

Agenda Item: AdHoc 1 + AdHoc 6

Source: Panasonic

Performance Analysis of TSTD scheme for SCH in TDD mode

1. Introduction

At WG1 #4, the application of TSTD(Time Switched Transmit Diversity) scheme of SCH in FDD^{[1][2]} was approved. This document shows performance for TDD.

2. Proposal and Simulation Parameters

Figure 1 shows the proposed transmission scheme of SCH. In case 2 and case 3, CP and CS are transmitted antenna 1 and antenna 2 alternatively. Table 1 is simulation parameters. In this analysis, only the performance of first step on cell search was evaluated.

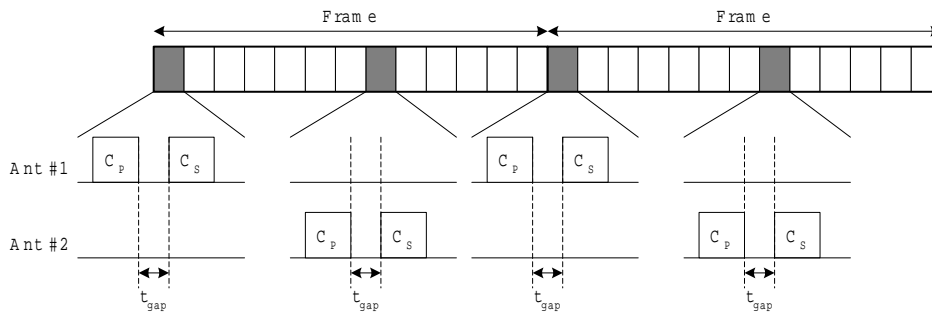


Figure 1 Proposed transmit scheme of SCH (case 2 and case 3)

Table2 Simulation parameter (not changed to 3.84Mcps)

Chip rate		4.096Mcps			
Scrambling code		16 chips			
Spreading code	CCPCH	OVSF			
	PSCH	<table border="0"> <tr> <td>C_P</td> <td>16*16 hierarchical sequence</td> </tr> <tr> <td>C_S</td> <td>256 chips Hadamard sequence scrambled by C_P</td> </tr> </table>	C _P	16*16 hierarchical sequence	C _S
C _P	16*16 hierarchical sequence				
C _S	256 chips Hadamard sequence scrambled by C _P				
Burst Type		Burst type 1			
Number of CCPCH		2 ch/cell (without PC)			
Number of scrambling code		128 (32Group*4codes)			
Cell structure		19 hexagonal cells (cell radius = 2km:Fig.2)			
Propagation model	Path loss exponent	3.8			
	Shadowing	Log-normal, standard deviation=10dB			
	Multi-path fading	6 path Rayleigh (Vehicular A)			
	Max. Doppler freq.	5.5, 64, 222Hz			
Averaging number at first step		2 frame (4 PSCH slots)			
Target channel power		Within -3dB of max power channel			
Power of ratio of C _P /CCPCH		3dB			
Power of ratio of C _S /CCPCH		3dB			
Sampling frequency at UE		16.384MHz			

The simulation assumed the 19 hexagonal cell layout shown Fig. 2. A cell site is located at center of each cell. We generated a random location of the test UE at a cell edge. This simulation condition was tight because of the weaker desired signal power and larger other-cell interference.

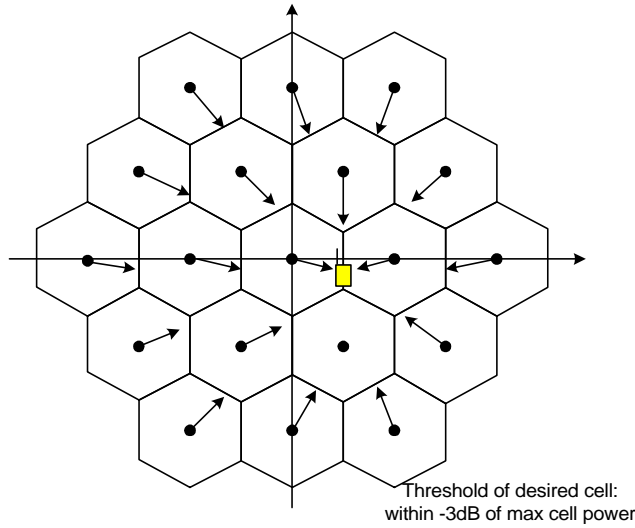


Figure 2 cell layout (cell radius = 2km)

