3GPP TSG RAN WG1 ***TSGR1#9(99)i05***

Agenda item: **Ad hoc 9**

Source: **Panasonic**

Title: **Simulation Results of Pre-wake Power Control (PWPC)**

Document for: **Discussion**

1. Introduction

This document shows the result of PWPC (Pre-wake power control) which was proposed by R1-99e55 and R1-99e56. It also describes about many implementation case.

When transmission were stopping for a certain period, power control must be stopping either. Therefore, after that period, there are much time is required to recover the control. Especially, after compressed mode, degradation of the performance is obviously. The basic idea of PWPC is the following: the UE records the ratio of received power of PDCH to that of a common control channel just before the transmission gap, just before transmission on the downlink is resumed the UE measures the received power of the common control channel and deducts the SIR at which the PDCH would be received if it was transmitted on the downlink. Based on this information it starts transmission on the uplink a slot earlier than normal and sends only pilot and TPC information in the first slot. This helps the downlink to converge faster.

When some UE supports PWPC and other UE doesn't support it, the BTS with PWPC can penetrate easily and only the former UE can have the advantages. When a BTS doesn't support PWPC, both UEs have the same performance.

There are two types of compressed mode ; both uplink and downlink are in compressed mode synchronously or only downlink is in compressed mode. Both cases can introduce PWPC.

PWPC can applied with any methods in TS25.214.

2. Basic Concept of PWPC

The condition which I used are follows:
1)Common pilot will be accommodated.
2)There are 15 slots in 1 frame.
3)When compressed mode, data will be compressed in 7 slots from 15 slots.

There are three figures. Figure 1 is the scheme of the conventional method.
Figure 2 is the proposed scheme (PWPC) when uplink is also compressed mode and Figure 3 is PWPC when uplink is not compressed mode.
In these figures, "N" are slots in normal frame, "C" are compressed slots in compressed frame, "R" are slots in recovery frame, "P" is the extra slot and hatched boxes are idle slots in compressed frame.
Figure 1 shows an example of the conventional scheme on compressed mode. This example shows that when the recovery frame start, downlink signal is too small and uplink is too large. In this case, too bad quality for downlink and too many interference for the other uplink may occur.
Figure 2 shows PWPC with uplink compressed mode. This scheme has extra uplink which is indicated as "P" with gray colored box. When the last downlink transmission, UE calculates the power ratio of dedicated signal and common pilot signal (RDC). UE multiplies the value when it calculates SIR on the end of idle slot. The result of that indicates SIR of dedicated channel with previous power control. UE makes TPC by the value. UE transmits uplink signal before recovering frame. This signal have to have no information except TPC. Therefore, only DPCCH should be transmitted. This extra transmission can be used to make TPC in the first downlink signal. For conventional method, the first TPC in downlink has no meaning, but this method can realize the effectiveness of that. This method can reduce the convergent time for 1 slot. It leads that data slots doesn't include the very bad quality slot of the first re-transmission. It also reduces the interference for the other users by the first re-transmission.
Figure 3 shows PWPC with no uplink compressed mode. Mechanism of the method is the same as the figure 2. However, the last slot before recovery period has DPDCH.

