

Digital Mapping Schemes for Broadcasting

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Abstract—This manual has a brief description about the design and implementataion of digital mapping schemes for broadcasting application using DVB-S2 [1] standard.

1. PHASE SHIFT KEYING (PSK)

Let

$$Y_k = X_k + V_k, \quad k = 1, \dots, N \quad (1.1)$$

where X_k is the transmitted symbol from the constellation symbols of specified mapping $\{X\}$ in the k th time slot and $V_k \sim \mathcal{N}(0, \sigma^2)$.

A. QPSK

Constellation Mapping symbol set $\{X\}$ is generated by

$$X_k \in \left\{ e^{j\frac{2\pi n}{4}} \right\} \quad n = 0, 1, 2, 3 \quad (1.2)$$

Demapping can be done by using,

$$\frac{2\pi}{4}i < \angle Y_k < \frac{2\pi}{4}(i+1) \implies \hat{X}_k = X_i \quad i = 0, \dots, 3 \quad (1.3)$$

Fig. 1 Shows the Constellation mapping for QPSK scheme and similarly Fig. 2 Shows the Simulation diagram.

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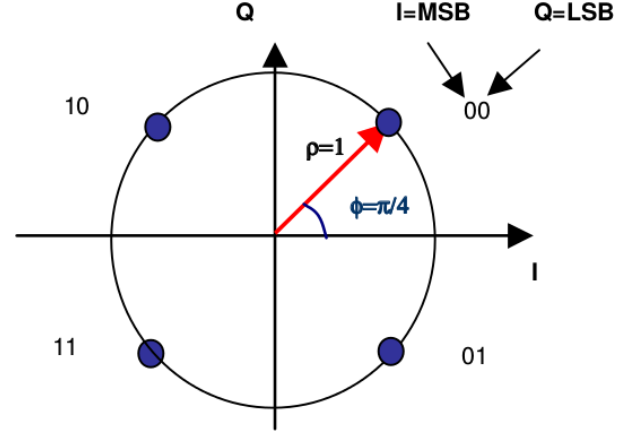


Fig. 1: Constellation diagram of QPSK

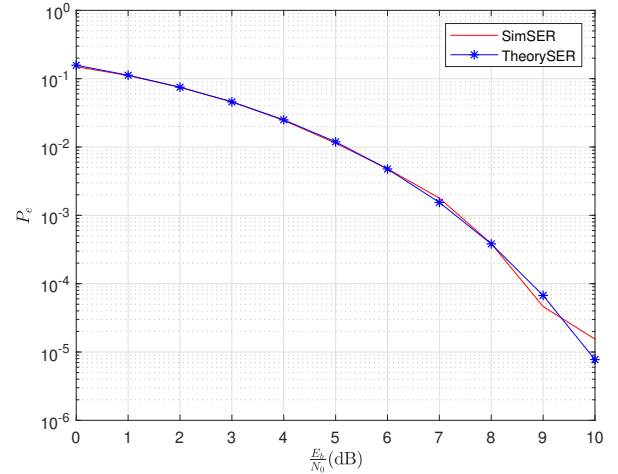


Fig. 2: SNR vs BER for QPSK

B. 8PSK

Constellation Mapping symbol set $\{X\}$ is generated by

$$X_k \in \left\{ e^{j\frac{2\pi n}{8}} \right\} \quad n = 0, 1, \dots, 7 \quad (1.4)$$

Demapping can be done by using,

$$\frac{2\pi}{8}i < \angle Y_k < \frac{2\pi}{8}(i+1) \implies \hat{X}_k = X_i \quad i = 0, \dots, 7 \quad (1.5)$$

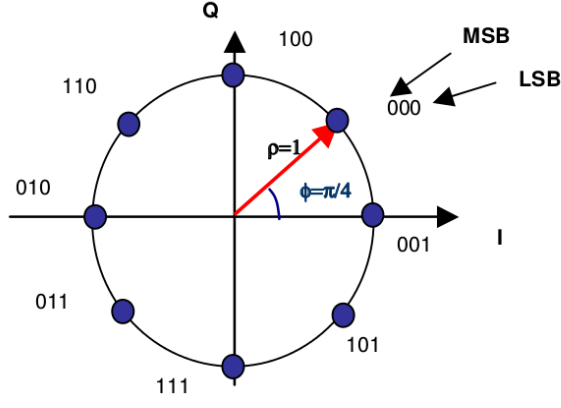


Fig. 3: Constellation diagram of 8-PSK

Fig. 3 Shows the Constellation mapping for 8-PSK symbols and Fig. 4 Shows the Simulation diagram.