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%

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

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

Then, p is the probability of acquisition for slot and chip synchronization at one trial, k is trial number. By k trials, probability that the UE can't acquired synchronization is $(1-p)^k$. So probability of acquisition by k trials is $1 - (1-p)^k$. Then solve (1) to derive trials (k), which means that 90% of all UE can acquire synchronization. We assume cell search time required at the first step is 25ms (2 frame averaging + processing time). When $p < 0.9$, this equation gives good approximation. When $p \geq 0.9$, we set acquisition time to 25 ms. We can obtain cell search time at 90% by equation of (3).

$$\begin{aligned} T_{search} &= 25 & p &\geq 0.9 \\ T_{search} &= -25 / \log_{10}(1 - p) & p &< 0.9 \end{aligned} \quad (3)$$

3. Simulation results

The simulation results of first step on cell search are shown in Figure 3. We can clearly understand that the introduction of TSTD scheme for SCH can significantly shorten the search time compared with single transmit antenna at low maximum Doppler frequency f_D . This is because TSTD scheme is more effective on transmit diversity gain at low f_D .

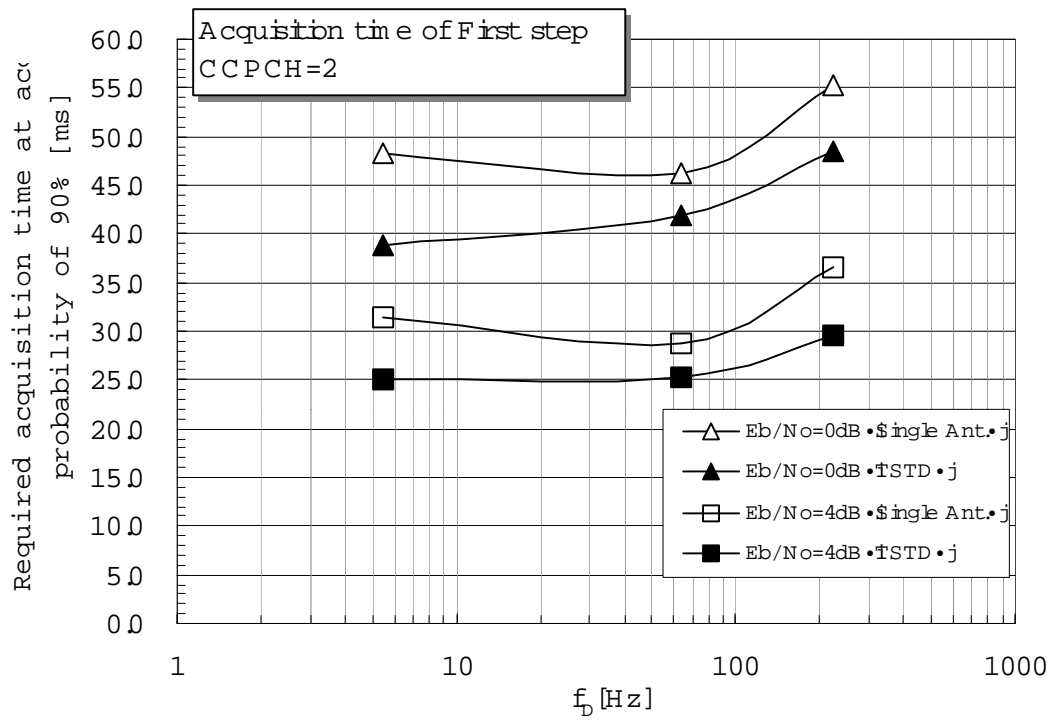


Figure 3 Acquisition time of first step

3. Conclusion

We evaluate TSTD schemes for SCH. The cell search time evaluated with computer simulation shows that the performance of cell search could be improved compared with single transmission antenna. It is easy to consider that the second step can be also improved by our proposed scheme.

4. References

- [1] Tdoc 3GPP TSGR1#4(99)354, "Performance Analysis of TSTD scheme for SCH"
- [2] Tdoc 3GPP TSGR1#4(99)433, "Text proposal for TSTD scheme of SCH"