5, 7, 9, 11, 13}

i = number of uplink slot at which the transmission resumes
j = number of uplink slot at which the last FB command was send before uplink entered compressed mode

```
do while (i ∈ S1 and j ∈ S1) or (i ∈ S2 and j ∈ S2)
    j = j-1
    if j < 0
        j = 14
    end if
end do
```

calculate w_2 based on FB commands received in uplink slots i and j

--End text proposal--