TSG-RAN Working Group1 meeting #4 **_TSGR1#4(99)354_**
Shin-Yokohama, Japan 18-20, April 1999

Agenda Item:

Source: **Panasonic**

Title: **Performance Analysis of TSTD scheme for SCH**

Document for: **Discussion**

Reference:

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1. Introduction

At the Ad Hoc 6 (Transmit diversity), the application of Tx diversity on different downlink physical channels has been discussed. We have proposed the introduction of TSTD(Time Switched Transmit Diversity) scheme for SCH combined with STTD encoding for PCCPCH (Perch channel)[1]. It is required to clarify the performance benefits if TSTD is to be used on SCH. In this document, we show the performance evaluation results of our proposed scheme.

Reference:
[1] Panasonic, "TSTD(Time Switched Transmit Diversity) scheme for SCH", Tdoc 152/99 3GPP RAN WG1, 22-26th, March 1999, Eskilstuna, Sweden

2. Proposal

Table 1 shown below was proposed on the document [1]. At this document, we proposed two schemes of multiplexing of SCH and PCCPCH (Proposal 1 and Proposal 2). But, on the discussion of SCH at Ad Hoc 12, the use of coherent detection at the second step of cell search processing was pointed out. Proposal 2 has a certain benefit from PA complexity of base station point of view. But this scheme has clearly some hardware impacts to mobile station. Therefore, we focused on only the Proposal 1 scheme and evaluated the performance improvement by it.

Nomenclature	Tx-diversity scheme
Primary SCH	TSTD
Secondary SCH	TSTD
Data symbols of PCCPCH (N_{data} = 5 symbols)	STTD
SCCPCH (N_{data} = 36 symbols)	STTD
DPCH channels	STTD/ FB mode

Table 1: Proposed Tx-diversity for different physical channels

As a first proposal (Proposal 1), Primary SCH (P-SCH) and Secondary SCH (S-SCH) are transmitted from same antenna. The total transmission power of both P-SCH and S-SCH is assumed to set higher than that of PCCPCH.

Figure 1 and Figure 2 show the current structure of SCH and PCCPCH (fixed antenna for SCH) and the proposed structure of SCH and PCCPCH (Proposal 1), respectively.

Figure 1 Structure of SCH and PCCPCH (the current scheme)

Figure 2 Structure of SCH and PCCPCH (the proposed scheme : Proposal 1)

3. Simulation parameter

The simulation parameters are as follows. In this analysis, only the performance of first step on cell search was evaluated.

Table2 Simulation parameter

Chip rate			4.096Mcpc
Symbol rate			16ksps
Spreading	Scrambling code		40960chips / 10ms part of Gold code
	TCH	Spreading code	Orthogonal code sequence
	CCH	Primary SCH	16*16 hierarchical sequence
		Secondary SCH	256 chips Hadamard sequence scrambled by P-SCH
Modulation		Data	QPSK
		Spreading	QPSK
Frame format			Random data, 160symbols / 10ms
Slot structure		PCCPCH	DATA:5 PL:4
		DPCH	Random data (no FEC)
Number of DPCH			0, 20, 40 ch/cell (C[*1]/PG=0, 7.8, 15.6%, without PC)
Number of scrambling code			128 •i 32Group*4codes•j
Cell structure			19 hexagonal cells (cell radius = 2km:Fig.3)
Propagation model	Path loss exponent		3.8
	Shadowing		Log-normal, standard deviation=10dB
	Multi-path fading		6 path Rayleigh (Vehicular A)
	Maximum Doppler freq.		5.5 , 64,222Hz
Averaging number at first step			1 frame (16 slots)
Target channel power			Within –3dB of max power channel
Power of ratio of P-SCH/DPCH			3dB
Power of ratio of S-SCH/DPCH			0dB
Power of ratio of CCH/DPCH			0dB
Over sampling frequency			16.384MHz

*1:the number of dedicated physical channels

The simulation assumed the 19 hexagonal cell layout shown Fig. 3. A cell site is located at center of each cell. We generated a random location of the test MS at a cell edge. This simulation condition was tight because of the weaker desired signal power and larger other-cell interference.

