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Agenda Item: **Ad hoc 17**

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Title: **Pilot Channel Structure for Location Services**

Document for: **Discussion**

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1. Introduction

Location Service (LCS) is an important feature of the IMT-2000 system. Several Schemes are proposed for the network based Location Service.
A report on coverage availabilty of pilot signal for location services is presented [1]. 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 neighbour cell's Common Pilot channel (CPICH). The basic assumption of this report is 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. But, some concerns on the UE's complexity are raised. In this paper, we propose a new pilot channel structure for LCS to decrease the complexity of UE and increase the coverage area of CPICH. In the proposed pilot structure, UTRAN increases the pilot channel power for a specific time period.
Ericsson proposed idle period downlink (IPDL) [2]. In IPDL, each node B will power-down the downlink for a specific time amount. When the node B is not transmitting the downlink, the probability that an UE can detect the other cells increases. For more efficient LCS, time aligned IPDL is proposed [3]. In [3], 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 IDPL, the received energy from the neighbour cell can be week to be easily detected. This can increase the frequency of idle period and the complexity of UE. Therefore, we also propose a combination of proposed pilot structure with IPDL for more efficient LCS.

2. Proposed Pilot Channel Structure

2.1 Pilot Channel Structure

In this paper, a new pilot channel structure is proposed for LCS. Figure 1 shows the proposed pilot channel structure. UTRAN increases the pilot channel power by ΔP (dB) at a predetermined time interval T_P, where P and T can be system parameters. UE

knows the location 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 4% of total UTRAN's TX power and the value of ΔP can be 10 dB. Then, the power of pilot becomes 40% of total UTRAN's TX power during the T_P time period. So, UE can decrease the integration time of searcher by 1/10 for the same or better detection performance.

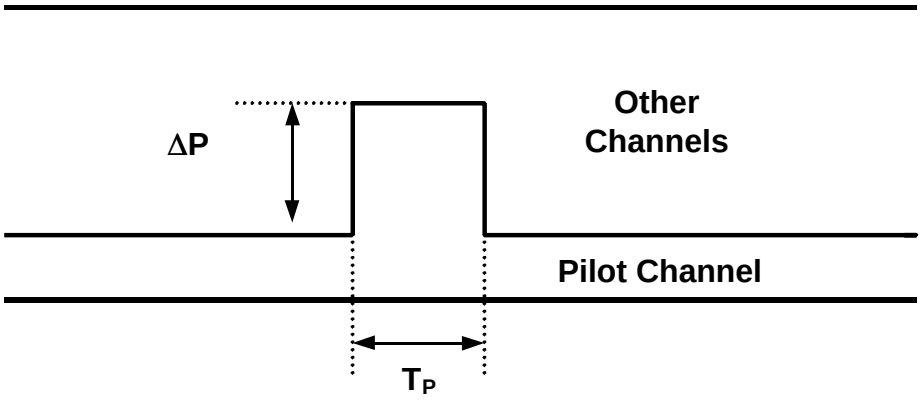

Figure 1 Proposed Pilot Channel Structure 1

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, we propose to increase the pilot power using a different channelization code C_P 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.

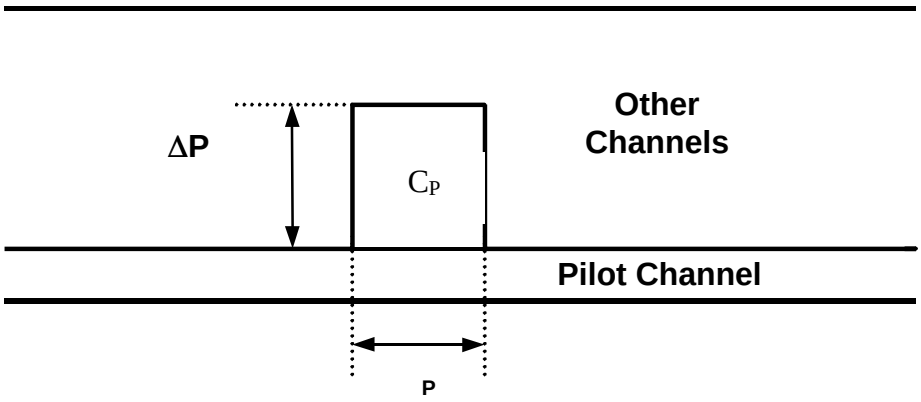

Figure 2 Proposed Pilot Channel Structure 2

2.2 Synchronised Operation of Proposed Pilot Channel

With IPDL, the probability that an UE can detect other cells is increased. For more efficient LCS, IPDL can be operated synchronously [3]. The main idea of synchronised operation of IPDL is that the idle periods of several node B's are aligned for better LCS.

