TSG-RAN Working Group 1 meeting No. 9 *TSGR1#9(99)j67*
Dresden, Germany
November 30 - December 3, 1999

Agenda Item: **Ad hoc 17**
Source: **Samsung Electronics Co.**
Title: **Simulation Results of Burst Pilot for LCS**
Document for: **Discussion and Approve**

1. Introduction

Last 3GPP TSG RAN WG1 meeting #8, we proposed New Pilot Channel Structure for Location Services[1]. New pilot channel proposed in [1] is called 'Burst Pilot'.
Currently, there are three methods for Standard Location Services(LCS)[2], the first is Cell coverage methods, the second is OTDOA methods with network configurable idle periods, and the third is network Assisted GPS methods. Among these three methods, Burst Pilot is used for idle period downlink(IPDL) methods.
IPDL was proposed by Ericsson[3]. In IPDL, each node B will power-off the downlink for a specific time in order for UEs to easily detect other cell's Common pilot channel(CPICH). When the node B is not transmitting the downlink, the probability that UE can detect CPICH of the other cells increases. For more efficient LCS, time aligned IPDL (TA-IPDL) is proposed by Motorola[4]. In [4], it is proposed that the idle period from each node B is aligned and several ways for the time alignment are suggested.
Even with the IPDL, the received energy by UE from the neighbour cell can be weak to be easily detected. A report on coverage availability of pilot signal for location services is presented [5]. The report says that for large coverage area at least one other pilot except serving cell is available at UE's location by searching the neighbouring cell's CPICH. However, this report has the basic assumption that UE integrates the input signal for a long time period to search a neighbouring cell because the power of CPICH is not enough for LCS purpose. In consideration of this, the UE's complexity can be increased and the frequency of idle period can also be increased.
Therefore, we proposed the combination of Burst Pilot with IPDL for more efficient LCS.
In this document, we briefly explain the concept of Burst Pilot and show simulation results of IPDL with burst pilot.

2. Structure of Burst Pilot

2.1 Channel Structure A of Burst Pilot

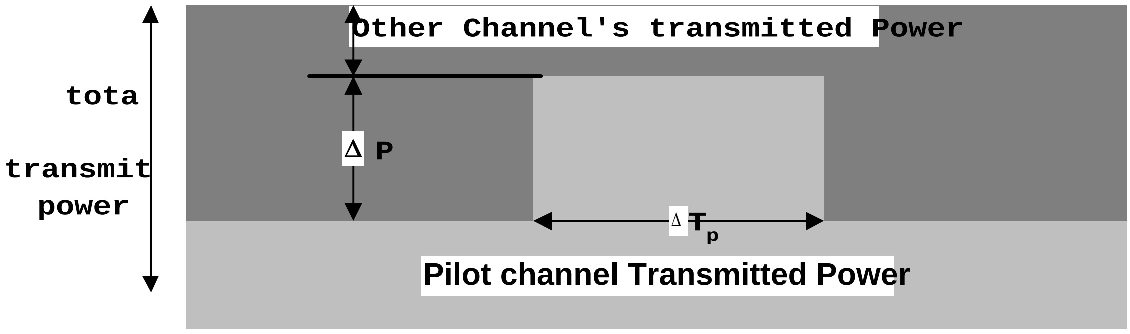

Figure 1. Channel structure A of Burst Pilot

Figure 1 shows the structure of Burst Pilot. UTRAN increases the pilot channel power by ΔP (dB) at a predetermined time interval T_P, where ΔP and T_P can be system parameters. UE knows the instance of the T_P time period and searches the neighbour cells by despreading the input signal received during the predetermined time period. If UE performs search with the input signal received at the T_P, the integration time for each decreased by $1/10^{\Delta P/10}$.

Another advantage of this scheme is the coherent combining gain.

For example, the normal power of CPICH is 10% of total UTRAN's TX power. If the value of ΔP can be 10 dB, then the power of pilot becomes 100% of total UTRAN's TX power during the T_P time period. Therefore, other channels are not transmitted and this is the normal TA-IPDL with Burst Pilot. In this case, UE can decrease the integration time of searcher by 1/10 for the same or better detection performance.