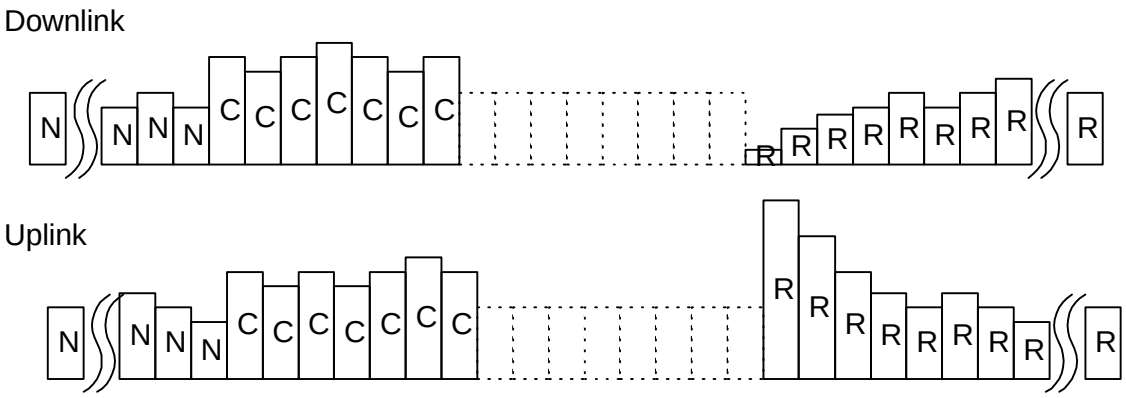

Figure 1 CONVENTIONAL SCHEME

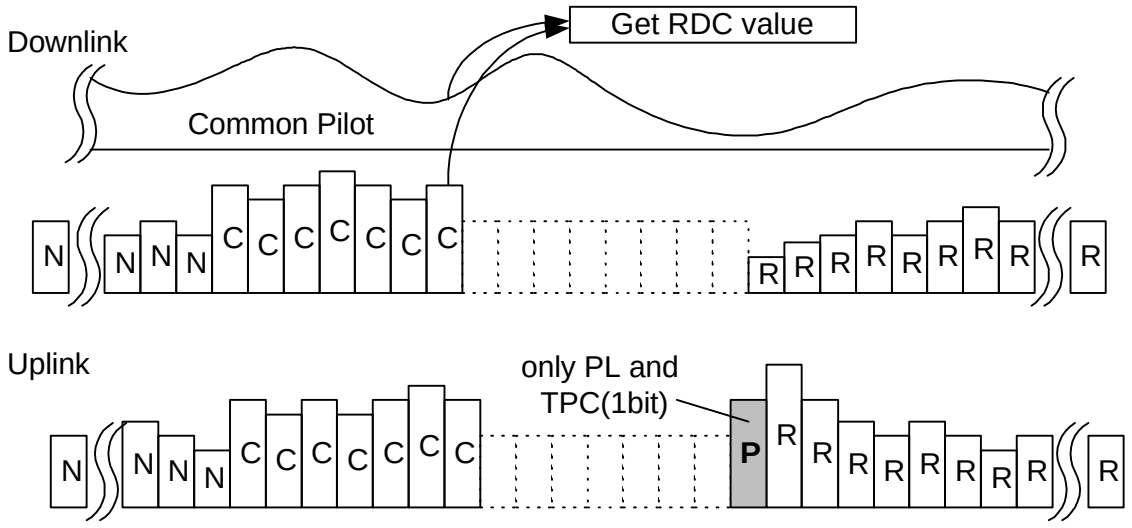

Figure 2 PROPOSED SCHEME (PWPC)

