TSG RAN WG1#6 **TSGR1(99)801**
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Agenda Item:
Source: **Golden Bridge Technology**
Title: **CPICH Simulations**
Document for: **Discussion**

Introduction

Recently, Common Pilot Channel has been adopted as a working assumption in 3GPP as a result of harmonization with 3GPP2. CPICH is intended to be used for the purposes of channel estimation and tracking. GBT would like to propose minor modifications to the CPICH so that it is used for acquisition as well. We are not challenging the current UTRA 3-step method. Our simulations have shown that the new method will outperform the current method by a factor of five (acquisition time) and it requires five times less power consumption in the UE. We would like WG1 to consider the minor changes to facilitate usage of this method for initial cell search.

Discussion

GBT is proposing to use the CPICH for the purposes of acquisition and initial cell search. We are not challenging the current UTRA 3-step method. The changes that are required to enable the usage of CPICH for acquisition are: replace the use of OVSF code with gold code, 2) block scramble the CPICH rather than symbol scrambling it.

As a result of discussions on the reflector, several questions, which embody some concerns on this method, have emerged. In this section, we provide some answers to those questions as a basis for further discussions in the physical meeting.

Questions and Answers on CPICH-based initial cell search and acquisition:

1. Is code planning required for this method? If so how complex is it?

Yes, code planning is required, we propose to use 16 different Gold codes in the cells. N=16 means there is an isolation of two tiers before the code is repeated. Therefore the code planning is simple and there is no concern over interference from the co-code cell.

The planning is simple when N is large, the complex code planning occurs at N=3-7

2. Is coherent detection feasible? What are the drawbacks associated with differential detection?

No, coherent detection is not possible. There is an unavoidable 3-dB loss when performing differential detection. However, the differential detection occurs in the second step where we can increase the observation window and detect the symbols in a slightly longer time period.

The issue of frequency offset (up to 5 kHz, 2.5-ppm accuracy in 2GHz) also exists which can be dealt with by sweeping the frequency and more processing. 2.5 ppm translates into a change of .33 Hz within 66.6 microseconds (one symbol duration/SF=256/3.84 Mcps.). So, there should be a method of estimating the frequency offset.

3. Does using a Gold code, which is not orthogonal to the OVSF codes (spread by the scrambling codes) hurt orthogolanity in the downlink direction?

The CPICH will not be orthogonal to the Traffic channels.
The negative impact is equivalent to the SCH1 and SCH2.

4. How does the complexity of the receiver compare with the 3-step process?

The same receiver is used in both cases. The Matched Filter has the same level of complexity in both cases. So, it is safe to conclude that both cases will be at the same level of complexity.

5. Power consumption in the UE?

The power consumption ratio is the ratio of the acquisition times between the two methods. The most power consuming devise would be the Matched Filter operating at the chip rate. The new method is approximately five times faster, so the power consumption is five times less. This is a significant improvement over the current method.

6. How does the acquisition performance compare?

The new method is faster for the following two reasons:

a. The duty cycle is 100% versus 10% duty cycle in the three-step process. This means a potential 10-fold increase in acquisition time.
b. The three-step process has the probability of collision and overlap, so one might fit 7 offsets within the 666 microseconds to avoid such conditions. This means that the better camping in the new method will lead to more improvement in acquisition time.

The simulation of the new method (first step) shows an improvement of a factor of three. The equivalent of the second and third step in the new method will take place within 35 ms. At the operating point of 1 dB SNR. The second step in the current UTRA method requires 300 ms at 1dB operating point.

Results

Table 1: First step [first approximation]/ new method
0 km/hr, single ray, Rayleigh fading

SNR in dB	E [T acquisition] in ms
1	90
2	60
3	45
4	35

The second and third step in the new method:

The second and third step in the new method will take 30-40 ms. At low SNR (0 dB and less, it takes 40 ms. At higher SNR, (2 dB and higher), it approaches 30 ms which is a lower bound. 10 ms is required for detection of the sequence, 10 ms for verification and reading the BCCH and 10 ms for processing. At 1 dB, the simulations show that 35 ms is required for the above mentioned chores. At 4 dB, the simulations show that 30 ms is required.

Table 2: First step [Current UTRA: TI paper]

SNR in dB	E [T acquisition] in ms
1	300
2	200
3	100

Table 3: Second step [Current UTRA: TTA paper: Tdoc 634/ 3 km/hr]

SNR in dB	E [T acquisition] in ms
1 dB	300
4 dB	100

Table 4: The acquisition time comparison of the two methods:

SNR in dB	E [T acquisition] New Method	E [T] current UTRA
1 dB	120	600
4 dB	65	200

The new method outperforms the current UTRA 3-step process by a factor of five in acquisition time at the SNR operating point of 1dB. This translates into five times less power consumption by the UE.

Proposal

GBT proposes the following changes:

1. Use of 16 different Gold codes (rather than OVSF code)
2. Block scrambling of CPICH rather than symbol scrambling the channel