The modulation and demodulation in gsm marketing essay

GSM (Global System for Mobile communications) is the most popular standard for mobile phones in the world . In GSM signaling and speech channels are digital and data communication is easy to build into the system

GSM is a cellular network, and mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network-macro, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment.

GSM networks operate in a number of different frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G). Most 2G GSM networks operate in the 900 MHz or 1800 MHz bands. Most 3G GSM networks in Europe operate in the 2100 MHz frequency band. 900MHz GSM uses a combination of TDMA and FDMA. It uses eight time slots, hence one carrier can support eight full rate or sixteen half rate channels. Channel separation is 200kHz with mobile transmit channels in the range 890 to 915MHz and mobile receive channels in the range 935 to 960MHz. Peak output power of the transmitters depends on the class of the mobile station and can be 0. 8, 2, 5, 8, or 20 watts.

GSM is based on digital cellular networks which have some advantages as listed below

Greater spectrum usage efficiency compared to analogue approaches.

Improved service quality for users in the form of improved speech quality, improved security through inbuilt encryption (there is none at present), and higher connection reliability.

Larger number of advanced user services and easier linkage to private and public ISDN networks.

CHAPTER 2:

GENERAL PROPERTIES OF GSM

GSM uses multiple access technology like FDMA/TDMA and CDMA

TDMA. With time division multiple access simultaneous conversations are supported by users transmitting in short bursts at different times or ‘ slots’.

FDMA. In frequency division multiple access, the total band is split into narrow frequency subbands and a channel is allocated exclusively to each user during the course of a call. One is used for transmission and one for reception.

CDMA. Code division multiple access allows all users access to all frequencies with the allocated band. A single user is extracted from the mayhem by looking for each user’s individual code using a correlator. Although not selected for the current generation of mobile digital technologies, CDMA holds much promise as the future technology of choice for GSM replacement in the next century.

• GSM uses frequency division duplexing.

• Channel for uplink is from : 890 – 915 MHz

• Channel for downlink is from 935 – 960 MHz

• Distance b/w the frequencies used for uplink and downlink (duplex distance) is 45 MHz

• Frequency difference between adjacent allocations in a frequency plan(channel spacing) is 200khz.

• Total number of frequencies are equal to 124

• Bit rate of each channel is 270. 9 kbit/s

• Duration of data frame in GSM is 4. 615 msec

• Number of time slots are 8 and each slot is of (4. 615 / 8) 0. 577 m sec

Speech bit rate is 13 kbits /sec

ARCHITECTURE OF GSM NETWORK

The GSM network can be divided into four main parts:

The Mobile Station (MS).

The Base Station Subsystem (BSS).

The Network and Switching Subsystem (NSS).

The Operation and Support Subsystem (OSS).

CHAPTER 3:

BACKGROUND OF GSM

The first GSM system specification was published in July 1991 and was immediately followed by several false starts. This was brought about by a combination over-optimism, difficulties in type approval testing, and inevitable changes to the GSM specification. The first terminals appeared on the market in June 1992.

A combination of high demand for mobile services and a lack of capacity in the installed analogue network, has made Germany the most advanced country for GSM deployment. In the UK, Vodafone have said that they now cover 60-70% of the UK population with their GSM service and expect 90% coverage by mid 1993.

GSM has also been accepted for use by over seventeen European countries and several others including New Zealand and Hong Kong ending a period of diverse and proprietary standards.

Some of the problems which were faced by the Europians when implementing these brand new technology were

In many countries there is no overt demand or need for GSM. Analogue services are available and under employed.

GSM coverage needs to be as wide as analogue before users will swap over.

The current generation of GSM hand portables are not as small or as light as analogue variants. This will limit the interest of many users, even though a better service may be provided by GSM technology.

Terminal prices for digital technologies are high compared to analogue.

It is likely that it will be very difficult to get users to pay higher call charges for an improved service so GSM cannot be positioned as a higher quality/higher price service.

CHAPTER 4:

IMPLEMENTATION

Modulation scheme which is used in GSM is GMSK which is based on MSK. MSK uses linear phase changes and is spectral efficient.