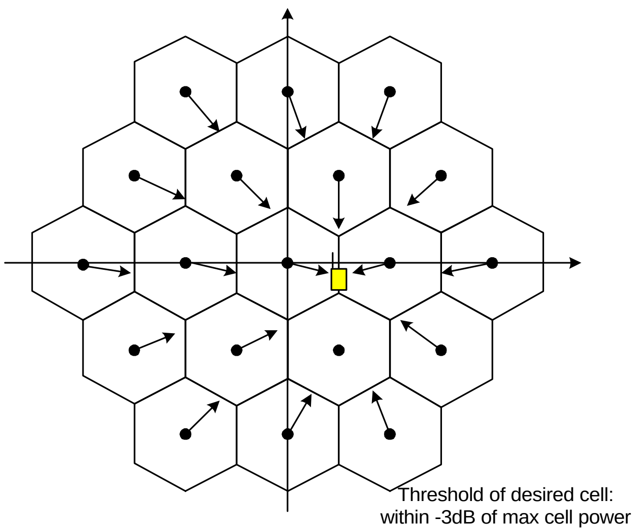

Figure 3 cell layout (cell radius = 2km)

During the cell search process, only the instantaneous received signals from all cell sites vary according to Rayleigh fading, the path losses remain constant. If the scrambling code belonging to one of the cell sites having the local average signal power within 3dB from the maximum value is searched, then cell search is declared to be successful. When the MS is connected to the other cell site, cell search is declared to have failed , then, the retrial was not implemented in this simulation. The number of independent trials is 400 times.

We denote equation for the cumulative probability of cell search time at 90%

$$1-(1-p)^{k} \geq 0.9 \quad \textbf{(1)}$$

$$k \geq -1/\log 10(1-p) \quad \textbf{(2)}$$

Then, p is the probability of acquisition for slot and chip synchronization at one trial, k is trial number. We assume cell search time required at the first step is 15ms.

$$T_{search} = -15/\log 10(1-p) \quad \textbf{(3)}$$

We can obtain cell search time at 90% by equation of (3) .

The median value of local average signal energy per bit-to-background noise ratio(E_b/N_0) in the sum of six path received power on each DPCH was set to 4, 8 and 12dB at the cell edge shown Fig.4 (note that $E_b/(N_0+I_0)$< 4,8 and 12dB respectively, where I_0 is the interference power spectrum density due to interference from own cell and other-cells). Figure 5 shows simulation model.

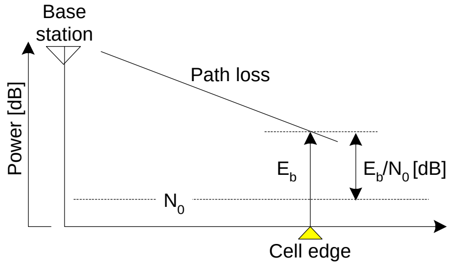

Figure 4 Definition of Averaging E_b/N_0

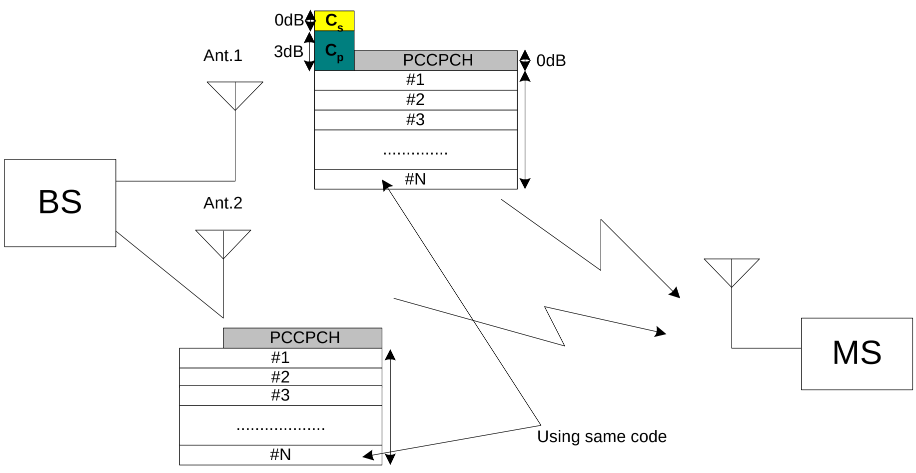

Figure 5 Simulation model

3. Simulation results

The simulation results of first step on cell search are shown in Figure 6 and Figure 7 (parameter is E_b/N_0 or C/PG). We can clearly understand that the introduction of TSTD scheme for SCH can significantly shorten the search time more than the current Fixed antenna scheme at low maximum Doppler frequency f_D . This is because TSTD scheme is more effective on transmit diversity gain at low f_D.

