TSG-RAN Working Group1 meeting #8
New York, USA, 12-15 Oct., 1999

TSGR1#8 *(99)e53*

Agenda Item: **Ad Hoc 9**

Source: **Panasonic**

Title: **0dB Command for Uplink Power Control**

Document for: **Discussion**

Introduction

During the discussion on the WG1/AdHoc09 reflector step size of the power control of normal mode has not been decided yet. It seems better that when the optimum step size is selected by Doppler frequency than fixed step size. However, the method to realise the adaptive step size is very difficult. We proposed 0dB command with adaptive threshold at demodulator.

Detailed description about 0dB command for uplink power control

0dB command will be introduced for uplink power control. It means that only downlink signal has 3 state TPC command. On UE side, it has the mechanism to demodulate 3 state TPC command. It is called adaptive threshold and is realised with following equation.

T(i) = Lima[T(i-1)*(A+B)/(A+Limb[X(i)])] ; when dedicated pilot symbol is used only
; T(i) is always 0.0 when dedicated pilot symbol is not used

$$Dtpc(i) = \begin{cases} 1 & ; X(i) >= T(i) \text{ and } TPC(i) >= 0 \\ 0 & ; X(i) < T(i) \\ -1 & ; X(i) >= T(i) \text{ and } TPC(i) < 0 \end{cases}$$

;Lima[y] is the limiter which limits y not to be larger than 10.0 and not to be less than 0.01

;Limb[z] is the limiter which limits z not to be larger than 1.0

T(i) is the threshold at the timing i.

A is the constant value (10 is the reasonable value).

B is the constant value (0.3 is the reasonable value).

X(i) is the power ratio of TPC and pilot symbol per chip at timing i.

TPC(i) is the demodulated TPC from CDMA receiver.

Dtpc(i) is the decided TPC command at timing i which is 3-State value (1,0,-1) of the equation in 3.1.1.

Simulation parameters and results are following tables.

There are 8 columns of data for each speed and they have the following meaning:

1. probability of occurrence of each of the nine possible permutations of transmitted TPC and received (interpreted TPC). The order is the following

B transmit TPC is 1 and received is 1 = no error

C transmit TPC is 1 and received is 0 = error

D transmit TPC is 1 and received is -1 = error

E transmit TPC is 0 and received is 1 = error

F transmit TPC is 0 and received is 0 = no error

G transmit TPC is 0 and received is -1 = error

H transmit TPC is -1 and received is 1 = error

I transmit TPC is -1 and received is 0 = error

J transmit TPC is -1 and received is -1 = no error

2. error probabilities of uplink TPC which only has 2 states. Hence, columns C,E,F,G,I are meaningless

3 Downlink Eb/No in dB

4 Uplink Eb/No in dB

5 Downlink raw BER, residual BER, FER

6 Uplink raw BER, residual BER, FER

7 Ratio of 0dB commands

8 Average value of adaptive threshold used for interpretation of TPC command

As the result we were interested in was only the comparative gain, for simplicity the channel estimation is memoryless and this explains the large Eb/No values.

Table 1 Simulation parameters

Item	Parameter
Spreading Factor	128(both links)
Convolutional Coding	R=1/3,k=9
3 State TPC Generation at base station	Detailed description in Appendix 1
TPC delay	1 slot
Slot/frame	16

Table 2 Eb/No for BER=0.1% of uplink channel (downlink is adjusted to BER=0.1%)

185Hz	B	C	D	E	F	G	H	I	J
DL_TPCBE1	3.90E-01	1.14E-02	1.31E-02	6.12E-02	4.51E-02	6.04E-02	1.48E-02	1.09E-02	3.93E-01
UL_TPCBE1	4.75E-01	0.00E+00	2.27E-02	0.00E+00	0.00E+00	0.00E+00	2.46E-02	0.00E+00	4.77E-01
DL_APOWER	1.15E+01								
UL_APOWER	1.15E+01								
DL_BERS	7.18E-02	1.00E-03	1.80E-02						
UL_BERS	7.58E-02	1.04E-03	1.50E-02						
NoPCDL/UL	0.00E+00	1.67E-01							
AVE_THLESH	1.01E-02								
74Hz									
DL_TPCBE1	3.87E-01	8.00E-03	1.01E-02	6.94E-02	4.69E-02	7.23E-02	1.15E-02	9.56E-03	3.85E-01
UL_TPCBE1	4.79E-01	0.00E+00	1.99E-02	0.00E+00	0.00E+00	0.00E+00	2.16E-02	0.00E+00	4.80E-01
DL_APOWER	1.04E+01								
UL_APOWER	1.07E+01								
DL_BERS	6.65E-02	9.36E-04	7.00E-03						
UL_BERS	7.82E-02	1.17E-03	1.00E-02						
NoPCDL/UL	0.00E+00	1.89E-01							
AVE_THLESH	1.02E-02								
37Hz									
DL_TPCBE1	3.73E-01	1.00E-02	9.06E-03	8.44E-02	4.54E-02	8.64E-02	1.05E-02	9.56E-03	3.72E-01
UL_TPCBE1	4.87E-01	0.00E+00	1.03E-02	0.00E+00	0.00E+00	0.00E+00	1.29E-02	0.00E+00	4.90E-01
DL_APOWER	8.95E+00								
UL_APOWER	1.08E+01								
DL_BERS	7.08E-02	1.13E-03	8.00E-03						
UL_BERS	6.10E-02	1.17E-03	9.00E-03						
NoPCDL/UL	0.00E+00	2.16E-01							

AVE_THLESH	1.02E-02								
18.5Hz									
DL_TPCBE1	3.69E-01	7.94E-03	5.63E-03	9.18E-02	5.03E-02	8.88E-02	6.06E-03	8.12E-03	3.72E-01
UL_TPCBE1	4.84E-01	0.00E+00	1.46E-02	0.00E+00	0.00E+00	0.00E+00	1.62E-02	0.00E+00	4.86E-01
DL_APOWER	8.69E+00								
UL_APOWER	9.85E+00								
DL_BERS	6.12E-02	9.93E-04	7.00E-03						
UL_BERS	7.79E-02	1.09E-03	1.20E-02						
NoPCDL/UL	0.00E+00	2.31E-01							
AVE_THLESH	1.02E-02								
5.55Hz									
DL_TPCBE1	3.50E-01	1.96E-02	1.37E-02	9.40E-02	4.44E-02	9.41E-02	1.54E-02	1.67E-02	3.52E-01
UL_TPCBE1	4.84E-01	0.00E+00	1.82E-02	0.00E+00	0.00E+00	0.00E+00	1.61E-02	0.00E+00	4.82E-01
DL_APOWER	6.64E+00								
UL_APOWER	9.58E+00								
DL_BERS	1.08E-01	1.04E-03	1.00E-02						
UL_BERS	8.43E-02	1.22E-03	9.00E-03						
NoPCDL/UL	0.00E+00	2.32E-01							
AVE_THLESH	1.04E-02								

Conclusion

We show the detailed data of 0dB command and its algorithm.

It is useful to allow 0dB command. UE should have the 0dB command detection method. Adaptive threshold is an example of that. BS transmission side can transmit 0dB command. It should be an option.