Block diagram of GMSK generator:

Some of the properties of the GMSK are

Improved spectral efficiency

Power Spectral Density

Reduced main lobe over MSK

Requires more power to transmit data than many comparable modulation schemes

Before the GMSK can be explained, some fundamentals of Minimum Shift Keying (MSK) must be known.

MSK (MINIMUM SHIFT-KEYING)

MSK uses changes in phase to represent 0's and 1's, but unlike most other keying schemes we have seen in class, the pulse sent to represent a 0 or a 1, not only depends on what information is being sent, but what was previously sent.

Following is the pulse used in MSK

Where

if a ‘ 1’ was sent

if a ‘ 0’ was sent

To see how this works assume that the data being sent is 111010000, then the phase of the signal would fluctuate as seen below

In order to see the signal constellation diagram consider the following equations

which can be simplefied as

where

and

Thus the equations for s1 and s2 depend only on andwith each taking one of two possible values. Therefore there are 4 different possibilities

therefore the signal constellation diagram will be

Advantages of MFSK

MSK produces a power spectrum density that falls off much faster compared to the spectrum of QPSK. While QPSK falls off at the inverse square of the frequency, MSK falls off at the inverse fourth power of the frequency. Thus MSK can operate in a smaller bandwidth compared to QPSK

GMSK(GAUSSIAN-MINIMUM SHIFT-KEYING)

Even though MSK's power spectrum density falls quite fast, it does not fall fast enough so that interference between adjacent signals in the frequency band can be avoided. To take care of the problem, the original binary signal is passed through a Gaussian shaped filter before it is modulated with MSK.

The principle parameter in designing an appropriate Gaussian filter is the time-bandwidth product WTb. Following figure shows the frequency response of different Gaussian filters. MSK has a time-bandwidth product of infinity

As can be seen that GMSKs power spectrum drops much quicker than MSK's. Furthermore, as WTb is decreased, the roll-off is much quicker

In the GSM standard a time-bandwidth product of 0. 3 was chosen as a compromise between spectral efficiency and intersymbol interference. With this value of WTb, 99% of the power spectrum is within a bandwidth of 250 kHz, and since GSM spectrum is divided into 200 kHz channels for multiple access, there is very little interference between the channels

The speed at which GSM can transmit at, with WTb= 0. 3, is 271 kb/s. It cannot go faster, since that would cause intersymbol interference

CHAPTER 5:

FUTURE OF GSM

The strong demand for GSM is continuing. Today, GSM is used by 2. 3 billion people worldwide and the strong growth is expected to be maintained. Most of the expansion occurs in high-growth markets, where the cost of mobile calls and terminals is crucial.

With the success of GSM and to meet the demanding requirements of the subscribers,

GPRS, HSCSD and EDGE has been introduced which offer high data rates for the transmission. 3rd Generation (3G) systems will soon be introduced in Pakistan offering new and interesting services to the users and will bring internet to new levels

In future strong focus of GSM operators will be on maintaining high quality of service, increasing usage and exploring new revenue streams on value added services, market visibility through various market initiatives to fulfill subscribers' satisfaction and demand and above all to increase the value of investment for the shareholders.

MATLAB CODE

(IMPLEMENTATION OF GMSK)

```
clear all;

close all;

DRate = 1; % data rate or 1 bit in one second

M = 18; % no. of sample per bit

N = 36; % no. of bits for simulation [-18: 18]

BT = 0. 5; % Bandwidth*Period (cannot change )

T = 1/DRate; % data period , i. e 1 bit in one second
```

Ts = T/M;

k=[-18: 18]; % Chen’s values. More than needed;

% only introduces a little more delay

alpha = sqrt(log(2))/(2*pi*BT); % alpha calculated for the gaussian filter response

h = exp(-(k*Ts).^2/(2*alpha^2*T^2))/(sqrt(2*pi)*alpha*T); % Gaussian Filter Response in time domain

figure;

plot(h)

title(‘ Response of Gaussian Filter’);

xlabel(‘ Sample at Ts’);

ylabel(‘ Normalized Magnitude’);

grid;

bits = [zeros(1, 36) 1 zeros(1, 36) 1 zeros(1, 36) -1 zeros(1, 36) -1 zeros(1, 36) 1 zeros(1, 36) 1 zeros(1, 36) 1 zeros(1, 36)];