If operator wants to transmit some other channels like PICH and S-CCPCH during idle period, we can choose the ratio of CPICH and other channels by decreasing ΔP. Even in this case, we can maintain the accuracy because CPICH has relatively high power.

2.2 Channel structure B of Burst Pilot

There may be some different ways of increasing the pilot channel's power. As shown in Figure 1, UTRAN can increase the existing CPICH's power during the time period T_P. But, this can impact the receiver operation of UE in channel estimation, frequency estimation and searcher operation. Therefore, the different channelization code C_P may used as shown in Figure 2. The code C_P is orthogonal to the forward link channels. In figure 2, the power of CPICH is constant and the pilot power is increased by transmitting a code channel C_P at the T_P period. UE searches the neighbour cells by despreading the input signal received during the time period T_P. UE can combine the signal of CPICH and that of the channel with C_P code.

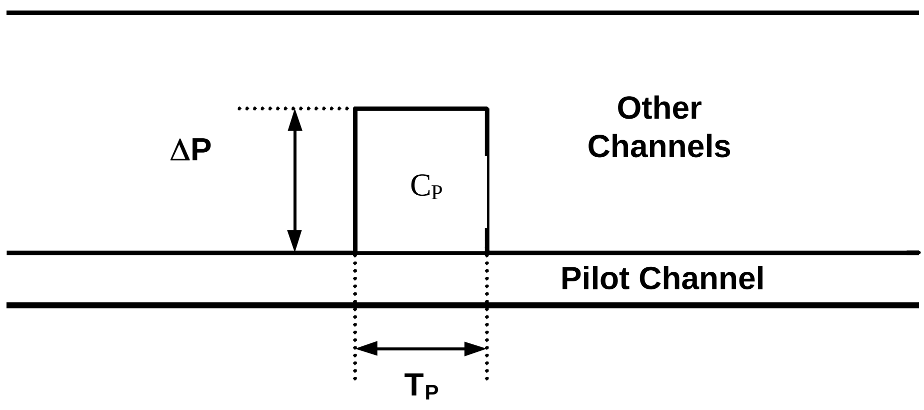

Figure 2 Channel Structure B of Burst Pilot

3. Network Simulator

Network simulator used in this document includes the common network simulator, general assumptions and methodology introduced in [4],[6], [7].

Parameters for common simulation are shown in Table 1. Since the ideal sectored antenna is assumed, the antenna gain equals the unity for the range of 120 degree around the direction of main beam and zero for the other directions. Cable losses, the internal loss of Low Noise Amplifier and body losses are ignored.

Because the sampling rate is 8 times of the chip rate, the resolution distance of the sampling time is 9.8 meter, speed of light times T_s. The output of ADC (Analog to Digital Converter) after sampling is 4 bits. The noise floor is assumed to be –118 dBm.

Frequency of Idle Periods	10 Hz
Number of Idle Periods	10
Channel Model	T1P1.5 Models in reference [3]
BTS separation: Urban, Suburban, Rural	1 km, 3 km, 20 km
Pathloss Model	$b + a \times 10 \times log_{10}$(range in meters)
Urban:	a = 3.52; b = 29.03
Suburban:	a = 3.48; b = 22.2
Rural:	a = 3.41; b = 0.34
Signal Used in Simulation	Common Pilot
Chip Rate	3.84 Mchips/sec
Sampling Rate	8 x Chip Rate
Integration Time	512 chips
Idle Period Length	5 x 256 chips
Sampling resolution	4 bits/sample
Vehicle Speed	50 km/hour

Transmit Power of BS	43 dBm (20W)
Transmit Power of Common Pilot	33 dBm (2W)
Noise Floor	-118 dBm
Standard Deviation of Slow Fading	8 dB
The number of Sectors in a Cell	3

Table 1. Parameters for Common Simulation

4. Simulation Results

The results for TA-IPDL with burst Pilot are shown in Figure 3. The advantages of the Burst Pilot are to overcome the noise floor and to extend the coverage over the cell site.
. The results for UrbanA and UrbanB as shown in Figure 3 come out when the pilot power of the sector 0 remains at 10 % power and the pilot powers of neighboring base stations increase from 0 dB (10 %) to 10 dB (100%). We can see the TA-IPDL with Burst pilot has better performance than that of normal TA-IPDL(0dB).
In case of bad urban, this difference will become larger.

