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Group: A1

Assignment: 4

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Assignment 4: Implement CDMA with Walsh code.

In this assignment you have to implement CDMA for multiple access of a common channel by n stations. Each sender uses a unique code word, given by the Walsh set, to encode its data, send it across the channel, and then perfectly reconstruct the data at n stations.

Code:

```
from math import log2,ceil
import random

n=int(input("how many stations?"))
N=2**ceil(log2(n))

# need to create a walsh_table of N x N
walsh=[0]*N
for i in range(N):
    walsh[i]=[0]*N

def set_walsh(walsh,size):
    if(size==1):
        walsh[0][0]=1
        return
    half_size=size//2
    set_walsh(walsh,half_size)
    for i in range(half_size):
        for j in range(half_size,size):
            walsh[i][j]=walsh[i][j-half_size]

    for i in range(half_size,size):
        for j in range(half_size):
            walsh[i][j]=walsh[i-half_size][j]

    for i in range(half_size,size):
        for j in range(half_size,size):
            walsh[i][j]=-walsh[i-half_size][j-half_size]

set_walsh(walsh,N)

data_to_send=[0]*N
val=input("give data?(yes to input manually, otherwise random gen):")
if val.lower()=="yes":
```

```

print("-1 for 0, 0 for silence, 1 for 1")
for i in range(n):
    data_to_send[i]=int(input(f"for the {i}th station:"))
else:
    for i in range(n):
        data_to_send[i]=random.randint(-1,1)

encoded_data=[0]*N
for i in range(N):
    for j in range(N):
        encoded_data[j]+=data_to_send[i]*walsh[i][j]

data_unpacked=[0]*N
for i in range(N):#unpacking for the ith station
    tot=0
    for j in range(N):
        tot+=encoded_data[j]*walsh[i][j]
    tot//=N
    data_unpacked[i]=tot

print("data should be:")
print(*data_to_send)

print("data got:")
print(*data_unpacked)
ok=True

for i in range(N):
    if data_unpacked[i]!=data_to_send[i]:
        print(f"data garbled at {i}")
        ok=False
        break

if ok:
    print("data sent and received right")

```

Output:

```

how many stations?10
give data?(yes to input manually, otherwise random gen):no
data should be:
0 0 -1 0 1 0 1 -1 -1 1 0 0 0 0 0
data got:
0 0 -1 0 1 0 1 -1 -1 1 0 0 0 0 0
data sent and received right

```

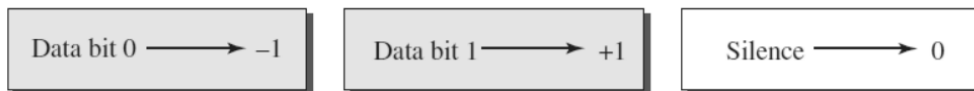
DESIGN:

CDMA is based on coding theory. Each station is assigned a code, which is a sequence of numbers called chips. They are called orthogonal sequences and have the following properties: Product of any two different chips is 0. A chip multiplied with itself gives the result N (= total number of stations)

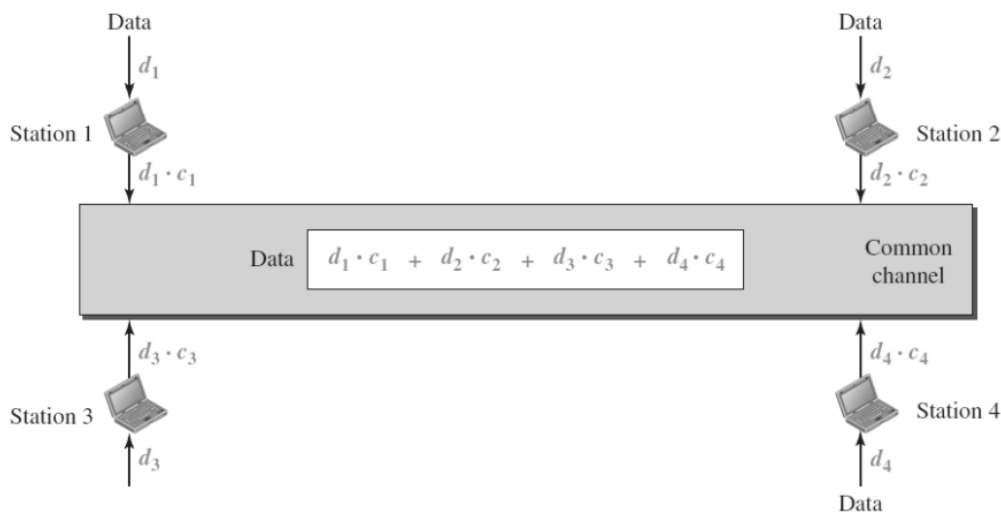
$$W_1 = \begin{bmatrix} +1 \end{bmatrix} \quad W_{2N} = \begin{bmatrix} W_N & W_N \\ W_N & \overline{W_N} \end{bmatrix}$$

The chips are generated using Walsh Table.

The number of sequences in a Walsh Table needs to be a power of 2. The encoding of bits are as follows:



The data on the channel is present in the form: To listen to any particular station, the station multiplies the data with the chip sequence of that station.



Discussion:

I could learn more about the CDMA protocol and its implementation with the help of this assignment