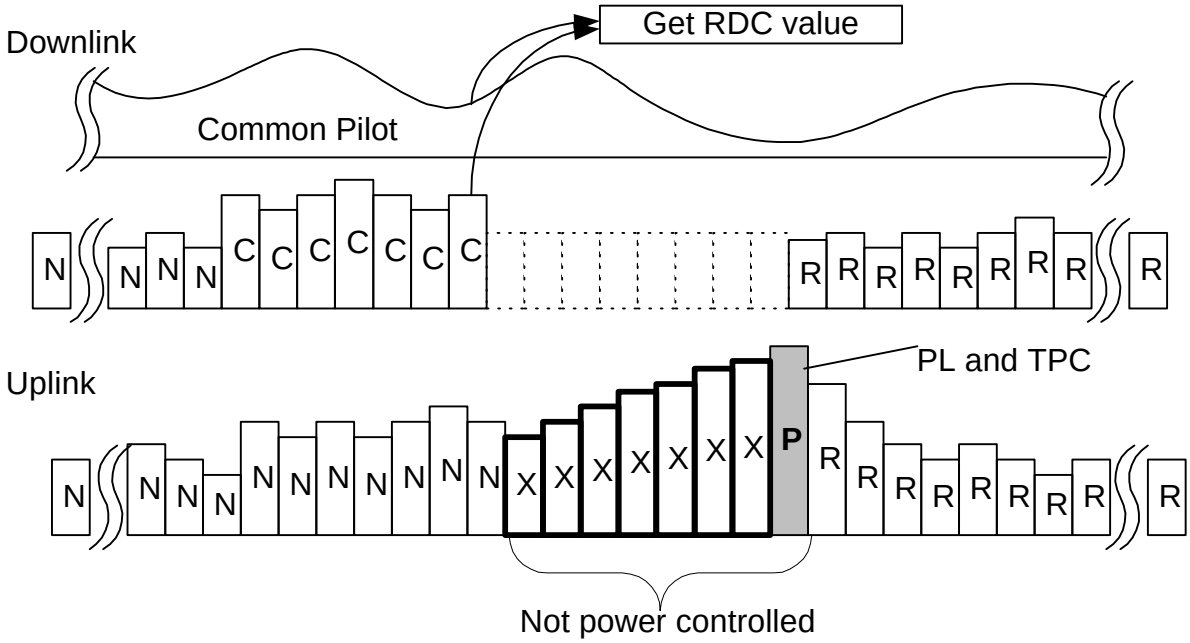

Figure 3 SCHEME OF PWPC WITHOUT UPLINK COMPRESSED MODE

3. Simulation Results

Figure 4..13 shows the result of simulation. Performance of PWPC is better than that of conventional method. When Doppler frequency is very low, the difference is not so much. It is because during idle period, channel is not so much changed. On the other hand, when Doppler frequency is very high, the difference is not so much either. It is because, when Doppler frequency is very high, power control itself has no effect. Simulation parameters are shown in Table 1.

These figures show that when PWPC is introduced, especially on middle Doppler frequency, Eb/No gain can be observed.

In this simulation, we didn't use weighting channel estimation which uses pilot symbols of several slots. The effect of this is equal for both conventional method and PWPC except the advantage of the extra slot. The last slot before idle period and the first slot of recovering frame cannot use weighting channel estimation. Pilot symbol of the extra slot helps the later. Therefore, the improvement of PWPC on uplink will be better than these results by the advantage of the extra slot

Table 1 Simulation Parameters

Item	Parameter	Item	Parameter
Slots/Frame	15	Chip Rate	3.84Mcps
Spreading Factor	128	Delay of Power Control	1 Slot
FEC	1/3,K=9 Conv. Code	Channel Estimation	Single Slot Estimation
Compressed Frame	Every 5 Frames	Total Frames	20000
Power Control Step Size	Always 1dB	Multipath Propagation	Pedestrian A

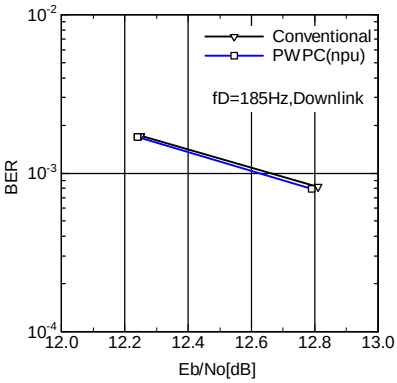

Figure 4 fD=185Hz(DL)

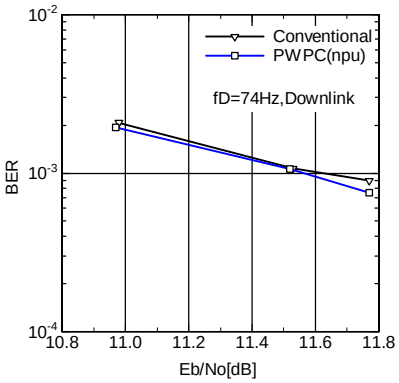

Figure 5 fD=74Hz(DL)

