Experiment - 6

ANALYSIS OF RELATION BETWEEN BIT RATE, SYMBOL RATE AND CHIP RATE

Aim: To analyze the relation between bit rate, symbol rate and chip rate.

Apparatus:

1. CDMA Modulator & Demodulator kit
2. Host to device USB cable
3. Power Supply for Modulator & Demodulator
4.

Theory:

Bit rate:

The bit rate is the number of bits that pass a given point in a telecommunication network in a given amount of time, usually a second. Thus, a bit rate is usually measured in some multiple of bits per second .

Symbol rate:

symbol rate also known as baud rate and modulation rate, is the number of symbol changes, waveform changes, or signaling events, across the transmission medium per time unit using adigitally modulated signal or a line code. The symbol rate is measured in baud (Bd)
or symbols/second.

Chip rate:

Chip rate in direct sequence spread spectrum technologies such as DSSS and CDMA, it is the number of bits per second (chips per second) used in the spreading signal. A different spreading signal is added to the data signal to code each transmission uniquely. Chip rate frequency can be observed on the mimic “Chip Clock” using digital storage oscilloscope or logic analyzer. Similarly “Bit Clock” can also be observed. User can vary the chip rate on the software and click on the “configuration button” to make the respective variation in the hardware.

Procedure:

1. Plug in the DC adaptor cable to the connector 2131B-PS situated on the left side of theunit and turn on the AC switch, the corresponding power LED on the left side of the mimic will turn ON, the 2131B unit is ready to work
2. Connect USB cable between computer / laptop and 2131B situated on the right side of the unit.
3. Connect FRC 40 pin Cable between 2131B modulator output to demodulator input.
4. Click on the Scientech 2131B shortcut icon on the desktop. A software graphical user interface will open.

5. Now Click on CDMA-DSSS Modulator block and a software graphical user interface will open.
6. To detect hardware, click on the Auto Detect Device.
7. After successfully hardware detection, now click on the "factory setting" button for default setting.
8. Click on the "Spreading Code Generation" block for Chip Rate setting. Bit Clock will depend on the Chip Rate frequency and length of the PN-Code sequence.

Output waveforms:

Chip Rate / Chip Clock of 1 MChip
Bit Clock = Chip Rate / PN-Code Length

Result: The relation between bit rate, symbol rate and chip rate is analyzed.

Experiment - 7

GENERATION OF DIFFERENT PN CODES

Aim: To Generate different PN codes like barker code, gold code and maximum length sequence code.

Apparatus:

1. CDMA Modulator & Demodulator kit
2. Host to device USB cable
3. Power Supply for Modulator & Demodulator

Theory:

Pseudo random binary sequences (PRBSs), also known as pseudo noise (PN), linear feedback shift register (LFSR) sequences or maximal length binary sequences (m sequences), are widely used in digital communications, instrumentation and measurements . In a truly random sequence the bit pattern never repeats. A pseudo random binary sequence is a semi-random sequence in the sense that it appears random within the sequence length, fulfilling the needs of randomness, but the entire sequence repeats indefinitely. To a casual observer the sequence appears totally random, however to a user who is aware of the way the sequence is generated all its propertiesshould be known. PN sequences have several interesting properties, which are exploited in a variety of applications. Because of their good autocorrelation two similar PN sequences can easily be phase synchronized, even when one of them is corrupted by noise. A PN sequence is an ideal test signal, as it simulates the random characteristics of a digital signal and can be easily generated. The following fig. 1 shows the overview of PN sequence.

Barker Code

Barker codes are binary numbers using two to 13 bits and have unique auto-correlation functions. The points adjacent to the peak of the correlation function equal zero. This is very useful in a radar system since any spurious response can be misinterpreted as a target. A Barker- coded pulse typically uses binary phase modulation.

Gold code

A Gold code, also known as Gold sequence, is a type of binary sequence, used in telecommunication (CDMA) and satellite navigation (GPS). Gold codes are named after Robert Gold. Gold codes have bounded small cross-correlations within a set, which is useful when multiple devices are broadcasting in the same frequency range. A set of Gold code sequences consists of 2^n+1 sequences each one with a period of 2^n-1

Maximum length sequence

A maximum length sequence (MLS) is a type of pseudorandom binary sequence. They areit sequences generated using maximal linear feedback shift registers.

