

Efficient Transmitter Design Techniques in Digital Communication

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Abstract—A brief description about the Efficient Transmitter Design techniques. Which includes Interleaver/Deinterleaver for combating bursty errors, Physical Layer Framing for the efficient detection of Frame starting, and Pulse Shaping for combating the InterSymbol Interference.

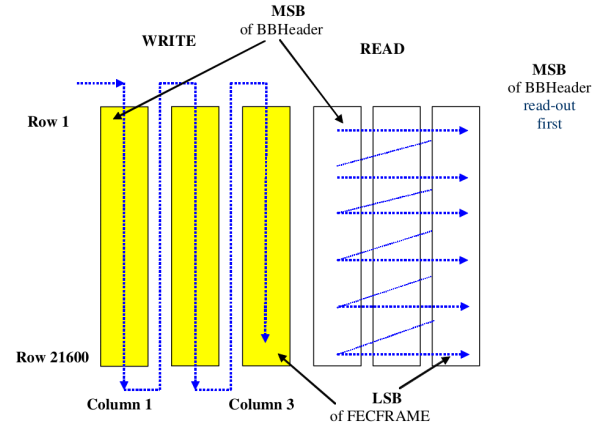


Fig. 1: Bit Interleaver Structure for 8PSK mapping scheme

1. INTERLEAVER/DEINTERLEAVER

For 8PSK, 16APSK, and 32APSK mapping schemes we will use block interleaver to mitigate the effects of bursty channel. For Concatenated Channel coding schemes bit interleaving is necessary. The mapped data is serially put as column wise and serially read out row wise.

Fig. 1 shows bit interleaving scheme for 8PSK.

Similarly, Fig. 2 shows the BER comparison of 8PSK mapping scheme with interleaver and without interleaver.

The configuration of the block interleaver for each modulation format is specified [1].

2. PHYSICAL LAYER FRAMING(PLFRAMING)

PLFRAMING useful for the specifying modulation scheme and code rate and frame characteris-

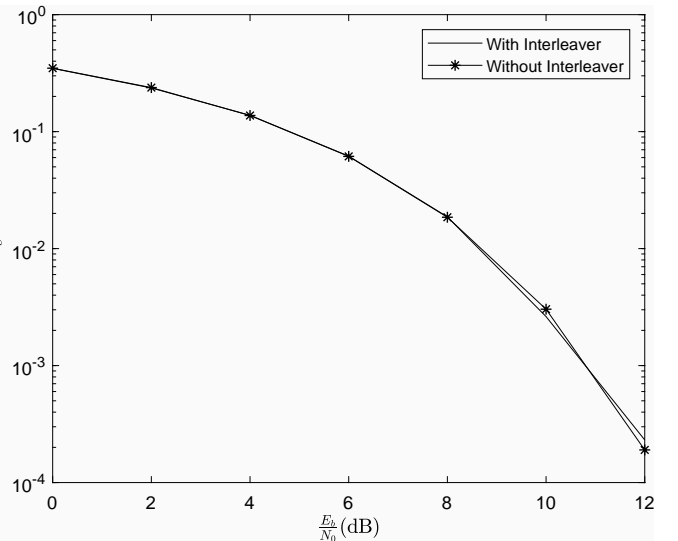


Fig. 2: Bit interleaver for 8PSK

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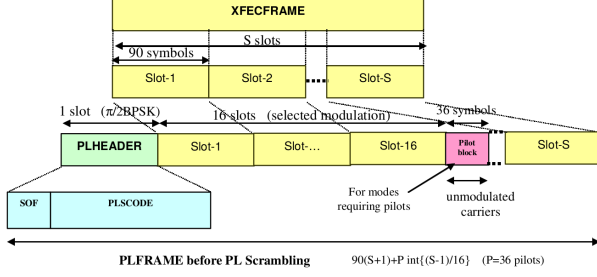


Fig. 3: Structure of PLFRAME.

tics. In receiver synchronization, Frame synchronization plays a key role.

Fig. 3 shows the Typical Structure of PLFRAME according to [1].

$$I_{2i-1} = Q_{2i-1} = \frac{1}{\sqrt{2}}(1 - 2y_{2i-1}) \quad i = 1, 2, \dots, 45 \quad (2.1)$$

$$I_{2i} = -Q_{2i} = -\frac{1}{\sqrt{2}}(1 - 2y_{2i-1}) \quad 1, 2, \dots, 45 \quad (2.2)$$

The PLHEADER, represented by binary stream y_1, \dots, y_{90} is modulated into 90 $\frac{\pi}{2}$ -BPSK symbols. Eqs.(2.1) and (2.2) shows the generation of $\frac{\pi}{2}$ -BPSK mapping.

- PLHEADER consists of two fields,
 - 1) Starting of Frame(SOF) 26 symbols
 - 2) Physical Layer Signalling Code (PLSC) , 64 symbols

A. Generation of SOF

SOF consists a fixed sequence $18D2E82_{HEX}$ in binary format which is from right to left.

