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Title: Synchronisation Channel Structure for Cell Search

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1. Introduction

In this contribution, a new synchronisation channel structure is proposed for cell search. In the structure, only one primary synchronisation channel is transmitted per 10 ms frame. By acquiring the primary synchronisation channel, UE can synchronise the 10ms frame boundary. The secondary synchronisation channel is transmitted after the primary channel to indicate the code group of the base station. This structure can decrease the complexity of UE and reduce the cell search time of UE.

2. Proposed Synchronisation Channel Structure

2.1 Synchronisation Channel Structure

The primary synchronisation channel (PSC) is transmitted once per every 10 ms frame. The PSC is unmodulated code common to all base station. It is 256 chip long and transmitted in the beginning of 10 ms frame. UE can synchronise the 10 ms frame boundary by acquiring the PSC. The spreading code for PSC can be constructed from the hierarchical sequences. [1]

The secondary synchronisation channel (SSC) is transmitted to indicate the code group of the base station. The SSC is 256 chip long and transmitted 256 chips after the end of PSC. SSC may be demodulated coherently to enhance the second stage acquisition performance by using the channel estimation from PSC, since PSC and SSC are placed within coherent time. Time interval of 256 chips is placed between PSC and SSC to allow enough time for UE to calculate the decision variable and make a decision. The SSC is modulated by one of 32 secondary synchronisation codes to inform the code group of the base station. Frame synchronisation information is not sent through SSC, since UE can synchronise the frame boundary by acquiring the PSC.

Figure 1 shows the synchronisation channel structure proposed in this contribution.

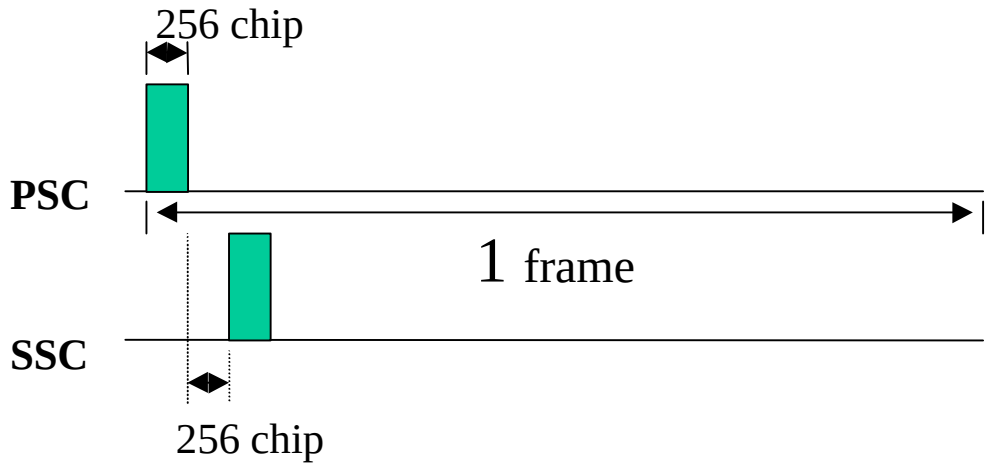

Fig. 1 Proposed Synchronisation Channel Structure

2.2 Receiver Operation

The first step of cell search operation is acquisition of PSC. UE acquires the PSC by using a matched filter. UE can acquire the PSC without accumulating the received signal slot by slot, since PSC is transmitted once per 10 ms frame with higher power compared with the current working assumption of 3GPP. UE calculates the received energy for each hypothesis and compares it with a threshold. Buffers for accumulating the received PSC channel energy are not necessary, since the decision is made from the energy of a PSC channel. This reduces the hardware complexity of UE receiver by eliminating the buffers for PSC accumulation.

The UE receiver begins the SSC synchronisation procedure after acquiring the PSC. Time interval of 256 chips is allowed for the UE to make a decision before the start of SSC. UE receiver despreads all possible secondary synchronisation codes and chooses the most possible hypothesis.

PSC and SSC are located within coherent time. If the frequency error of receiver is small, SSC can be demodulated coherently by using the channel estimation result of PSC. So, UE receiver can demodulate the SSC in case of neighboring cell search after initial acquisition and AFC. Another benefit of placing PSC and SSH within coherent time is that if PSC is detected with high energy, SSC can be demodulated with high probability. This can reduce the time required for SSC drastically.