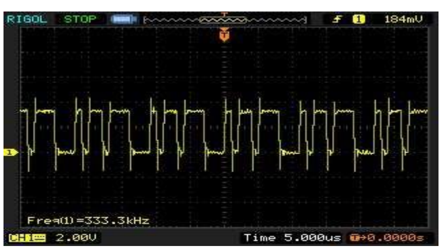
Procedure:

1. Plug in the DC adaptor cable to the connector 2131B-PS situated on the left side of theunit and turn on the AC switch, the corresponding power LED on the left side of the mimic will turn ON, the 2131B unit is ready to work
2. Connect USB cable between computer / laptop and 2131B situated on the right side of the unit.
3. Connect FRC 40 pin Cable between 2131B modulator output to demodulator input.
4. Click on the Scientech 2131B shortcut icon on the desktop. A software graphical user interface will open
5. Now Click on CDMA-DSSS Modulator block .A software graphical user interface will open.
6. To detect hardware, click on the Auto Detect Device.
7. After successfully hardware detection, now click on the “factory setting” button for default setting.
8. Click on the “Spreading Code Generation” block for Chip Rate setting, PN-Code setting.
9. Select the chip rate as 1 MChip/s and select various PN codes with different spreading factor.

Output waveforms:

Barker Code:

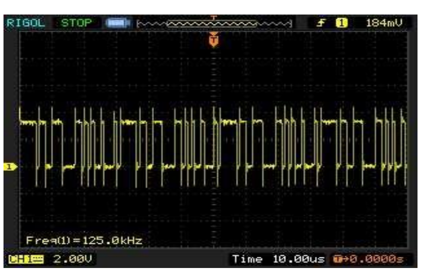
11-bit Barker Code



13-bit Barker Code

Gold Code:

N=5(Length 31)

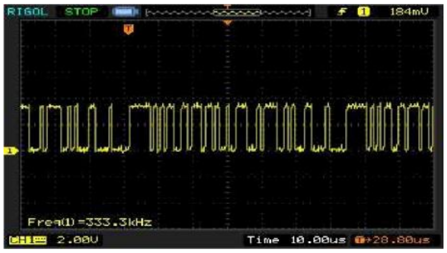


N=6(Length 63)

Maximum Length Sequence:

N=5

N=6



Result: Different PN codes like barker code, gold code and maximum length sequence code are generated.

Experiment - 8

BIT ERROR RATE MEASURMENT OF CDMA-DSSS

Aim: Bit Error Rate (BER) measurement of CDMA-DSSS complete system using different signal gain and noise gain i.e. SNR.

Apparatus:

1. CDMA Modulator & Demodulator kit
2. Host to device USB cable
3. Power Supply for Modulator & Demodulator

Procedure:

1. Plug in the DC adaptor cable to the connector 2131B-PS situated on the left side of theunit and turn on the AC switch, the corresponding power LED on the left side of the mimic will turn ON, the 2131B unit is ready to work
2. Connect USB cable between computer / laptop and 2131B situated on the right side of the unit.
3. Connect FRC 40 pin Cable between 2131B modulator output to demodulator input.
4. Click on the Scientech 2131B shortcut icon on the desktop.
5. Now Click on CDMA-DSSS Modulator block .A software graphical user interface will open.
6. To detect hardware, click on the Auto Detect Device.
7. After successfully hardware detection, now click on the “factory setting” button for default setting.
8. Similarly click on CDMA-DSSS De-Modulator block .A software graphical user interface will open.
9. Follow same steps like, click on the Auto Detect Device, Factory setting & after doing setting as per requirement; finally click on Configuration button for hardware configuration.
10. Click on BER Table Button.
11. Now at modulator side set the signal gain and noise gain and configure it.
12. Come back to De-Modulator side and click on Monitor button and new Bit Error’s will display.
13. Now enter this numerical value in “No. of Error Bits” in the BER table with respect to the present signal & noise gain setting.
14. Similarly follow the same steps for other reading as well.

Reference Setting for Modulator Section:

