TSG-RAN Working Group 1 meeting #9 *TSGR1#9(99)99j07*
Dresden, Germany

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Agenda Item: **Ad Hoc 8**

Source: **Siemens**

Title: **Complexity Estimation for GSM cell reconfirmation using Normal Bursts**

Document for: **Discussion and Information**

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1. Abstract

At the TSG RAN WG1 #7 meeting in Hannover we presented an enhanced method for the GSM cell reconfirmation procedure for GSM neighbouring cells from UTRA during a connection [1]. This method is applicable after the UE has already successfully decoded a first SCH burst of the GSM cells, which are to be observed.

At the TSG RAN WG1 #8 meeting in New York we delivered further simulation results [2], which were carried out by using different kinds of channel environments in order to confirm the performance and viability of the proposed method.

The text proposal for changes to Specification 25.215 V2.0.0 was accepted in New York [3] in principle, but will not be implemented because Annex A of TS 25.215 is moved to TS 25.922. Moreover in the last Adhoc 8 meeting some complexity concerns arose. In order to clarify the issue and to comment on the concerns this paper provides a complexity estimation by comparing the conventional SCH burst method with the proposed Normal Burst method.

2. Complexity Estimation of the conventional SCH Burst method

A dual (UMTS/GSM) mode UE must reconfirm each monitored GSM cell from time to time. Therefore a periodical SCH detection of the monitored neighbour and serving cells at the expected point in time is performed. Since the relative time distance between the UE and the serving and neighbour cells can change within one reconfirmation period, the mobile conducts the SCH detection, i. e. a correlation with its extended training sequence with a sliding window of 26 bits (this value is assumed for the complexity estimation). A maximum time advance change of ±13 bits can be monitored, corresponding to a distance of 14 kilometre.

Figure 1 presents the schematic of the conventional reconfirmation method (using the SCH burst): The received signal is correlated with the extended training sequence of the SCH burst, using a sliding window of $\pm$13 bits. The position of the peak gained by the computed correlation delivers the relative timing. But any correlation with an arbitrary signal results always in a peak, too. And not only the timing is relevant, but also the SNR (Signal-to-Noise-Ratio) of each cell should be checked. Therefore, to counteract the false peak detection and to estimate the prevalent SNR, a CRC Parity Check of the received information bits, which surround the training sequence, is computed after the maximum correlation peak detection, the channel equaliser, the convolutional decoder and block decoder (CRC). If this CRC Parity Check fails for a certain repetition period, the monitoring of this cell will be cancelled.

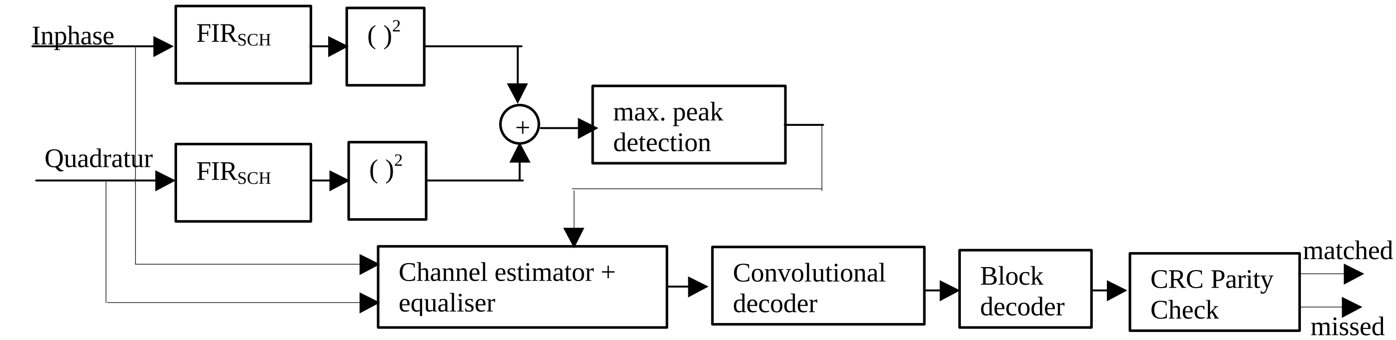

Figure 1: *Conventional GSM cell reconfirmation by using the SCH burst*

3. Complexity Estimation of the Normal Burst method

Figure 2 presents the proposed Normal Burst method for the GSM cell reconfirmation in a comprehensive way: The received signal is correlated with the TSC (Training sequence code) of the Normal burst, using a sliding window of ± 13 bits. The position of the peak gained by the computed correlation delivers the relative timing. This is pretty equivalent to figure 1 except for the correlation sequence and its different length. The add-on, which calculates the sum of the squared received input values, corresponds to the formula presented in [1]. Like in Figure 1 a maximum peak detection succeeds followed by a threshold query. The whole decoding sequence is skipped so that the computational complexity is reduced.