Figure 2 show the detection scenario of receiver operation for the proposed synchronisation structure.

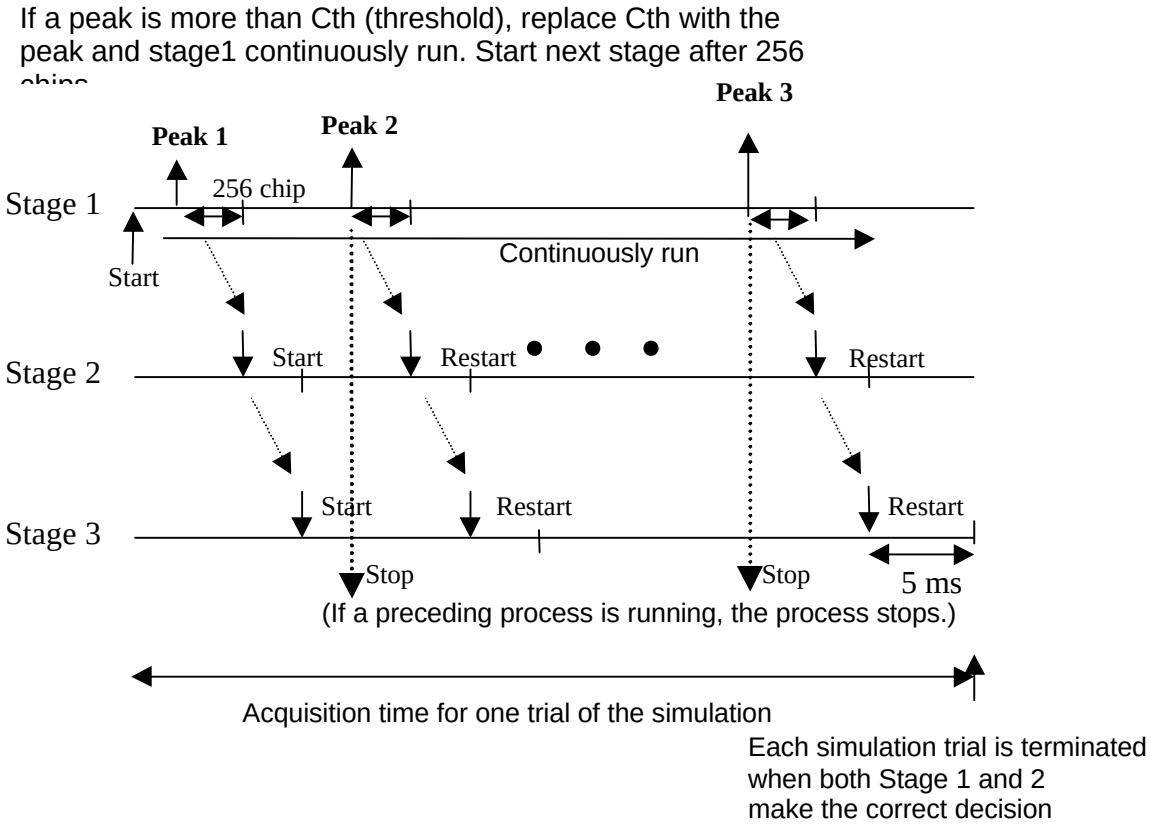

Fig. 2 Receiver operation for the synchronisation channel

2.3 Comparison with the current working assumption

Table 1 summarise the difference s between the proposed synchronisation channel and current working assumption of 3GPP.

Table 1. The comparison with the current working assumption

		Proposed	3GPP
Synchronisation Channels	PSC	1 per Frame (40% power)	16 per frame (5% power)
	SSC	1 per frame (40% power)	16 per frame (5% power)
Search Operation in each stage	1st Stage Search	Frame Sync.	Slot Sync.
	2nd Stage Search	Group Identify	Frame Sync. & Group Identify
	3rd Stage Search	Spreading Code Identify	Spreading Code Identify
Complexity Of each State	1st Stage	Buffer not required	Buffer Required
	2nd Stage	32 Hypothesis	512 Hypothesis
	3rd Stage	Same (16 hypothesis)	Same (16 hypothesis)

3. Performance Simulation

3.1 Simulation parameters

Computer simulation is performed to evaluate the mean acquisition performance of the proposed and the current working proposal of 3GPP. The detailed simulation parameters are as shown in table 2.