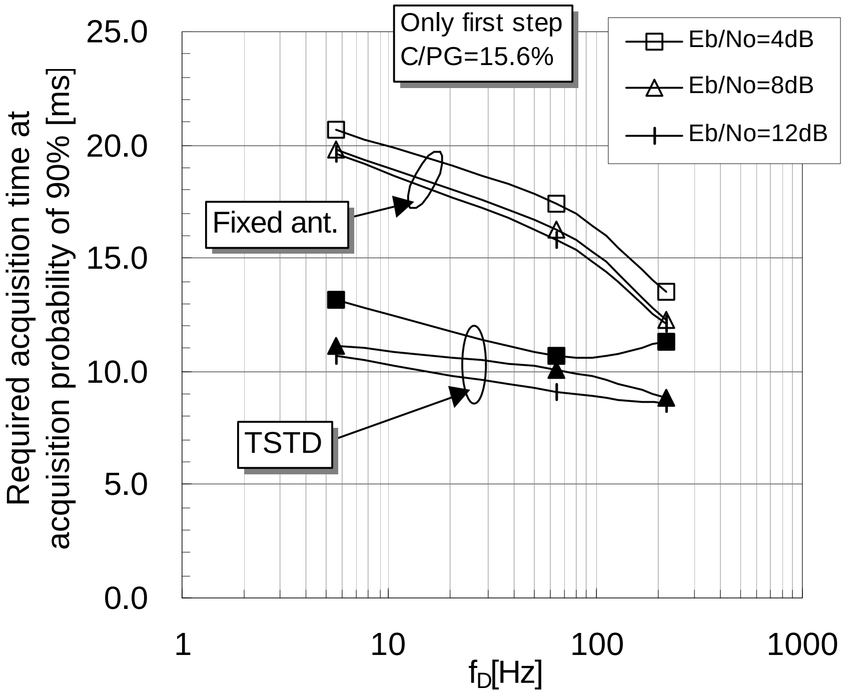

Figure 6 Effect of TSTD scheme for SCH (parameter is E_b/N_0)

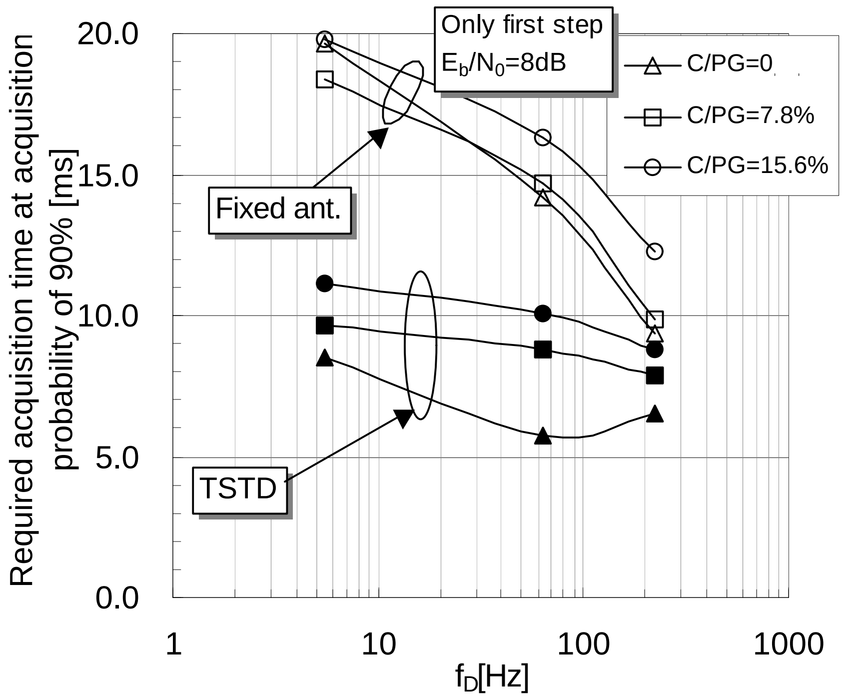

Figure 7 Effect of TSTD scheme for SCH (parameter is C/PG)

4. Conclusion

We propose to employ TSTD schemes for SCH as Primary SCH and Secondary SCH are transmitted from same antenna. The cell search time was evaluated by computer simulation. It was demonstrated that the performance of cell search could be improved than that of the current scheme at the first step. It is easy to consider that the second step can be also improved by our proposed scheme.

The merits achieved by our proposed schemes are summarised as follows.

(1) Possible to reduce the interference to other channels (due to the decrease of SCH transmission power)
(2) No impact to the mobile station