TSG-RAN Working Group 1 meeting #3 TSGR1#3(99)185
Stockholm, Sweden
22-26 March, 1999

Source: Motorola

Using rate-matching DTX for GSM monitoring

1. Introduction

In UTRA FDD, intersystem measurements to be performed for handover preparation require idle periods in the downlink in order to avoid the use of two receiver chains in dual mode terminals. Current proposals rely on downlink slotted mode in order to provide these silence periods. Two possibilities exist to implement the slotted mode[1]. Preserving the user data rate by simply reducing the spreading factor by a factor of 2 has the disadvantage of reducing the number of codes available (and may even lead to code shortage). On the other hand, increasing the coding rate degrades the BER performance. In both cases, the use of downlink slotted mode decreases downlink capacity. A previous contribution [6] presented at ETSI L1 meeting in Espoo proposed to use rate-matching DTX to perform GSM monitoring.
This document presents a possible implementation of this concept for 8 kbps speech services. Note that this is just an example, pending the availability of the mappings for the actual speech service.

2. ~~Introduction~~FDD to GSM handover

UTRA FDD to GSM handover preparation requires:

1) Detection of GSM FCCH (frequency correction) and SCH (synchronization) channels, which are transmitted every 10 GSM frames on the time-slot 0. Both channels have to be decoded at least once every 10 seconds for each neighbouring cell.
2) GSM BCCH power measurements, once per GSM 4.615ms frame (GSM 05.08 specifies that the sample period is at minimum 200 μs). ~~the d~~

~~GSM BCCH power measurements, once per GSM 4.615ms frame (GSM 05.08 specifies that the sample period is at minimum of 200 μs).~~

2.1 Detection of FCCH and SCH

The 26-frame GSM multiframe corresponds in duration with 12 FDD frames (120ms). In order to detect the GSM FCCH and SCH, the UE needs to monitor 8 GSM time slots (TS) in this superframe. Several proposals exist on how this should be performed.

Reference [3] defines the time t_{req} required to monitor *c* GSM time slots by:

$$t_{req}=2\times t_{synth}+(c+1)TS_{GSM}$$

with TS_{GSM}, the time slot duration in GSM and t_{synth}, the time needed to switch from one frequency to another. A common assumption is that the frequency synthesizer needs $t_{synth}\approx 500$ μs to change from the UMTS frequency to the GSM BCCH frequency.

There are several possible implementations:

- Monitor 8 slots in a row, with t_{req}=6ms,
- Monitor 4 slots in each idle period, and have 2 idle periods separated by 30ms. t_{req}=3.88ms in this case.

2.2 Power level measurements on the BCCH

GSM 05.08 states that a MS must perform 1 RxLev measurement of 200 μs on 1 BCCH carrier of the neighbouring cells (6 cells) every 4.615ms (1 GSM frame). The BCCH carriers that have to be measured by the MS are broadcast in the BCCH channel of the "active" cell.
In an UMTS context the list of GSM BCCH carriers to be measured will have to be transmitted by the active cell to the mobile station.

The required time for 1 measurement is:

$$t_{req}=2\times t_{synth}+0.2 =1.2ms$$

It can be seen that if only one BCCH is measured each time, the 83% of t_{req} is used to perform frequency changes and 17% to perform BCCH measurement. Therefore, as stated in [4], it seems advisable to perform several power measurements each time.

$$t_{req}=3\times t_{synth}+2*0.2 =1.9ms \quad \textit{if 2 measures are performed}$$
$$t_{req}=7\times t_{synth}+6*0.2 = 4.7ms \quad \textit{if 6 measures are performed}$$

If we have to perform 1 measure each 4.625 ms (GSM frame duration) that means that we will need to perform 26 measures each 120 ms (common multiple to GSM frame and UMTS frame) and 2160 measures each 10s.

~~**There are two issues associated with these measurements requirements:**~~
~~**a- How do you get these idle periods?**~~
~~**b- How does the mobile know that the BTS has left him an idle period to make measurements?**~~

~~❖ **Answer to question a-**~~
~~**The idle periods were primarily supposed to be obtained by the so-called "slotted mode", during which there are breaks in the downlink transmission, or by using a dual receiver approach.**~~

~~**However, it was agreed at the Helsinki meeting that DTX should be applied for dynamic rate matching in the downlink. In that case, most services currently used as examples for the simulations already rely on a heavy use of DTX:**~~
~~- **8kbps speech, in which the idle period represents 25% of a slot (not mentioning voice DTX), which gives 30ms per 120ms frame,**~~
~~- **64kbps LCD service, in which the idle period represents 8% of a slot, which gives 9.6ms per 120ms frame,**~~
~~- **144kbps LCD service, in which the idle period represents 2.5% of a slot, which gives 6.28ms per 120ms frame.**~~

2.3 Proposal for 8kbps speech service

Considering the 8kbps speech service (Downlink SF = 128, coding rate 1/3), rate matching DTX leaves 2.5ms idle period each 10ms (UMTS frame). Idle periods of two consecutive frames can be appended to form a 5ms idle period (Figure **Error! Unknown switch argument.**).

