徽标

描述已自动生成

**IT.2407 - IoT and Cellular Network**

**TD**

**La chaîne de transmission numérique**

**GUO Xiaofan**

Contents

[Problem 1: Single carrier modulation 3](#_Toc166871459)

[1. Demodulation the signal to find back. 3](#_Toc166871460)

[2. The processing of the received signal. 4](#_Toc166871461)

[3. Indicate the duration of the symbols. 5](#_Toc166871462)

[4. Name of the song. 6](#_Toc166871463)

[Problem 2: OFDM signal 6](#_Toc166871464)

[1. Find the spacing. 6](#_Toc166871465)

[2. Find the data rate. 7](#_Toc166871466)

[3. Find the 16QAM symbols transmitted. 7](#_Toc166871467)

[4. Name of the song. 8](#_Toc166871468)

# Problem 1: Single carrier modulation

## Demodulation the signal to find back.

1. The form of the modulated signal is:

A – Amplitude

φ – the phase determined by the 16QAM constellation diagram

Then,

Remove high-frequency () components with a low-pass filter (with a frequency ), to get .

:

Then,

Remove high-frequency () components with a low-pass filter (with a frequency ), to get .

1. Based on , can get A and φ.

## The processing of the received signal.

**In-phase Component Processing Flow**

1. **Receiving the Signal:** receive the signal transmitted at a carrier frequency of 800 MHz.
2. **Spectrum Analysis:** Perform spectrum analysis on the received signal, finding that the signal has energy distributed around 0 GHz and 1.6 GHz (2 \* 800 MHz).
3. **Multiplying the Signal by** : To extract the in-phase component , multiply the signal by . This generates a new signal containing components of the original signal and a high-frequency component.
4. **Low-pass Filtering:** Pass the product signal through a low-pass filter to remove high-frequency components around 1.6 GHz, retaining only the baseband signal. After filtering, the time-domain signal becomes clearer, mainly containing low-frequency oscillations representing different binary symbols and a small amount of noise.
5. **Reading** : In the time-domain signal, read the in-phase component . These values correspond to the in-phase component of the original 16QAM modulated signal.

**Quadrature Component Processing Flow**

1. **Multiplying the Signal by** : To extract the quadrature component , multiply the signal by . This generates a new signal containing components of the original signal and a high-frequency component.
2. **Low-pass Filtering:** Pass the product signal through a low-pass filter to remove high-frequency components around 1.6 GHz, retaining only the baseband signal. After filtering, the time-domain signal becomes clearer, mainly containing low-frequency oscillations representing different binary symbols and a small amount of noise.
3. **Reading** : In the time-domain signal, read the quadrature component . These values correspond to the quadrature component of the original 16QAM modulated signal.

## Indicate the duration of the symbols.

(-1, 3) ->0100

(1, 1) ->1101

(-1, -1) ->0111

(3, 1) ->1001

(-3, -3) ->0010

(-3, 3) ->0000

(-1, -1) ->0111

(-1, -1) ->0111

(-1, -3) ->0110

(-3, 1) ->0001

(-1, -1) ->0111

(3, 1) ->1001

## Name of the song.

图形用户界面, 文本, 应用程序, 电子邮件

描述已自动生成

# Problem 2: OFDM signal

## Find the spacing.

Between two neighbours’ subcarriers:

## Find the data rate.

1. For using 32AQM, and the message occupies only 20 subcarriers:
2. Information bits per symbol =

## Find the 16QAM symbols transmitted.

(-1, -3)->01010

(-3, -1) ->01111

(-3, 3) ->01100

(-1, -5) ->00011

(-3, 3)->01100

(1, 3) ->11000

(-3, 3) ->01100

(5, -1) ->10111

(-5, 1) ->00101

(-3, 5) ->00000

(-1, 1) ->01001

(-1, -5) ->00011

(-3, 3) ->01100

(1, 3) ->11000

(-3, 3) ->01100

(3, -3) ->11110

(-3, 3) ->01100

(3, 1) ->11101

(-3, 3) ->01100

(-1, -3) ->01010

## Name of the song.

图形用户界面

描述已自动生成