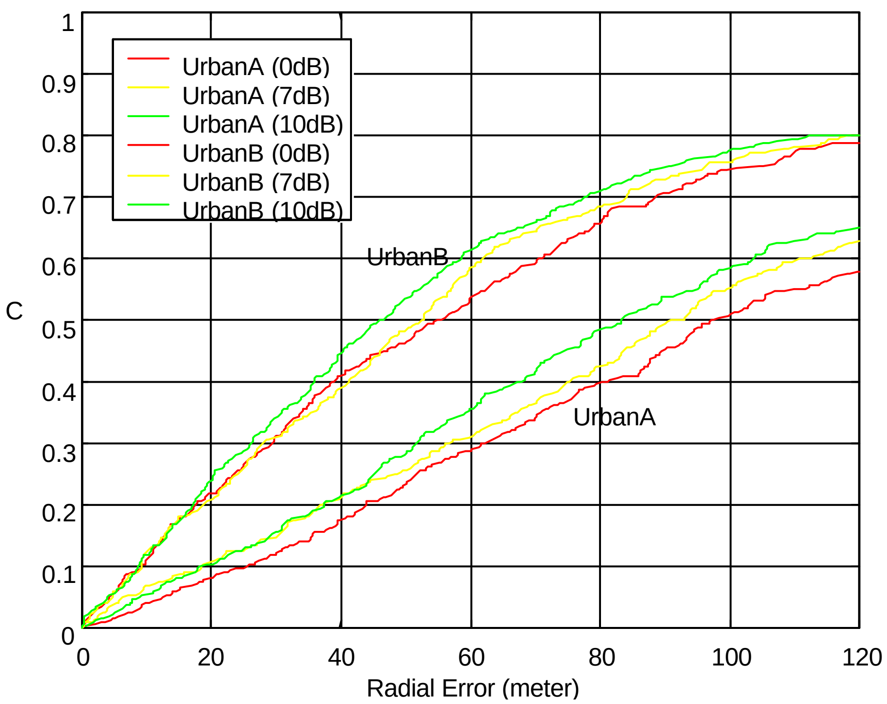

Figure 3. CDF of the radial error for UrbanA and UrbanB

5. Conclusion

In this paper, a Burst pilot channel structure is proposed for LCS and the simulation results of TA-IPDL with burst pilot is submitted. As we look the simulation result of this paper, we evidently know that to use Burst pilot is beneficial to LCS. In addition to performance improvement, we can get some benefits of Burst Pilot as follows.

- Performance of TA-IPDL with Burst Pilot is much better than that of IPDL.
- Coverage area of a cell can be increased.
- Less process is required at UE for the same location performance. That is, UE's complexity for LCS can be minimised, because the idle period can be shorter and the frequency of the idle period can be decreased.
- It is possible that UTRAN can flexibly allocate the pilot power for LCS and normal operation.
- In consideration of UE's receiver, TA-IPDL with Burst Pilot has little impact on AGC than other methods(IPDL, TA-IPDL and so on), because the power received at the UE is constant.

References.

[1] TSGR1#8(99)f51, Pilot Channel structure for location services, Samsung Electronics Co.
[2] TSGR2#7 (99)c60 ,Draft stage 2 specification for UTRAN location services(LCS) 25.923 v.1.4.0
[3] Tdoc SMG2 UMTS-L1 327/98, Method for downlink positioning (IP-DL), Ericsson
[4] TSGR1#7(99)b79, Time-Aligned IP-DL positioning technique, Motorola
[5] TSGR1#7(99)c36, Pilot signal coverage for Location Services (LCS), Nortel Networks
[6] TSGR1#4(99)346, Recapitulation of the IPDL method, Ericsson
[7] T1P1.5/98-110r1, Evaluation of Positioning Measurement System, Ericsson

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