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Agenda Item:

Source: **Nokia**

Title: **Complexity of blind rate detection for AMR with turbo coding**

Document for: **Discussion**

Introduction

In the current 3GPP specification turbo coding is assumed to be used for services on dedicated channels using bit rates higher than 32 kbps. Companies such as Lucent have commented that turbo coding could be extended to all bit rates, i.e. also for speech with AMR coding. In this document some thoughts are raised about replacing convolutional coding in all cases with turbo coding.

AMR codec, blind rate detection and turbo coding

It has been argued by Lucent that turbo coding outperforms convolutional coding also at low bit rates, i.e. small encoding block sizes. This far no exhaustive comparison by simulation has been seen in 3GPP documentation, though. Complexity comparison, however, is available in [1]. The conclusion in this document is that in terms of silicon are a 256-state Viterbi decoder and a 4-state SCCC are roughly similar. However, 3GPP default turbo coder is 8-PCCC for which direct complexity comparison is not available. Based on [1] it is not possible to draw conclusions as far as 8-PCCC is concerned.

The lowest bit rate for AMR codec is 4.75 kbps which makes 95 bits per a 20 ms frame. Out of these bits only 39 are high priority bits that are to be encoded separately. Were turbo coder to be used to encode all data services, also these very small block sizes need to be processed.

The detailed application of blind rate detection is yet to be specified. However, it may be possible that support for blind rate detection is required for speech transmission in downlink. When Viterbi decoding is employed, only one run of data through the decoder is done in order to calculate path metrics. For each possible end bit position a trace-back is carried out. Path metric computation is the largest part of Viterbi processing; thus blind rate detection does not introduce a lot of extra effort since path metric computation is done only once. However, for blind rate detection of n rates, turbo decoding must be processed n times. Due to the iterative nature of turbo decoding process only one assumed data rate, i.e. a block of length h, is decoded during one run. Since AMR codec supports eight modes (and SID + an idle mode) the order of processing complexity for turbo decoder would be quite a lot higher than that of Viterbi decoder.

Naturally, it is open whether BRD or TFCI is employed with AMR in downlink. Since this has not yet been decided, it is too early to change channel encoding assumptions at this stage.

Conclusions

Based on the above mentioned concerns when BRD is used, Nokia feels that the current specification should be left unchanged with respect to channel coding, i.e. turbo coding is used only for dedicated channels with data rates above 32 kbps.

References

[1] Lucent, "VLSI implementation of a 256-state Viterbi decoder and comparison with 4-state SCCC", TSGR1#4(99)435