Table 2. Simulation parameters

	Initial acquisition
Channel model	2 path Vehicular, with path 0 and –2.5 dB
Doppler	5.6 Hz
SCH power	3GPP – 10% of BS power (16 shot per frame = 10% X 16) Proposed - PSC power : 40 % of BS power (1 shot per frame = 40% X 1) - SSC power : 40 % of BS power (1 shot per frame = 40% X 1)

PSC & SSC power	3GPP – total SCH power equally divided between the 2 SCHs, 5% of BS power
Primary Cell/IOC	Variable, -8 to –2dB
Stage 1	3GPP – Length=5ms
Stage 2	3GPP – Coherent detection (10ms), Proposed – Non Coherent detection
Stage 3	Ideal 5ms for both 3GPP and Proposed
Over-sampling	Without over-sampling

3.2 Simulation results

Figure 3 shows the simulation results of the mean search time for the proposed structure and the current working assumption of 3GPP. The SSC of the proposed structure is demodulated non-coherently while that of current working proposal of 3GPP is demodulated coherently. It is noticed that the mean search time can be decreased up to 50% compared with that of the conventional one. If we demodulate the SSC of proposed structure coherently, more performance gain is expected.

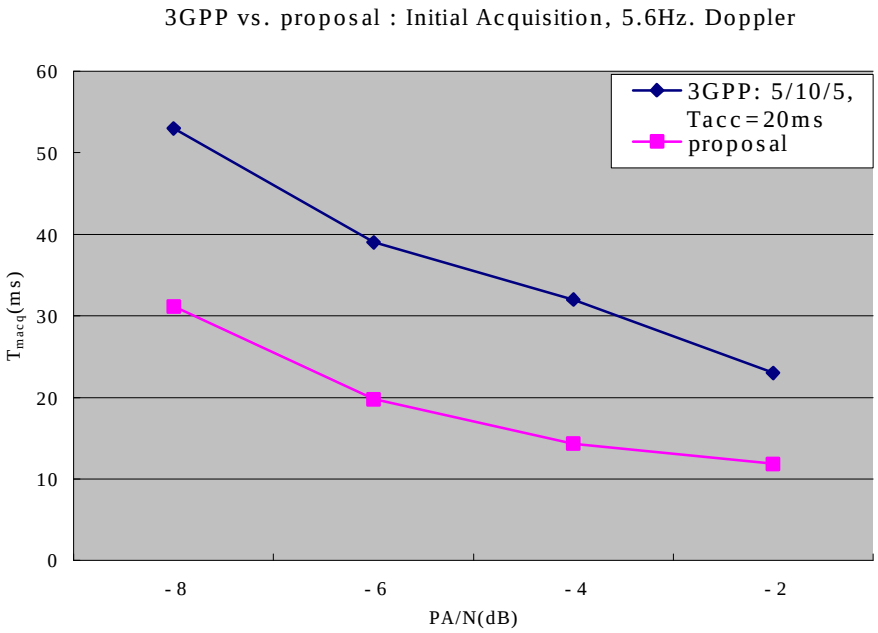

Figure 3. Mean search time performance

~~3.~~4. Conclusion

In this contribution, a new synch channel structure for cell search is proposed. The proposed synchronisation channel structure has following advantages over the current working assumption of 3GPP.

- Reduced complexity

Buffers for accumulating the PSC energy are not necessary.
Memory elements for SSC detection can be minimised.

- Decreased mean search time with increased P/S-SCH power allocation
  This structure can minimise the time required for the SCH acquisition.
- Coherent detection of SSC can be possible with proposed scheme.

~~4.~~5. ~~-~~Reference

[1] A new Hierarchical Correlation Sequence with good properties in the presence of a frequency error, 3GPP TSG W1 Tdoc 99/146, Siemens