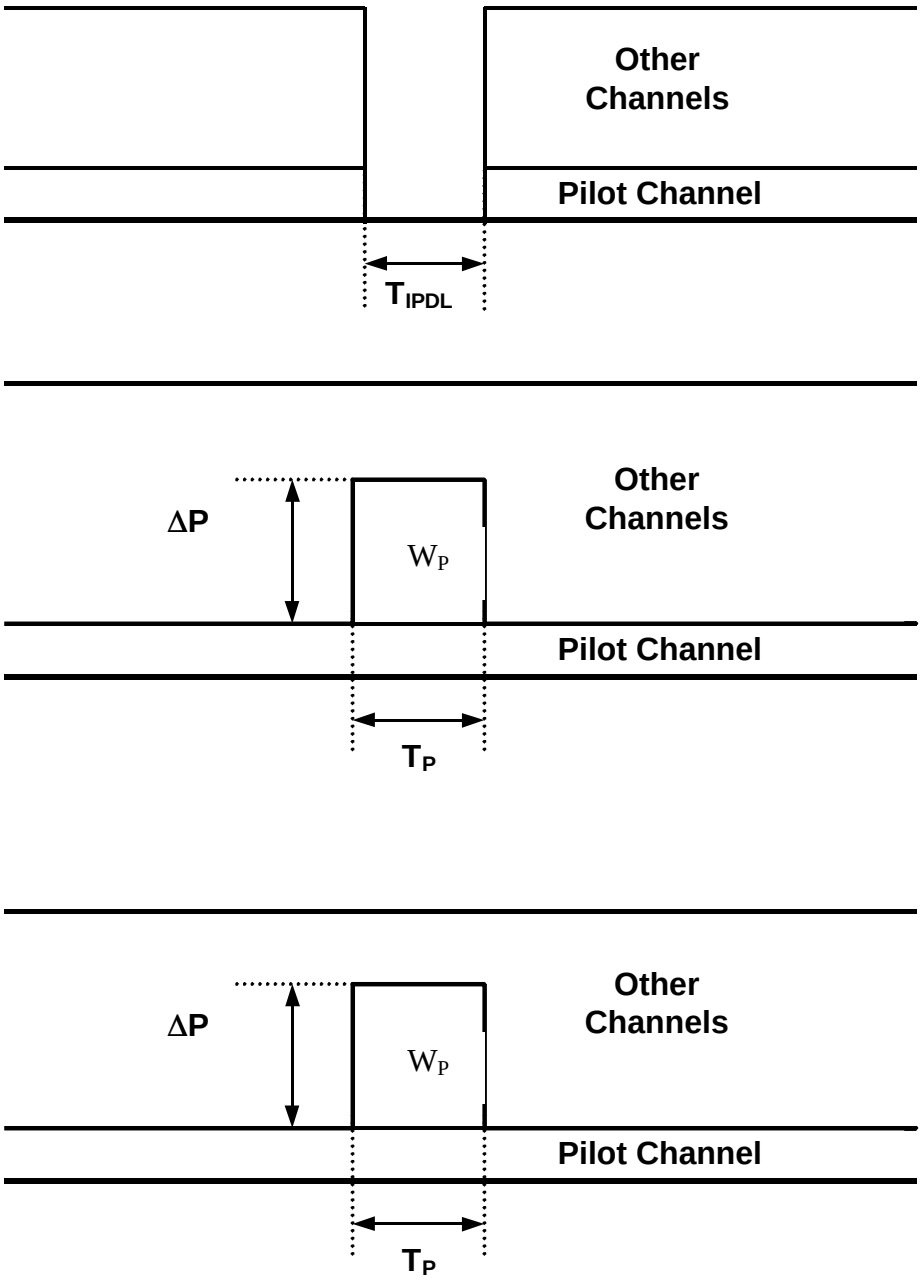

Figure 3 Burst Pilot with IPDL

Even with IPDL, UE's can have some problems in detecting signals from other cells. This is due to the fact that pilot channel power is only a few percent of total UTRAN's transmission power. The low power CPICH can also increase the complexity of UE receiver. Therefore, higher power CPICH is needed for more efficient LCS. But, high power CPICH can decrease the capacity of downlink.
In this paper, we also propose pilot channel synchronised with IPDL as shown in Figure 3. As synchronised IPDL, the timing among neighbouring UTRAN's are assumed to be synchronised. During an idle period of an UTRAN, the neighbouring UTRAN's increase the power of CPICH. UE can use the pilot with increased power level for the LCS. With the proposed scheme, the idle period can be shorter and the frequency of idle period can be decreased.

3. Advantage of Proposed Pilot channel Structure

Some of the benefits of proposed pilot channel structure can be summarised as follows.

- 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.
- 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.

4. Conclusion

In this paper, a new pilot channel structure is proposed for LCS. UTAN increase the power of pilot channel for a predetermined time interval and UE acquires neighbour cells using the input signal received at the time interval. This scheme can also be used with IPDL to enhance the performance of LCS. With proposed pilot channel structure, the complexity of UE can be minimised, the idle period for LSC can be shorter and the frequency of the idle period can be decreased.

References.

[1] TSGR1#7(99)c36, Pilot signal coverage for Location Services (LCS), Nortel Networks

[2] Tdoc SMG2 UMTS-L1 327/98, Method for downlink positioning (IP-DL), Ericsson

[3] TSGR1#7(99)b79, Time-Aligned IP-DL positioning technique, Motorola

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