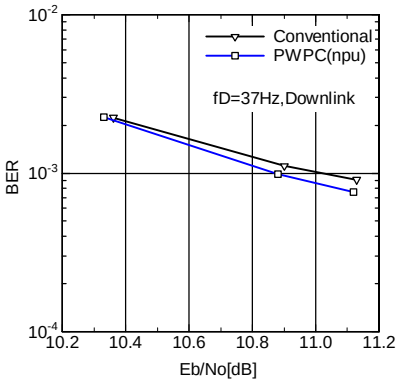

Figure 6 fD=37Hz(DL)

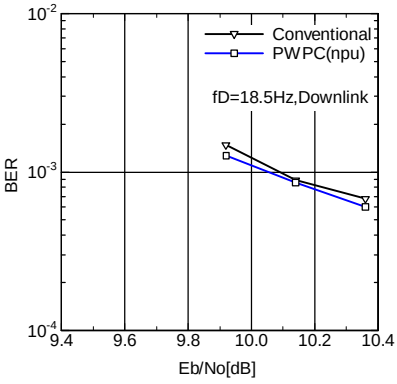

Figure 7 fD=18.5Hz(DL)

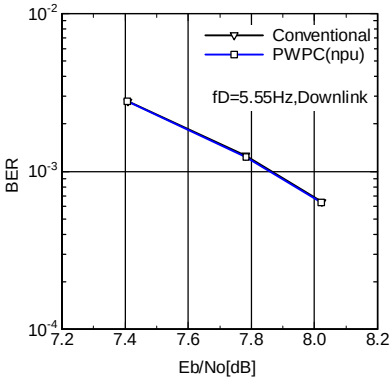

Figure 8 fD=5.55Hz(DL)

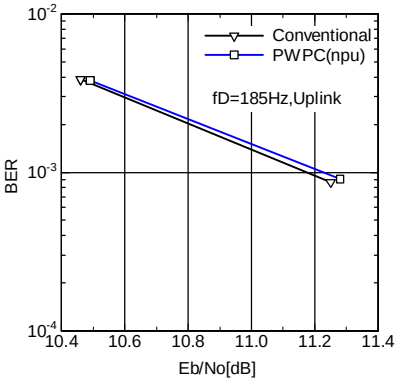

Figure 9 fD=185Hz(UL)

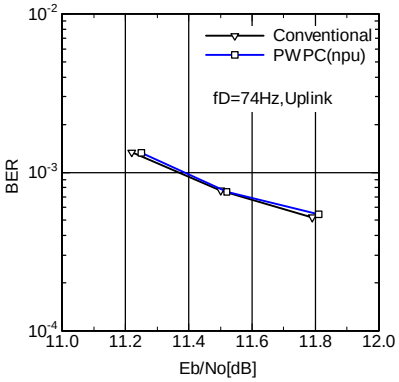

Figure 10 fD=74Hz(UL)

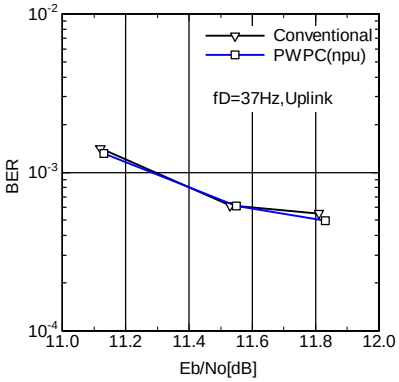

Figure 11 fD=37Hz(UL)

