TSG-RAN WG4 meeting #8
26th – 29th October 1999
Sophia Antipolis

Agenda item: 8.4
Source: Motorola
Title: Methodology of Implementation Margin Determination
Document for: Discussion

1.Introduction

RAN WG4 intends to define Node-B receiver performance figures in section 8 of TS 25.104. These figures are to be based upon floating point simulations, with real-life effects being accounted for by means of appropriate implementation margins. Implementation margins were briefly discussed at the recent WG4 AH01 ad-hoc meeting in the Netherlands and it became clear that there was general disagreement as to the exact values and that no justification or evidence was presented in order to support the proposed values. This short paper attempts to break down the implementation margin into its contributing factors, and it is suggested that, over time, the margin figure attributable to each of these should be refined in order that WG4 is able to arrive at a commonly-agreed overall implementation margin figure.

2.Contributing Factors

Many real-life implementation factors have an effect upon receiver performance. The following table contains a brief list outlining these.

Item	Factor	Reason
1	Baseband filter mismatch	Ideal root raised-cosine matched filter cannot be implemented due to adjacent channel rejection requirements.
2	AGC	The receiver must attempt to maintain the composite received signal at an appropriate level at the ADC input. Non-ideal management of AGC gain will result in sub-optimal signal to quantisation noise ratio at the ADC output.
3	ADC	Increased noise energy due to quantisation process.
4	Real Channel Estimation	Simulations assume ideal channel estimation. Pilot-based channel estimation based upon coherent integration within each finger will introduce a noise term into the channel estimate for each finger and will adversely effect demodulation performance.
5	Receiver Noise Figure	This effect will be extremely small so long as the receiver performance test is performed at an adequate receiver signal input level. Noise figure will only become an important factor for signal levels close to sensitivity.
6	Fixed Point Arithmetic	Rounding errors due to fixed-point implementation will introduce non-linear noise terms in the signal path.
7	Automatic Frequency Correction	Longer term deterministic frequency offsets due to clock inaccuracies or persistent channel conditions may be compensated for via automatic loops. The ability of this loop to track these changes will impact demodulation performance.
8	Delay Estimation	Simulations assume ideal delay estimation in determining the appropriate despreading offset point for each finger. Real channel-tap delay estimation will always be subject to estimation error and this estimation will lead to poorer demodulation performance.
9	Finger Management	As channel rays appear and disappear (so called 'birth and death propagation conditions'), so the receiver must decide whether or not the ray exists. If a ray exists but is not assigned a finger or if a finger is assigned to a non-existent ray, then demodulation performance will suffer due to reduced SNR.
10	Oversampling	For implementation complexity reasons, different oversampling factors may be used to perform various functions within the receiver. The degree of oversampling used in each will affect overall performance.

The magnitude of these various effects may not be the same for all normative reference channels and will also vary depending on the tested propagation conditions. For example, the effect of real channel estimation is likely to be larger for test case 3 (120kmph) than for test case 1 (3kmph), but will also vary as a function of the DPCCH power which is higher for the 384kbps reference channel than for the 12.2kbps reference channel. On the other hand, the magnitude of the effects caused by some of the other implementation factors may be reasonably independent of channel conditions or service rate. Appropriate implementation margin figures must be reached WITH JUSTIFICATION for each normative reference channel rate, each propagation condition test, and each implementation-margin contributing factor.

It is likely that the overall implementation margin figure will be dominated by one or two main factors. Where the effect of a contributing factor is small, this should be stated and little further work need be done. Concentration of effort should be made towards the larger effects. These are likely to be any of those listed above dealing with channel estimation, delay and finger management.

3.Conclusions

Appropriate implementation margin figures must be reached with justification within WG4 for each normative reference channel rate, each propagation condition test, and for each implementation-margin contributing factor. This should be accomplished via theoretical, computational or real-life equipment testing means. Where this is unreasonably complex or unfeasible, agreement must be reached via other means.