TSG-RAN Working Group 3 meeting #1
Bonn 2nd - 5th February 1999

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Agenda Item: 8.1, General UTRAN Architecture
Source: Siemens, Italtel
Title: **Requirements for Frame-Synchronisation in TDD**
Document for:

For information and proposal

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1 Introduction

The TDD operation requires frame synchronisation, since asynchronous downlink/uplink frames cause an interference. Due to the capture effect, a mobile can get blocked by a nearby asynchronous mobile, so that it looses the connection to its Node B. There are various interference types:

- Node B cross interference
- UE cross interference
- Node B-UE cross interference

All these types exist for uplink and downlink and are depicted in the following figure:

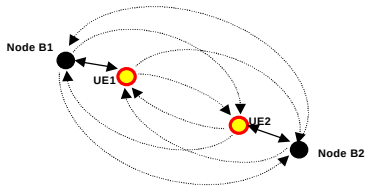

Figure 1: Interference types

A frame synchronisation means that Node B and UE must be phase synchronous. To avoid the drift of the phase over time a frequency synchronisation is also necessary, since their relation is

$$j(t) = \int_{-\infty}^{t} f(t)dt$$

2 References

[1] UMTS ZZ.01, v0.1.0, 1999-01, UTRAN Architecture Desription

3 Requirement for the frequency stability

Frequency stability is the ability of UEs and Nodes B to transmit at the assigned carrier frequency. The proposed frequency stability is specified below:

Base Station ± 0.05 ppm

Mobile Station ± 3 ppm (unlocked), ± 0.1 ppm (locked to Node B received carrier)

These values are equal to those of GSM.

4 Requirement for the phase stability

A time slot consists of a data block and a guard period. The main purpose of the guard period (GP) is to compensate e.g. the propagation delay on a random access. This is necessary to avoid the interference to the adjacent timeslot. The length of the different burst types is listed in the following table:

Burst type	GP [chips]	GP [µs]
Burst type 1	96	23.4
Burst type 2	96	23.4
Random access burst	1280	312.5

The format of a burst is shown in the following figure:

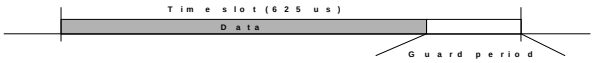

Figure 2: Burst format

It is obvious that the tolerance of synchronisation also has an influence to the guard period t_g. Following inequality must be fulfilled, to avoid interference :

$$t_g \geq t_{prop}(r) + \tfrac{1}{2}t_{ta}\tfrac{1}{2} + \tfrac{1}{2}t_s\tfrac{1}{2}$$

Where $t_{prop}(r)$ correspondents to the propagation in dependence to the cell radius r, which changes for different environments, and t_{ta} is the failure of the timing advance regulation and finally t_s is the failure of synchronisation. The values of t_{ta} and t_s are tbd.

Since the resulting capacity C in dependence of the nominal capacity C_{nom} is given by the following formula

$$C = C_{nom} \cdot \textbf{Error!}$$

Where t_{ts} is the duration of a timeslot, which is 625µs. Obviously the guard period t_g must be kept as small as possible and so the synchronisation failure to minimise the capacity loss.
Thus the value of synchronisation failure is a trade off between the capacity loss and the length of the guard period.

5 Proposal

It is proposed to put the text in [1], chapter 10.1.2 in brackets with the indication ‘FDD’ and to add the following text:
„[TDD. In TDD mode Frame Synchronisation is used within neighbouring cells to minimise cross-interference (Node B-Node B, UE-UE, Node B-UE cross-interference).]”