

Agenda Item:

Source: Nokia

Title: Maximum turbo coding block size: text proposal

Document for: Decision

Introduction

Recently both turbo encoder and turbo internal interleaver have been selected for the 3GPP L1 specification. However, a maximum encoding segment length for turbo coding has not yet been chosen. The application of turbo code has been simulated around encoding block lengths from 80 up to 5120. Old AdHoc 5 material [1] gives a rough understanding that encoding block sizes around 2000 bits would be ok, above this size further performance gain is small. The maximum size of the coding block should be at least twice what is thought to be optimal for encoding purposes. This stems from the algorithm for creating the input data blocks (section 4.2.2.3 of 25.212); input data block slightly larger than the maximum encoding block length is split into two halves. Implicitly, in 3GPP discussion 5120 bits has turned out to be the biggest block size. This would seem to be a good value to choose as the maximum turbo coding block size.

Text proposal for 25.212

4.2.2 Channel coding

The following options are available for the transport-channel specific coding, see also Figure 4-3:

- Convolutional coding
- Turbo coding
- Service-specific coding, e.g. unequal error protection for some types of speech codecs.

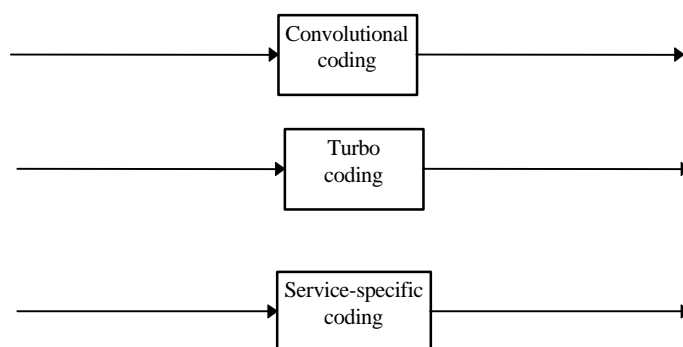


Figure 4-3. Channel coding.

Turbo coding should be used for data rate above 32 kbps. Data rates equal to or less than 32 kbps are for further study. The maximum encoding segment length for turbo coding is 5120 bits.

4.2.2.2 Turbo code internal interleaver

Figure 4-7 depicts the overall 8 State PCCC Turbo coding scheme including Turbo code internal interleaver. The Turbo code internal interleaver consists of mother interleaver generation and pruning. For arbitrary given block length K , one mother interleaver is selected from the 224 mother interleavers set. After the mother interleaver generation, l -bits are pruned in order to adjust the mother interleaver to the block length K . The definition of l is shown in Figure 4-7.

