Physical Layer Design for a Narrow Band Communication System

G V V Sharma

***Abstract*—This a simple document explaining a question about the concept of similar triangles.**

Download all python codes from

svn co https://github.com/SiddharthPh/Summer2020/trunk/geometry/codes

and latex-tikz codes from

svn co https://github.com/gadepall/school/trunk/ncert/geometry/figs

1 Specifications

1.1. QPSK

$$\mathbf{y} = \mathbf{s} + \mathbf{n} \tag{1.1.1}$$

where $\mathbf{s} \in \{s_0, s_1, s_2, s_3\}$

$$s_0 = \begin{pmatrix} \sqrt{E_s} \\ 0 \end{pmatrix} \tag{1.1.2}$$

$$s_1 = \begin{pmatrix} 0 \\ \sqrt{E_s} \end{pmatrix} \tag{1.1.3}$$

$$s_2 = \begin{pmatrix} -\sqrt{E_s} \\ 0 \end{pmatrix} \tag{1.1.4}$$

$$s_3 = \begin{pmatrix} 0 \\ -\sqrt{E_s} \end{pmatrix} \tag{1.1.5}$$

1.2. Encoding

s_0 denote bits 00, s_1 denote bits 01, s_2 denote bits 11,s_3 denote bits 10.

1.3. Decoding

Let $\mathbf{r}$ be the received bits, $\mathbf{r} = [r_1, r_2]$

$$r_1 = \begin{cases} 0, & \mathbf{y} \in D1 \cup D2 \iff y_1 + y_2 > 0 \\ 1, & \mathbf{y} \in D3 \cup D4 \iff y_1 + y_2 < 0 \end{cases} \tag{1.3.1}$$

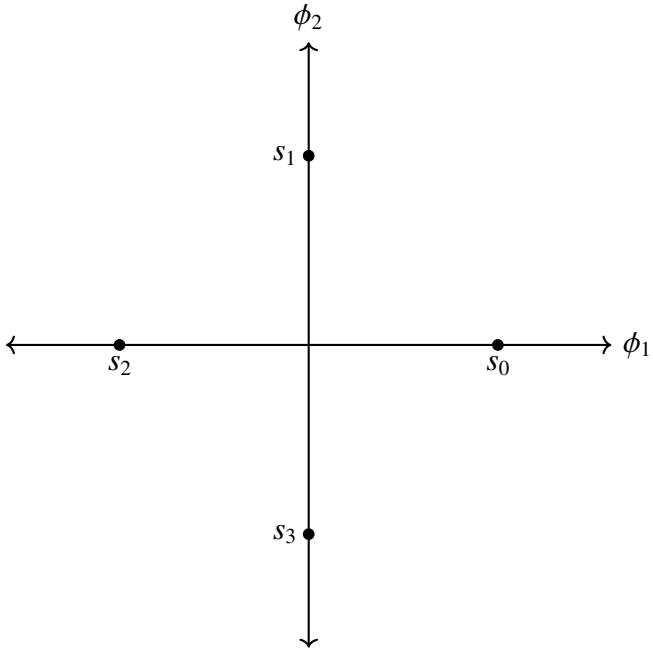

Fig. 1.3: constellation diagram

$$r_2 = \begin{cases} 0, & \mathbf{y} \in D1 \cup D4 \iff y_2 - y_1 < 0 \\ 1, & \mathbf{y} \in D2 \cup D3 \iff y_2 - y_1 > 0 \end{cases} \tag{1.3.2}$$

For detecting s_0, $y_1 > -y_2$ and $y_1 > y_2$.
For detecting s_1, $y_1 > -y_2$ and $y_1 < y_2$.
For detecting s_2, $y_1 < -y_2$ and $y_1 < y_2$.
For detecting s_3, $y_1 < -y_2$ and $y_1 > y_2$.

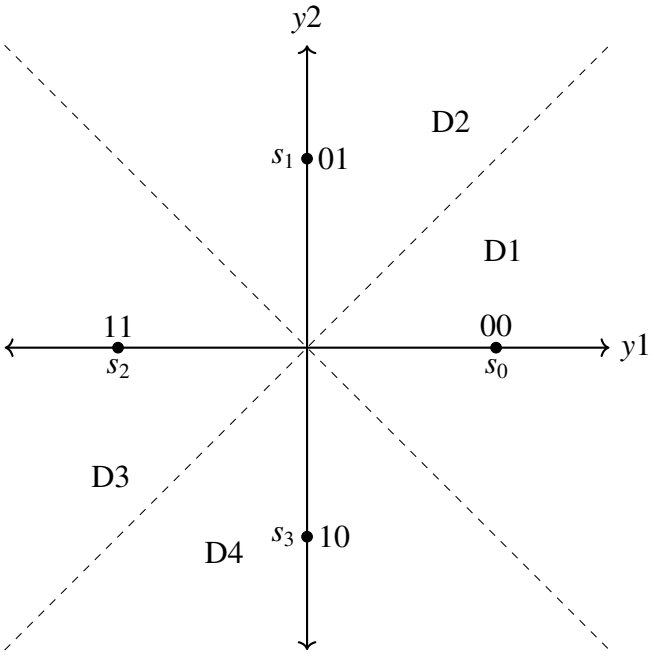

Fig. 1.3: constellation diagram