

Agenda Item: 7.3

Source: Broadcom

Title: Text proposal on Rate matching for TS36.212

Document for: Discussion/Decision

Based on the analysis and performance improvement show in [1] we propose the text modification for TS36.212 as follow.

5.1.4.1.2 Sub-block interleaver

The sub-block interleaving is a block interleaver and consists of bits input to a matrix with padding, the inter-column permutation for the matrix and bits output from the matrix. The bits input to the block interleaver are denoted by $u_0, u_1, u_2, \dots, u_{K'-1}$, where K' is the number of bits. The output bit sequence from the block interleaver is derived as follows:

- (1) Assign $C = 32$ to be the number of columns of the matrix. The columns of the matrix are numbered $0, 1, 2, \dots, C - 1$ from left to right.
- (2) Determine the number of rows of the matrix, R , by finding minimum integer R such that:

$$K' \leq R \times C.$$

The rows of rectangular matrix are numbered $0, 1, 2, \dots, R - 1$ from top to bottom.

- (3) If $R \times C > K'$, then $N_D = (R \times C - K')$ dummy bits are padded such that $y_k = \langle NULL \rangle$ for $k = 0, 1, \dots, N_D - 1$. Then, write the input bit sequence, i.e., $y_{N_D+k} = u_k, k = 0, 1, \dots, K'-1$, into the $R \times C$ matrix row by row starting with bit y_0 in column 0 of row 0:

$$\begin{bmatrix} y_0 & y_1 & y_2 & \cdots & y_{C-1} \\ y_C & y_{C+1} & y_{C+2} & \cdots & y_{2C-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ y_{(R-1) \times C} & y_{(R-1) \times C + 1} & y_{(R-1) \times C + 2} & \cdots & y_{(R \times C - 1)} \end{bmatrix}$$

For s_i and $p1_i$:

- (4) Perform the inter-column permutation for the matrix based on the pattern $\langle P(j) \rangle_{j \in \{0, 1, \dots, C-1\}}$ that is shown in table [xx], where $P(j)$ is the original column position of the j -th permuted column. After permutation of the columns, the inter-column permuted $R \times C$ matrix is equal to

$$\begin{bmatrix} y_{P(0)} & y_{P(1)} & y_{P(2)} & \cdots & y_{P(C-1)} \\ y_{P(0)+C} & y_{P(1)+C} & y_{P(2)+C} & \cdots & y_{P(C-1)+C} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ y_{P(0)+(R-1) \times C} & y_{P(1)+(R-1) \times C} & y_{P(2)+(R-1) \times C} & \cdots & y_{P(C-1)+(R-1) \times C} \end{bmatrix}$$

- (5) The output of the block interleaver is the bit sequence read out column by column from the inter-column permuted $R \times C$ matrix. The bits after sub-block interleaving are denoted by $v_0, v_1, v_2, \dots, v_{K''-1}$, where v_0 corresponds to $y_{P(0)}$, v_1 to $y_{P(0)+C}$, ... and $K'' = (R \times C)$.

For $p2_i$:

- (4) The output of the sub-block interleaver is denoted by $v_0, v_1, v_2, \dots, v_{K''-1}$, where $v_i = y_{\pi(i)}$ and where

$$\pi(i) = \left(P\left(\left\lfloor \frac{i}{R} \right\rfloor\right) + C \times (i \% R) + 1 \right) \% K'' \quad \pi(i) = \left(P\left(\left\lfloor \frac{i}{R} \right\rfloor\right) + C \times (i \% R) + 3 \right) \% K''$$

Comment [bzs1]: Replace offset index 1 with 3

The permutation function P is defined in Table [xx].

Table [xx] Inter-column permutation pattern for sub-block interleaver

Number of columns C	Inter-column permutation pattern < P(0), P(1), ..., P(C-1) >
32	< 0, 16, 8, 24, 4, 20, 12, 28, 2, 18, 10, 26, 6, 22, 14, 30, 1, 17, 9, 25, 5, 21, 13, 29, 3, 19, 11, 27, 7, 23, 15, 31 >

5.1.4.1.3 Bit collection, selection and transmission

The circular buffer of length $K_z = 3K''$ for the r -th coded block is generated as follows:

$$\begin{aligned} z_i &= s'_i && \text{for } i = 0, \dots, K''-1 \\ z_{K''+2i} &= p1'_i && \text{for } i = 0, \dots, K''-1 \\ z_{K''+2i+1} &= p2'_i && \text{for } i = 0, \dots, K''-1 \end{aligned}$$

Denoting by K_{rm} the rate matching output sequence length for this coded block, and rv_{idx} the redundancy version number for this transmission, the rate matching output bit sequence is $z'_i, i = 0, 1, \dots, K_{rm} - 1$.

Set $k_0 = R \times (24 \times rv_{idx} + 2)$ ~~$k_0 = R \times (24 \times rv_{idx} + 3)$~~

Comment [bzs2]: Replace skip index 2 with 3

[1] Broadcom, "On Rate Matching Parameters for TS36.212," 3GPP TSG RAN WG1 #50, R1-07410