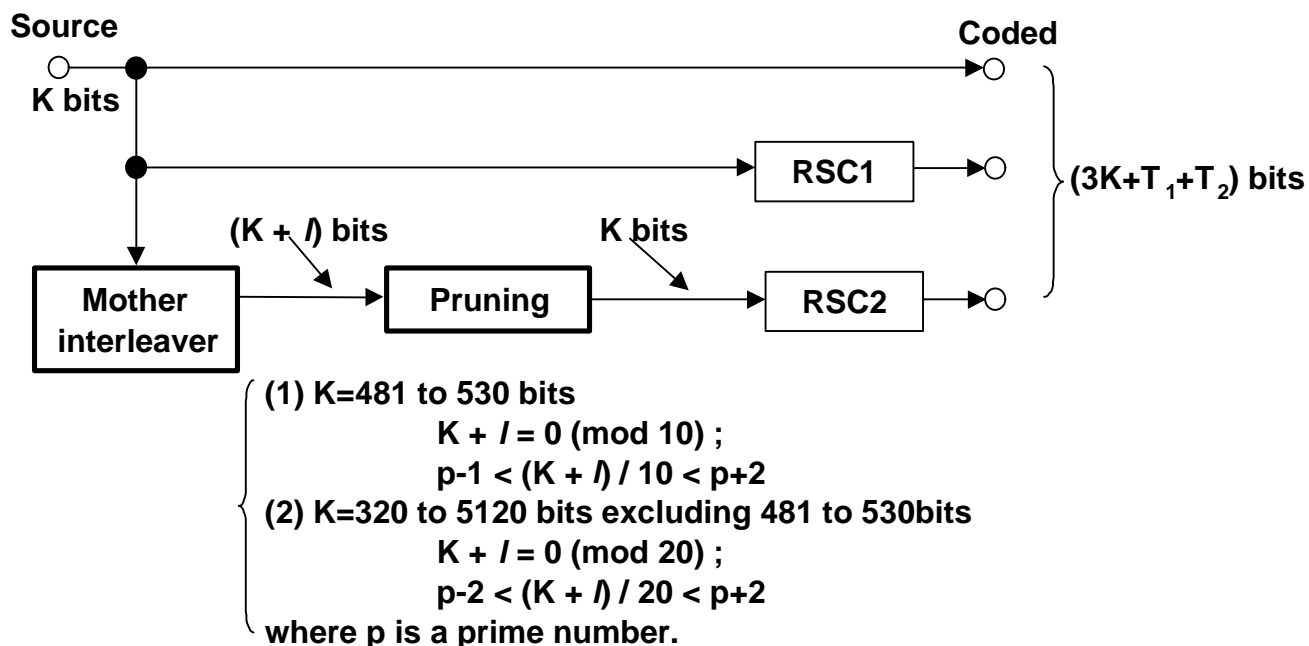


Figure 4-7. Overall 8 State PCCC Turbo Coding

4.2.2.2.1 Mother interleaver generation

<Editor's note: Block length of 8192 is FFS.>

The interleaving consists of three stages. In first stage, the input sequence is written into the rectangular matrix row by row. The second stage is intra-row permutation. The third stage is inter-row permutation. The three-stage permutations are described as follows, the input block length is assumed to be K (320 to ~~5120~~8192 bits).

4.2.2.2.3 Encoding blocks for Turbo code

<Editor's note: 8192 is FFS.>

Input data blocks for a turbo encoder consist of the user data and possible extra data being appended to the user data before turbo encoding. The encoding segments for a turbo encoder are defined in terms of systematic bits. The segment includes the user data, a possible error detection field (CRC), possible filler bits, and the termination. ~~The maximum encoding segment length is 8192.~~ The Algorithm for combining and segmentation is as follows:

- Let $N_s = \text{round_up}((R_{\text{DATA}} * T_{\text{DELAY}} + N_{\text{EXTRA}}) / (\del{5120}8192 - N_{\text{TAIL}}))$

Text proposal for 25.222

6.2.2 Channel coding

The following options are available for the transport-channel specific coding, see also Figure 6-2:

- Convolutional coding
- Turbo coding
- Service-specific coding, e.g. unequal error protection for some types of speech codecs.

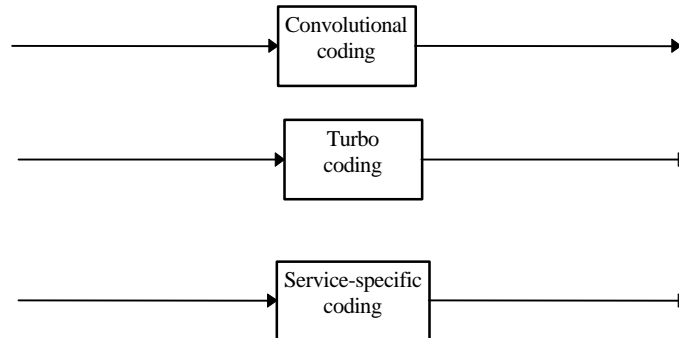


Figure 6-2. Channel coding in UTRA/TDD.

The maximum encoding segment length for turbo coding is 5120 bits. In Real Time (RT) services a FEC coding is used, instead Non Real Time (NRT) services could be well managed with a proper combination of FEC and ARQ.

6.2.2.2.3 Turbo code internal interleaver

<Editor's note: The following is a working assumption of Ad Hoc 5>

Figure 6-7 depicts the overall 8 State PCCC Turbo coding scheme including Turbo code internal interleaver. The Turbo code internal interleaver consists of mother interleaver generation and pruning. For arbitrary given block length K , one mother interleaver is selected from the 224 mother interleavers set. After the mother interleaver generation, l -bits are pruned in order to adjust the mother interleaver to the block length K . The definition of l is shown in Figure 6-7.