% Modulation

m = filter(h, 1, bits);% bits are passed through the all pole filter described by h, i. e bits are

```
% shaped by gaussian filter

t0=. 35; % signal duration

ts= 0. 00135; % sampling interval

fc= 200; % carrier frequency

kf= 100; % Modulation index

fs= 1/ts; % sampling frequency

t=[0: ts: t0]; % time vector

df= 0. 25; % required frequency resolution

int_m(1)= 0;

for i= 1: length(t)-1 % Integral of m

int_m(i+1)= int_m(i)+m(i)*ts;

end

tx_signal= cos(2*pi*fc*t+2*pi*kf*int_m); % it is frequency modulation not the
phase modulating with the integral of the signal

x = cos(2*pi*fc*t);

y = sin(2*pi*fc*t);

figure;
```

```
subplot(3, 1, 1)

stem(bits(1: 200))

title(‘ Gaussian Filtered Pulse Train’);

grid;

subplot(3, 1, 2)

plot(m(1: 230))

title(‘ Gaussian Shaped train’);

xlim([0 225]);

subplot(3, 1, 3)

plot(tx_signal)

title(‘ Modulated signal’);

xlim([0 225]);

% Channel Equalization

%load ‘ C: CASEDigital_Communicationprojectgmskalichannel. mat’

load ‘ channel. mat’

h = channel;

N1 = 700;
```

```
x1 = randn(N1, 1);

d = filter(h, 1, x1);

Ord = 256;

Lambda = 0. 98;

delta = 0. 001;

P = delta*eye(Ord);

w = zeros(Ord, 1);

for n = Ord: N1

u = x1(n:-1: n-Ord+1);

pi = P*u;

k = Lambda + u'*pi;

K = pi/k;

e(n) = d(n) – w'*u;

w = w + K *e(n);

PPrime = K*pi';

P = (P-PPrime)/Lambda;

w_err(n) = norm(h-w);
```

```
end

figure;

subplot(3, 1, 1);

plot(w);

title(‘ Channel Response’);

subplot(3, 1, 2);

plot(h,’r’);

title(‘ Adaptive Channel Response’);

rcvd_signal = conv(h, tx_signal);

subplot(3, 1, 3);

plot(rcvd_signal);

title(‘ Received Signal’);

eq_signal = conv(1/w, rcvd_signal);

figure;

subplot(3, 1, 1);

plot(eq_signal);

title(‘ Equalizer Output’);
```

```
subplot(3, 1, 2);

plot(eq_signal);

title(‘ Equalizer Output’);

axis([208 500 -2 2]);

subplot(3, 1, 3);

plot(tx_signal,’r’);

title(‘ Modulated Signal’);

% Demodulation

eq_signal1 = eq_signal(200: 460-1);

In = x.*eq_signal1;

Qn = y.*eq_signal1;

noiseI = awgn(In, 20);

noiseQ = awgn(Qn, 20);

I = In + noiseI;

Q = Qn + noiseQ;

LP = fir1(32, 0. 18);

yI = filter(LP, 1, I);
```

```
yQ = filter(LP, 1, Q);

figure;

subplot(2, 1, 1);

plot(yI);

title(‘ Inphase Component’);

xlim([0 256]);

subplot(2, 1, 2);

plot(yQ);

title(‘ Quadrature Component’);

xlim([0 256]);

Z = yI + yQ*j;

demod(1: N) = imag(Z(1: N));

demod(N+1: length(Z)) = imag(Z(N+1: length(Z)).*conj(Z(1: length(Z)-N)));

xt = -10*demod(1: N/2: length(demod))

xd = xt(4: 2: length(xt))

figure;

stem(xd)
```

```
title(' Demodulated Signal');
```

OUTPUTS

TABLE OF CONTENTS

CHAPTER 1:

INTRODUCTION

CHAPTER 2:

GENERAL PROPERTIES OF GSM

CHAPTER 3:

BACKGROUND OF GSM

CHAPTER 4:

IMPLEMENTATION

MSK

GMSK

CHAPTER 5:

FUTURE OF GSM

CHAPTER 6:

MATLAB IMPLEMENTATION