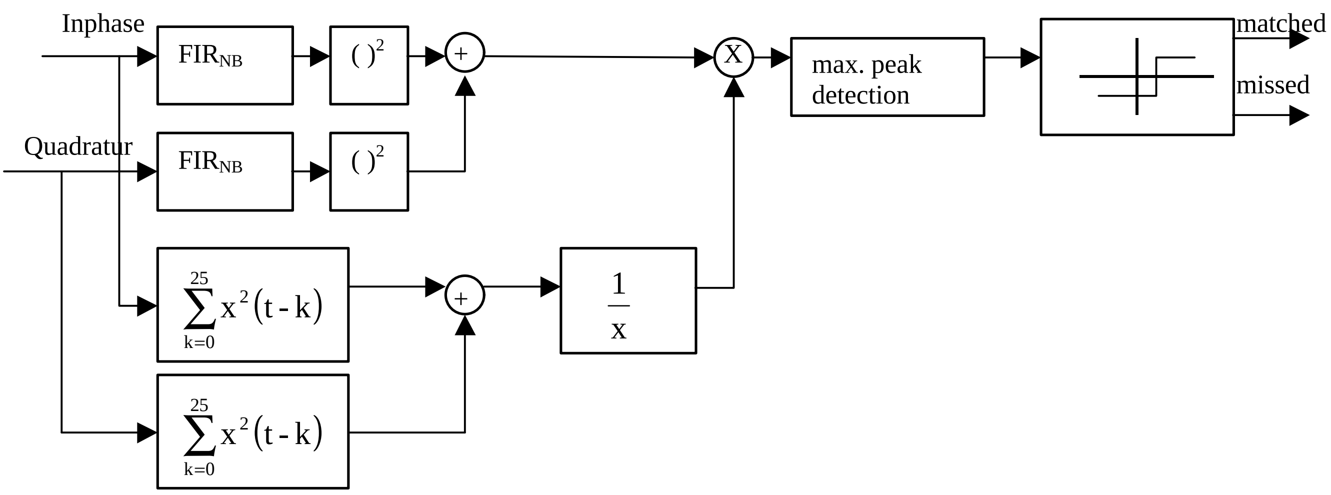

Figure 2: *Proposed NB detection for GSM cell reconfirmation*

4. Complexity Comparison

Table 1 enumerates all computation units. The second and third column depict the estimated number of arithmetic operations of both the SCH method and NB method. Of course, these values are only coarse estimations, but you can recognise that the GSM cell reconfirmation complexity can be reduced considerably by using the Normal Burst method.

	SCH method [Operations]	**NB method [Operations]**
FIR	2*64*26 Operations	2*26*26 Operations
$( )^2$	2*26	2*26
+	26	26
max. peak detection	26	26
channel estimator + equaliser	(39+4)*16*(1+1+1)	-
Conv. Decoder (2 x 39 bits)	39*(16*(1+2+2))	-
Block decoder (25 data, 10 parity, 4 tail) + CRC check	35*2	-
$\sum_{k=0}^{25} x^2(t-k)$	-	2*(26+25+25*3)
Division	-	26*16
Threshold query	-	1
Sum	**8686 Operations**	**2125 Operations**

Table 1: *Complexity comparison*

The Normal Burst method requires only about a quarter of the operations compared to the SCH method, so no complexity issues are to be expected.

5. Conclusions

By using the Normal Burst for GSM cell reconfirmation no drawbacks exist and a lot of important advantages can be achieved [2]. The main advantage is the gained flexibility for scheduling a reconfirmation and the reduction of the needed TGL (transmission gap length) from 4 to 3 UMTS slots. This advantage comes at no extra cost regarding computational complexity.

6. References

[1] TSGR1#7(99)A81; Hannover, Germany; 9-1999; Siemens; Method and Algorithm for the GSM cell reconfirmation
[2] TSGR1#8(99)G33; New York, U.S.A.; 10-1999; Siemens; GSM cell reconfirmation using Normal Bursts
[3] TSGR1#8(99)h45; New York, U.S.A.; 10-1999; Report from physical Ad Hoc #8 meeting