Input Data = Test Data mode

Clock = Internal

Chip Rate = l MChip/s

PN-Code = 13-bit Barker

Modulation = BPSK

Signal Gain = Setting as per BER Table

RRC Filter = Enable

Noise Gain = Setting as per BER Table

Offset Carrier Frequency = 0

Output Sample Format = Unsigned

Interpolation = On

Spectrum Spreading = EnableSpectrum Inversion = Off

Reference Setting for De-Modulator

Section: Input Data Format = Unsigned

Clock = Internal

Chip Rate = l MChip/s

PN-Code = 13-bit Barker

Modulation = BPSK

Offset Carrier Frequency = 0 Output

Sample Format = I/Q SerialCarrier

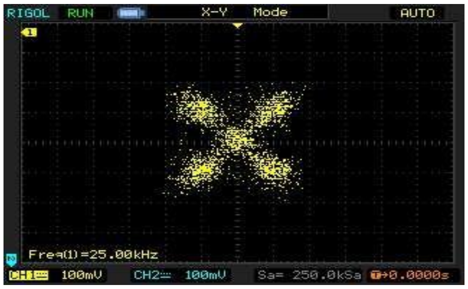
Loop Tracking = Nominal

Spectrum Spreading = Enable

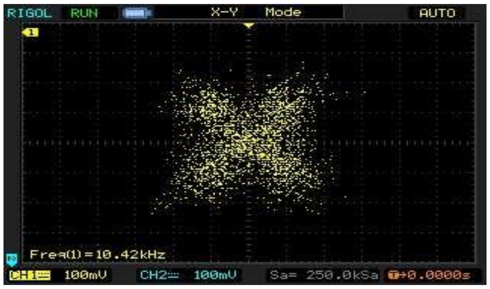
Spectrum Inversion = Off

Output:

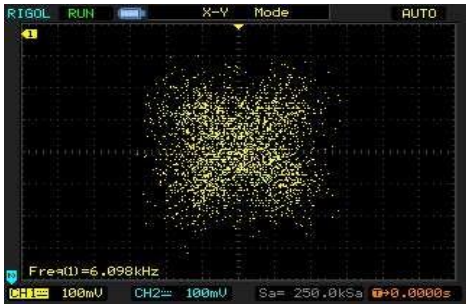
Signal Gain = 64 & Noise Gain = 32



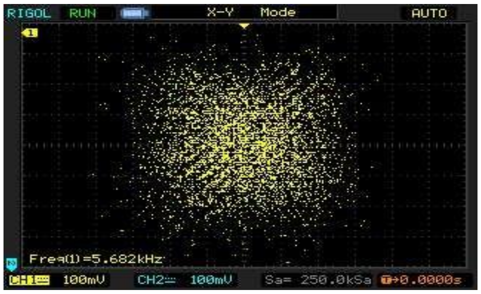
Signal Gain = 64 & Noise Gain = 64



Signal Gain = 64 & Noise Gain = 91



Signal Gain = 64 & Noise Gain = **128**



Result: Bit Error Rate (BER) measurement of CDMA-DSSS complete system using different signal gain and noise gain i e. SNR is successfully completed.

Experiment – 9

Performance Analysis of Handoff in CDMA and GSM Cellular Systems

Aim: To analyze the handoff performance in CDMA and GSM Cellular Systems

Apparatus:

1. MATLAB 2012

Theory:

Write theory regarding Handoff

Program Code:

```
clc
clear all;
hte=150; %height of transmitting base station antenna in meters
hre=10;  %height of receving antenna of mobile station in meters
sdA=3;    %standard deviation of noise for Base station A
sdB=5;   %standard deviation of noise for Base station B
noiseA=sdA*randn(1,50);
noiseB=sdB*randn(1,50);
disp('uplink freq=835 Mhz')
disp('downlink freq=880 Mhz')
disp('urban environment =900 Mhz')
fc=input(Enter uplink, downlink or urban environment frequency?=')
 for d=1:50
        % path loss calculation Between Mobile & Base station A
        LA(d)=(69.55+26.6*log10(fc))-(13.82*log10(hte))-((1.11*log10(fc)-
        0.7)*(10)+(1.56*log10(fc)- 0.8))+((44.9-6.55*log10(hte))*log10(d));

        %path loss calculation Between Mobile & Base station B
        LB(d)=(69.55+26.6*log10(fc))-(13.82*log10(hte))-((1.11*log10(fc)-
        0.7)*(10)+(1.56*log10(fc)- 0.8))+((44.9-6.55*log10(hte))*log10(51-(d)));
        % path loss calculation for free space model
        LF(d)=32.4+20*log10(fc)+20*log10(d);

        SrA(d)=60-LA(d); % Received power at A without noise

        SrB(d)=60-LB(d); % Received power at B without noise

        PrA(d)=60-LA(d)+noiseA(d);%Received power at A with Gaussian noise sd=3

        PrB(d)=60-LB(d)+noiseB(d);%Received power at B with Gaussian noise sd=5

 end
```

```
figure(1)
subplot(2,1,1);
plot (PrA);
hold on
plot (PrB,'m');
axis([0 50 -90 -50]);
xlabel('distance');
ylabel('signal strength')
grid

subplot(2,1,2);
plot(SrA);
hold on
plot(SrB,'m');
axis([0 50 -90 -50]);
xlabel('distance');
ylabel('signal strength')
grid

figure(2)
plot(LA,'m');
xlabel('distance');
ylabel('signal strength')
hold on
plot(LF);
xlabel('distance');
ylabel('signal strength')
```