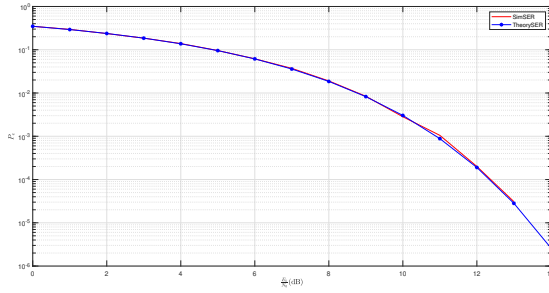


Fig. 4: SNR vs BER for 8-PSK

2. AMPLITUDE PHASE SHIFT KEYING (APSK)

A. 16-APSK

Constellation Mapping symbol set $\{X\}$ is generated by

$$X_k \in \{X\} = \begin{cases} r_1 e^{j(\phi_1 + \frac{2\pi}{4}n)} & n = 0, \dots, 3 \\ r_2 e^{j(\phi_2 + \frac{2\pi}{12}n)} & n = 0, 1, \dots, 11 \end{cases} \quad (2.1)$$

Demapping can be done by using,

$$|Y_k| < \frac{r_1 + r_2}{2} \& \frac{2\pi}{4}i < \angle Y_k < \frac{2\pi}{4}(i+1) \quad (2.2)$$

$$\Rightarrow \hat{X}_k = X_i \quad i = 0, \dots, 3 \quad (2.3)$$

$$|Y_k| > \frac{r_1 + r_2}{2} \& \frac{2\pi}{12}i < \angle Y_k < \frac{2\pi}{12}(i+1) \quad (2.4)$$

$$\Rightarrow \hat{X}_k = X_i \quad i = 4, \dots, 15 \quad (2.5)$$

Where $\frac{r_2}{r_1} = 2.6, \phi_1 = 45, \phi_2 = 15$ Fig. 5 Shows the Constellation mapping for 16-APSK symbols and Fig. 6 Shows the Simulation diagram.