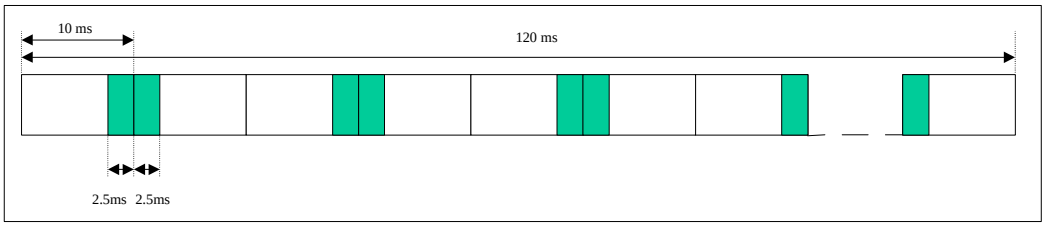

Figure Error! Unknown switch argument. **: Rate metching DTX idle period appending**

According to GSM 05.08, SCH monitoring has to be done once each 10s at least for each neighbouring cell, and it requires *at most* 11 frames (see [5] for details) of 120ms, with two idle periods of 3.88ms separated by 30ms in each 120 ms frame (Figure **Error! Unknown switch argument.**). This measure can be done in a 5ms DTX period and there is enough time left to perform a power measure at the same GSM carrier and another power measure of a different GSM carrier. Note that there is a 2.5ms idle period between the periods used to perform SCH monitoring. This idle period can be used to perform 2 additional BCCH power measures.

We will suppose that the remaining BCCH power measures are performed in groups of 6 (4.7ms).

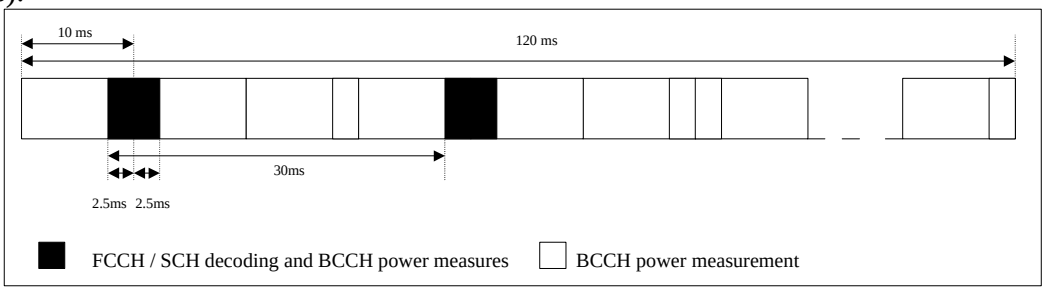

Figure Error! Unknown switch argument.**: FFCH / SCH decoding**

Table **Error! Unknown switch argument.** summarises the GSM monitoring capabilities that can be achieved using rate matching DTX when considering different numbers of cells to be monitored:

Numer of cells	2.5ms Idle periods available within 10s	2.5 ms Idle periods used for FCCH / SCH decoding	Number of possible BCCH pow meas
1	1000	44	2934
2	1000	88	2890
3	1000	132	2824
4	1000	176	2780
5	1000	220	2714
6	1000	264	2670

Table Error! Unknown switch argument. **: GSM monitoring provided in a 10s interval**

Note that the number of BCCH power measures provided is always superior to the rate specified in GSM 05.08, one each 4.615 ms (2160 each 10s).

3 GSM monitoring implementation

Tdoc 529/98 [4] proposes that the Network operator should have control over the handover performance parameters to trade off the loss in capacity due to slotted mode frames with GSM handover performance. The proposal in Tdoc 529/98 can be modified as follows to be implemented in the 8kbps speech service case:

- the MS requests the network to start GSM monitoring procedure,
- the Network determines the DL slot timing for GSM monitoring and indicates that and the GSM cells to monitor to the MS.
- the MS signals completion of FCCH search to the network.

Exactly as for slotted mode, it also relies on a signalling mechanism, to indicate to the mobile that a window for measurements is opened. Two options are possible: higher layer signalling (L2 and above) or L1 signalling, but they are the same for both slotted mode, and DTX rate-matching mode. Additional information needs to be sent out to the mobile, to indicate the GSM BCCH frequencies to monitor.

4 Conclusion

This contribution proposed rate-matching DTX periods to be used for intersystem handover preparation. Numerical examples to support this concept are given in the case of FDD to GSM handover, for 8 kbps speech services. This has the main advantage of providing the mobile with idle periods with no increase in code resource usage. Signalling requirements to indicate to the mobile that measurements are enabled are the same as for slotted mode. Also, issues related to interruption of closed loop power control are the same as for slotted mode.

5 References

[1] UMTS xx.04, UTRA FDD multiplexing, channel coding, and interleaving description.

[2] UMTS xx.05, UTRA FDD spreading and modulation.

[3] Tdoc 498/98, France Telecom, *Downlink slotted frames for seamless handover from UTRA to GSM*.

[4] Tdoc 529/98, NEC, *Handover procedure for UTRA-FDD to GSM*.

[5] Tdoc 566/98, Siemens, *Reduced search time for GSM synchronisation from UTRA*.

[6] Tdox 684/98, Motorola, *Using rate matching DTX for intersystem handover preparation.*