TSG-RAN Working Group 1 meeting #7
Hannover, Germany
August 30-September 3, 1999

TSGR1#7(99)b25

Agenda item:

Source: Ericsson

Title: Path delay measurement

Document for: Approval

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1 Introduction

For simple positioning applications it may be suitable to use an estimation of the distance between a certain Node B and an UE. If the distance from several Node B's are estimated a more accurate positioning of the UE can be made. This paper proposes two measurements that are needed to calculate the path delay from a Node B to a UE. From the path delay the distance can easily be estimated.

2 Measuring the path delay

The method to estimate the path delay to the UE described below can only be used in connected mode. To estimate the path delay between a Node B and a UE, the time between the Node B transmission of a downlink DPCH frame and the reception in Node B of the corresponding uplink DPCCH/DPDCH frame has to be measured, see RTD in figure 1. Also internally in the UE there is a delay between the reception of a downlink DPCH frame and the transmission of the next uplink DPCCH/DPDCH frame, see T_{RxTx} in figure 1. This UE internal delay is only known by the UE.

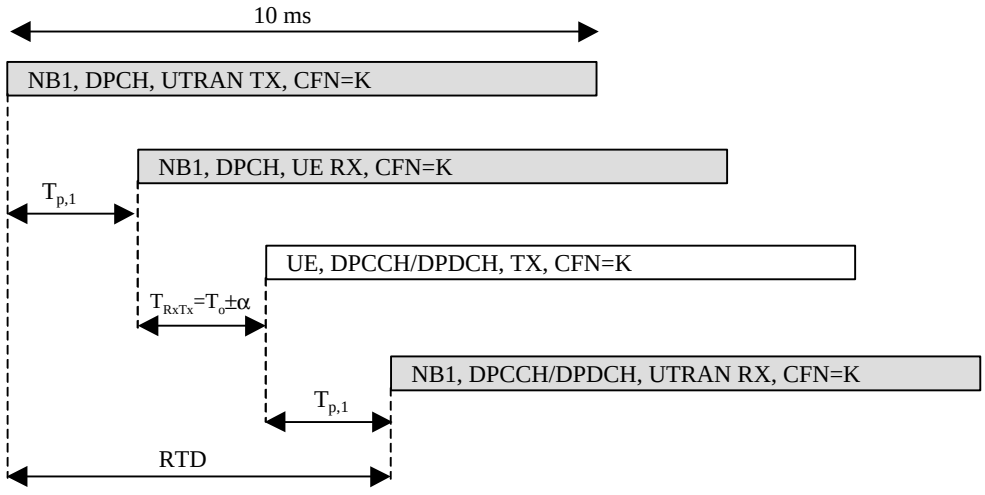

Figure 1 Path delay measurements

The parameters in figure 1 are explained below:

NB1: Node B no. 1

CFN: Connection Frame Number

$T_{p,1}$: Propagation delay between NB1 and the UE.

RTD: Round Trip Delay, is defined as the difference between:
The time of the uplink reception of the beginning of a DPCCH/DPDCH frame (first significant path of the path delay profile averaged over approx. [1 frame]) from the UE
and
The time of transmission of the beginning of the corresponding downlink DPCH frame to a UE.
RTD is given in chip units with the range 0 to 4095 chips.

T_o: A constant timing offset between the first received DPCH frame in the UE and the following uplink DPCCH/DPDCH frame. T_o is used to set up the transmission frame timing in the UE and given in number of chips.

T_{RxTx}: The time between reception in the UE of the first significant path, of the path delay profile averaged over approx. [1 frame], of the beginning of a downlink DPCH frame from NB1 unil the start of transmission of the corresponding uplink DPCCH/DPDCH frame. T_{RxTx} is always positive, given in chip units and has a range of 0 to 2047 chips.

The path delay $T_{p,1}$ can then be estimated as:

$\mathbf{T_{p,1}} = (RTD - T_{RxTx})/2$

From the path delay the distance can easily be calculated.

When measuring RTD from several Node B's to a UE it is required that RTD measured in all Node B's and the T_{RxTx} measured in the UE is measured at that same Connection Frame Number (CFN).

The Node B round trip delay (RTD) measurement can also be used to estimate how large margin there is to handle the 1 slot delay required in the inner loop power control.

3 Proposal

It is proposed that the UTRAN shall be able to measure RTD defined in section 2. The UE shall be able to measure T_{RxTx} as defined in section 2. Text proposals for the measurements are found in section 4.

4 Text Proposal for TS 25.231

8 Radio link measurements

8.1 UE measurement abilities

8.1.6 UE RxTx timing

Definition	The difference in time between the UE uplink DPCCH/DPDCH frame transmission and the first significant path, of the path delay profile averaged over approx. [1 frame], of the downlink DPCH frame from the measured radio link. Measurement shall be made for each cell included in the active set.
Purpose	Estimation of the path delay and the distance between and UTRAN access point and the UE.
Filtering	TBD.
Range/mapping	Always positive, given in chip units with the range 0 to 2047 chips.

Physical channel(s) where the measurement shall be possible.	Idle mode/Connected mode (I/C)	
	Intra-frequency	Inter-frequency
DPCH.	C	N.A.

8.2 UTRAN measurement abilities

8.2.6 Round Trip Delay (RTD)

Definition	Round Trip Delay (RTD), is defined as RTD = $T_{RX} - T_{TX}$, where T_{TX} = The time of transmission of the beginning of a downlink DPCH frame to a UE. T_{RX} = The time of reception of the beginning of the corresponding uplink DPCCH/DPDCH frame (first significant path of the path delay profile averaged over approximately [1 frame]) from the UE.
Purpose	Estimation of the path delay and the distance between a UTRAN access point and the UE.
Filtering	TBD.
Range/mapping	Given in chip units with the range 0 to 4095 chips.

Physical channel(s) where the measurement shall be possible.
DPCH for each RL transmitted from an UTRAN access point and DPDCH/DPCCH for each RL received in an UTRAN access point.

5 References

[1] TS 25.302 v2.4.0 Services provided by the Physical Layer