B. Generation of PLSC

- Generation of PLSC involves defining 7 symbols and multiplying first 6 symbols with the defined G matrix in [1]. First 5 symbols called as MODCOD field and next 2 symbols as TYPE field.
- First 5 symbols represents MODCOD which specifies Frame's mapping scheme and code rate.
- Next 2 symbols represents TYPE field which specifies Frame length and presence and absence of pilot fields. (0 = normal: 64 800 bits; 1 = short: 16 200 bits) ; (0 = no pilots, 1 = pilots)

Mode	MOD COD	Mode	MOD COD	Mode	MOD COD	Mode	MOD COD
QPSK 1/4	1 _D	QPSK 5/6	9 _D	8PSK 9/10	17 _D	32APSK 4/5	25 _D
QPSK 1/3	2 _D	QPSK 8/9	10 _D	16APSK 2/3	18 _D	32APSK 5/6	26 _D
QPSK 2/5	3 _D	QPSK 9/10	11 _D	16APSK 3/4	19 _D	32APSK 8/9	27 _D
QPSK 1/2	4 _D	8PSK 3/5	12 _D	16APSK 4/5	20 _D	32APSK 9/10	28 _D
QPSK 3/5	5 _D	8PSK 2/3	13 _D	16APSK 5/6	21 _D	Reserved	29 _D
QPSK 2/3	6 _D	8PSK 3/4	14 _D	16APSK 8/9	22 _D	Reserved	30 _D
QPSK 3/4	7 _D	8PSK 5/6	15 _D	16APSK 9/10	23 _D	Reserved	31 _D
QPSK 4/5	8 _D	8PSK 8/9	16 _D	32APSK 3/4	24 _D	DUMMY PLFRAME	0 _D

Fig. 4: MODCOD coding for various mapping schemes

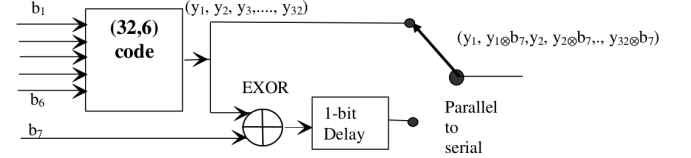


Fig. 5: Physical Layer Signalling generation

Fig. 4 shows the MODCOD coding for various mapping schemes. Similarly, Fig. 5 shows the generation of 64 bits.

After the generation of PLS code, we will again scramble the PLS Code with the fixed SCR sequence which is defined in the [1].

$$PLSC = PLSC \oplus SCR \quad (2.3)$$

C. Generation of Pilots

Pilot block consists of $P = 36$ symbols. Each pilot is composed of un-modulated complex symbol. Where, $I = Q = \frac{1}{\sqrt{2}}$. The first pilot block inserted 16 slots after the PLHEADER and next is inserted after the 32 slots and so on.

$$K = \begin{cases} 90 \times (S + 1) & \text{with out pilots} \\ 90 \times (S + 1) + 36 \times \alpha_{PIL} & \text{with pilots} \end{cases} \quad (2.4)$$

Where, $\alpha_{PIL} = \left\lfloor \frac{(S-1)}{16} \right\rfloor$.

Eq.(2.4) specifies the total length K of the PL-

PARAMETERS OF THE normal and short PLFRAME

	normal frame: $\eta_{LDPC} = 64800$ bits				short frame: $\eta_{LDPC} = 16200$ bits			
η_{MOD}	S	α_{PIL}	K	η (%)	S	α_{PIL}	K	η (%)
QPSK: 2	360	22	33282	97.35	90	5	8370	96.77
8PSK: 3	240	14	22194	97.32	60	3	5598	96.46
16APSK: 4	180	11	16686	97.09	45	2	4212	96.15
32APSK: 5	144	8	13338	97.17	36	2	3402	95.24

Fig. 6: paramters of plframe

FRAME. Smiliarly, Fig. 6 Shows the Parameters of PLFRAME.

3. PULSE SHAPING

- After randomization, the signals shall be square root raised cosine filtered. The roll-off factor shall be $\alpha = 0,35, 0,25$ and $0,20$, depending on the service requirements.
- Suitable $H(f)$ will be choosen from the [1].

$$H(f) = \begin{cases} 1 & |f| < f_N(1 - \alpha) \\ \left\{ \frac{1}{2} + \frac{1}{2} \sin \frac{\pi}{2} \left[\frac{f_N - |f|}{\alpha} \right] \right\}^{\frac{1}{2}} & |f| = f_N(1 - \alpha) \\ 0 & |f| > f_N(1 - \alpha) \end{cases} \quad (3.1)$$

REFERENCES

- [1] A. Morello and V. Mignone, "DVB-S2X: The New Extensions to the Second Generation DVB Satellite Standard DVB-S2," *Int. J. Satell. Commun. Netw.*, vol. 34, no. 3, pp. 323–325, May 2016. [Online]. Available: <https://doi.org/10.1002/sat.1167>