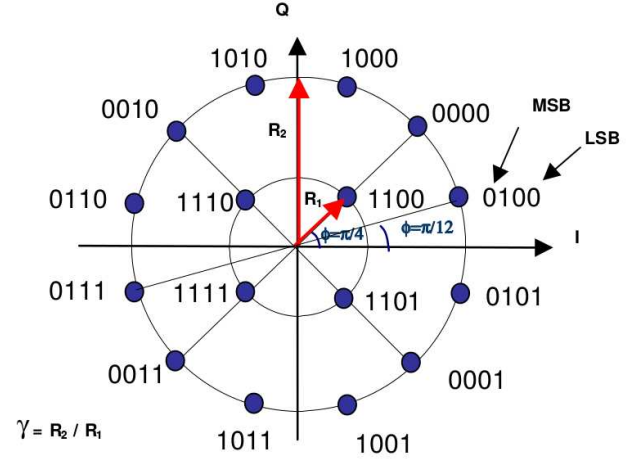


Fig. 5: Constellation diagram of 16APSK

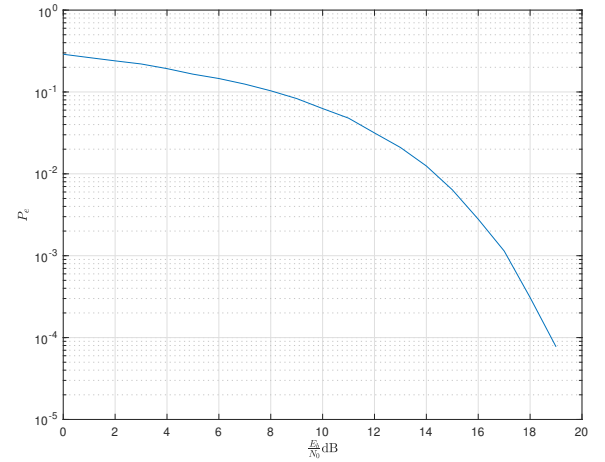


Fig. 6: SNR vs BER for 16-APSK

B. 32-APSK

Constellation Mapping symbol set $\{X\}$ is generated by

$$X_k \in \{X\} = \begin{cases} r_1 e^{j(\phi_1 + \frac{2\pi}{4}n)} & n = 0, \dots, 3 \\ r_2 e^{j(\phi_2 + \frac{2\pi}{12}n)} & n = 0, 1, \dots, 11 \\ r_3 e^{j(\phi_3 + \frac{2\pi}{16}n)} & n = 0, 1, \dots, 16 \end{cases} \quad (2.6)$$

Where $\frac{r_2}{r_1} = 2.54, \frac{r_3}{r_2} = 4.33, \phi_1 = 45, \phi_2 = 15, \phi_3 = 0$.

Demapping can be done by using,

$$|Y_k| < \frac{r_1 + r_2}{2} \&\& \frac{2\pi}{4}i < \angle Y_k < \frac{2\pi}{4}(i+1) \quad (2.7)$$

$$\Rightarrow \hat{X}_k = X_i \quad i = 0, \dots, 3 \quad (2.8)$$

$$\frac{r_1 + r_2}{2} < |Y_k| < \frac{r_2 + r_3}{2} \&\& \frac{2\pi}{12}i < \angle Y_k < \frac{2\pi}{12}(i+1) \quad (2.9)$$

$$\Rightarrow \hat{X}_k = X_i \quad i = 4, \dots, 15 \quad (2.10)$$

$$|Y_k| > \frac{r_2 + r_3}{2} \&\& \frac{2\pi}{12}i < \angle Y_k < \frac{2\pi}{12}(i+1) \quad (2.11)$$

$$\Rightarrow \hat{X}_k = X_i \quad i = 16, \dots, 31 \quad (2.12)$$

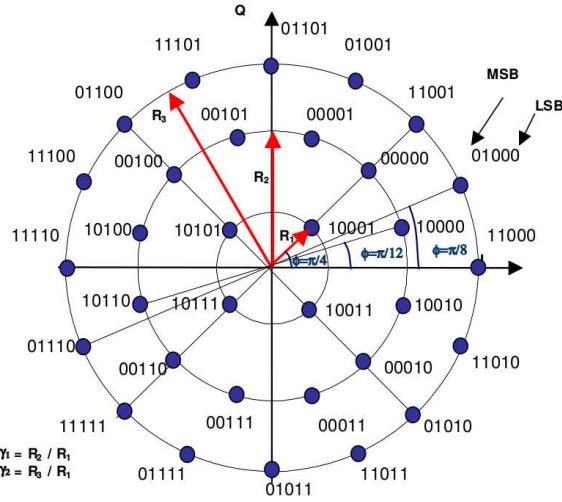


Fig. 7: Constellation diagram of 32APSK

Fig. 7 shows the Constellation mapping for 32-APSK symbols and Fig. 8 shows the Simulation diagram.

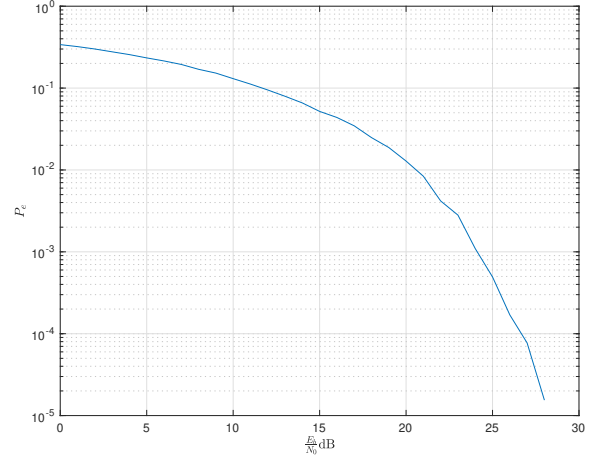


Fig. 8: SNR vs BER for 32-APSK

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>