# BigCat Wireless - EC401
# **Assignment 1**

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*1. List the differences between wired and wireless communication?*

| **Wired Communications** | **Wireless Communications** |
|---|---|
| In a wired communication system there exists a physical medium (like wires) | In wireless communication systems, there does not exist any physical medium |
| In such systems, information is sent in form of electrical signals (or optical signals) | Information is transmitted using electromagnetic waves. |
| Collision Detection is used | Collision Avoidance is used |

*2. Perform addition of -1.895[S(1,7)] + 0.125[S(0,3)]*

Operand 1 ($O_1$) = S(1,7) = -1.895
Operand 2 ($O_2$) = S(0,3) = 0.125
Resultant bit growth = S(max(1,0)+1,max(7,3)) = S(2,7)

Scaling, we get:

$$-1.895 * 2^7 = -242 = 100001110 \ \ (2'scomplement)$$
$$0.125 * 2^7 = 16 = 000010000$$

$$\begin{aligned} -1.895[S(1,7)] + 0.125[S(0,3)] = & \\ 100001110 & \\ (+) \ \ 000010000 & \\ \hline 0 \quad 100011110 & \\ ====> -226 & \end{aligned}$$

Scaling back, we get:

$$-226/2^7 = -1.765625$$

Therefore, -1.895[S(1,7)] + 0.125[S(0,3)] = -1.765625

*3. Perform multiplication of -0.125[S(0,3)] * -0.5[S(0,3)]*

Operand 1 ($O_1$) = S(0,3) = -0.125
Operand 2 ($O_2$) = S(0,3) = -0.5
Resultant bit growth = S(0+0+1,3+3) = S(1,6)

Scaling, we get:

$$-0.125 * 2^3 = -1 = 1111 \ \ (2'scomplement)$$
$$-0.5 * 2^3 = -4 = 1100 \ \ (2'scomplement)$$

$$\begin{aligned} -0.125[S(0,3)] * -0.5[S(0,3)] = \\ 1111 \\ (*) \ \ 1100 \\ \hline 0000 \\ 0000 \\ 1111 \\ 1111 \\ \hline 010110100 \\ ====> 4 \end{aligned}$$

Scaling back, we get:

$$4/2^6 = 0.0625$$

Therefore, -0.125[S(0,3)] * -0.5[S(0,3)] = 0.0625

*4. Represent the number 11101100 S(1,6) in result format S(0,3)*

Rounding off 11101100 S(1,6) to result format S(0,3) =

$$\begin{aligned} 11101100 \\ (+) \ \ 00001000 \\ \hline 11110100 \end{aligned}$$

After Truncation, the result in S(0,3) would be 1111 = -0.125

*5. Generate 16-QAM modulated signal without using inbuilt Matlab functions and plot the same using rectangular plane (IQ-Plot)*

A seperate function for 16 QAM modulation is defined and used to modulate a random signal. The constellation diagram obtained is also shown.

```
% main.m
M = 16;
x = randi([0 M - 1], 100, 1);
y = qammod16(x);
scatterplot(y);
```

```
% qammod.m
function y = qammod16(x)
len = length(x);
y = zeros(len, 1);
for i = 1:len
    switch x(i)
        case 0
            y(i) = - 3.0 + 1.0i;
        case 1
            y(i) = - 3.0 - 3.0i;
        case 2
            y(i) = - 3.0 - 1.0i;
        case 3
            y(i) = - 1.0 + 3.0i;
        case 4
            y(i) = - 3.0 + 3.0i;
        case 5
            y(i) = - 1.0 + 1.0i;
        case 6
            y(i) = - 1.0 - 3.0i;
        case 7
            y(i) = - 1.0 - 1.0i;
        case 8
            y(i) = 3.0 + 3.0i;
        case 9
            y(i) = 3.0 + 1.0i;
        case 10
            y(i) = 3.0 - 3.0i;
        case 11
            y(i) = 3.0 - 1.0i;
        case 12
            y(i) = 1.0 + 3.0i;
        case 13
            y(i) = 1.0 + 1.0i;
        case 14
            y(i) = 1.0 - 3.0i;
        case 15
            y(i) = 1.0 - 1.0i;
    end
end
end
```

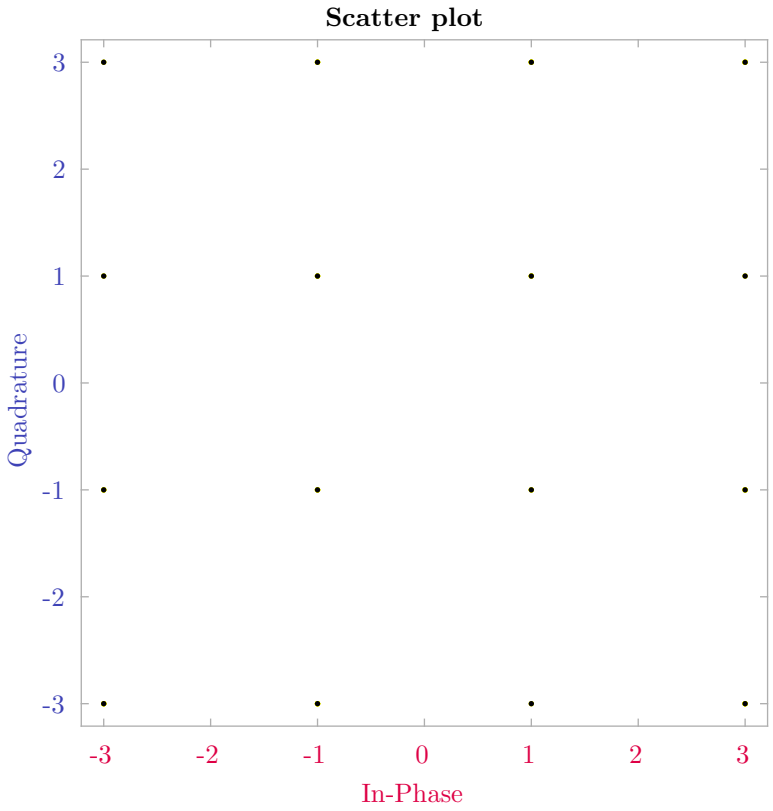


Figure 1: Constellation Diagram - 16 QAM