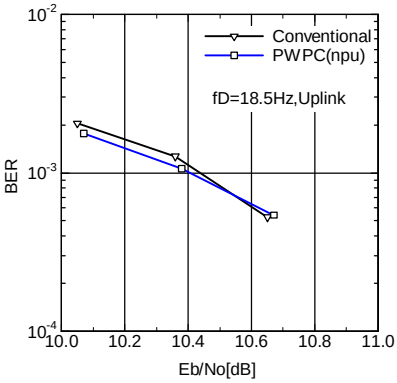

Figure 12 fD=18.5Hz(UL)

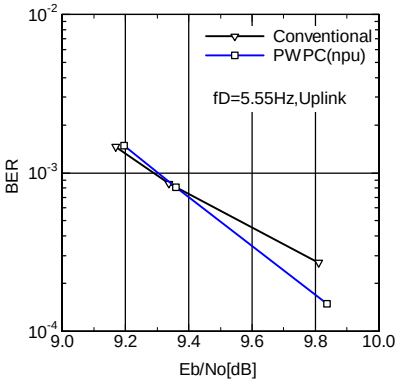

Figure 13 fD=5.55Hz(UL)

4. Four Cases of PWPC

There are many cases to introduce PWPC. UE can select to introduce PWPC or not and BTS can also select to do. The description for all ceses are following.

Case 1 : BTS supports PWPC (BTS_SP) and both Links are in Compressed Mode Simultaneously

This case, BTS supports PWPC and both links are in compressed mode simultaneously. However, some UE supports it and the other doesn't support it. We call the UE which supports PWPC as UE_SP and call UE which doesn't support PWPC as UE_NP. BTS_SP can know which UE is UE_SP and which UE is UE_NP by monitor the extra slot. When the SIR of the extra slot is enough, BTS_SP assumes that the UE is UE_SP. It is easy for BTS_SP and it leads more advantage. UE_SP also can select to use PWPC only when the condition on which PWPC has gain.

Case 2 : BTS doesn't support PWPC (BTS_NP) and both Links are in Compressed Mode Simultaneously

This case, BTS doesn't support PWPC and both links are in compressed mode simultaneously. BTS_NP doesn't have the function to receive extra slot. Therefore, it can not know which UE is UE_SP and which UE is UE_NP. Since BTS_NP only ignore the extra slot, when BTS_NP works as usual, both UE_NP and UE_SP are incurred no damage.

Case 3 : BTS supports PWPC (BTS_SP) and only Downlink is in Compressed Mode

This case, BTS supports PWPC and only downlink is in compressed mode. In this case, BTS_SP cannot know which UE is UE_SP by monitor the extra slot, because both UE_SP and UE_NP continue to transmit. In this case, one mandatory signaling is required. Since there are no downlink dedicated signal exists, during downlink compressed mode, TPCs on uplink slots (TPC_US) have no meaning. Therefore,

these bits can be used for the signaling of PWPC supporting. When TPC_USs are 0 (decision by majority or combining can be used), BTS_SP assumes the UE as UE_NP and when TPC_USs are not all 1.

Case 4 : BTS doesn't support PWPC (BTS_SP) and only Downlink is in Compressed Mode

This case, BTS doesn't support PWPC only downlink is in compressed mode. BTS_NP doesn't have the function to decide that TPC_USs' indication. Therefore, it can not know which UE is UE_SP and which UE is UE_NP. Since BTS_NP only ignore the all TPC_USs include extra slot, when BTS_NP works as usual, both UE_NP and UE_SP are incurred no damage.

We assumed four cases and found that when only the signaling of TPS_US is mandatory, BTS and UE can select to introduce PWPC or not unrestrained.

5. Conclusion

We show that PWPC can improve Eb/No-BER performance. PWPC has many advantages but UE and BTS can select to introduce it unrestrained with only one signaling can be mandatory.

The mandatory signaling is ;

when only downlink is in idle period of compressed mode, TPCs on uplink slots of UE which doesn't support PWPC must be all 0 and that of UE which supports PWPC must be all 1.