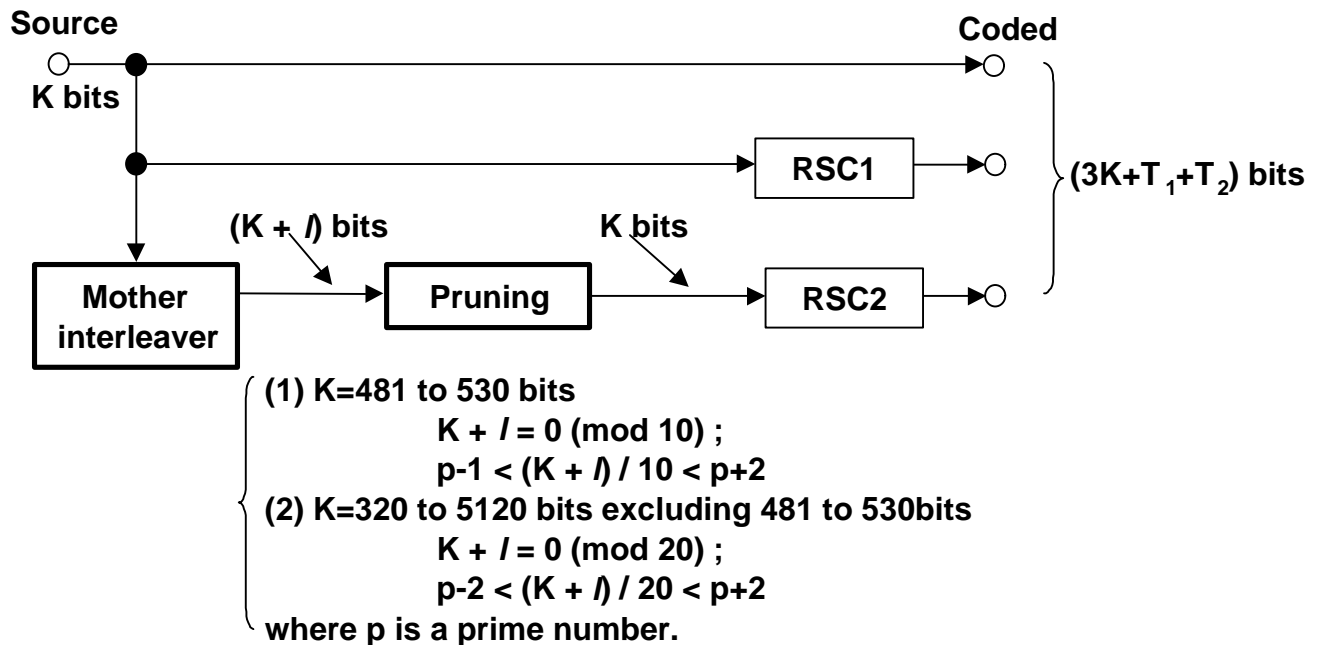


Figure 6-7. Overall 8 State PCCC Turbo Coding

6.2.2.2.3.1 Mother interleaver generation

The interleaving consists of three stages. In first stage, the input sequence is written into the rectangular matrix row by row. The second stage is intra-row permutation. The third stage is inter-row permutation. The three-stage permutations are described as follows, the input block length is assumed to be K (320 to ~~51208192~~ bits). *<Editor's note: Segment length of 8192 is FFS.>*

6.2.2.2.4 Encoding blocks for turbo code

<Editor's note: Segment length of 8192 is FFS.>

Input data blocks for a turbo encoder consist of the user data and possible extra data being appended to the user data before turbo encoding. The encoding segments for a turbo encoder are defined in terms of systematic bits. The segment includes the user data, a possible error detection field (CRC), possible filler bits, and the termination. ~~The maximum encoding segment length is 8192.~~ The Algorithm for combining and segmentation is as follows:

1. Let $N_S = \text{round_up}((R_{\text{DATA}} * T_{\text{DELAY}} + N_{\text{EXTRA}}) / (\del{51208192} - N_{\text{TAIL}}))$

References

- [1] Lucent, "A unifying code proposal for all data rates, block sizes and QoS: Performance/Complexity trade-off", TSGR1#3(99)189