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Computer-Based Comparative Analysis of BPSK versus other PSK Modulation Models

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Abstract: Digital communication has been experiencing a lot of tremendous growth and success. It employs digital technique of modulation and demodulation which makes it more efficient, complex and secure in long distance transmission than its analogue counterpart. Of various types of digital modulation, Binary Phase shift Keying (BPSK) technique of modulation is believed to be reliable in long distance transmission with minimal errors. In this paper, computer based analysis is been carried out to comparatively model and analyse BPSK technique along-side other M-PSK techniques over an AWGN channel paying specific attention to the bit error rates(BER), number of errors and number of samples generated by the MATLAB simulation. The MATLAB simulation results show the BPSK method proves to be a better technique where distance and error generation are top factors to be considered.

Keywords: Modulation, BPSK, BER, AWGN channel.

I. INTRODUCTION

The transit to digital modulation provides more information capacity and unanimity with digital data services, higher data security, better quality communications, and quicker system availability. The aim of a digital communication system is to convey digital data between two or more nodes. Digital modulation techniques possess greater capacity to transport large amounts of traffic than analogue modulation technique[1]

In radio communications this is usually achieved by adjusting a physical characteristic of a sinusoidal carrier, either the frequency, phase, amplitude or a combination thereof by a digital signal usually "1"s and "0"s. This is performed in real systems with a modulator at the transmitting end and a detector at the receiving end [2]

The modulator imposes the physical change to the carrier and a demodulator detects the resultant modulation on reception of various Digital modulation techniques [3] BPSK is one of the simplest, most robust of all the PSK techniques .The BPSK modulation and demodulation is designed using MATLAB Simulink [4].

In this paper, implementation of BPSK modulation and demodulation over an AWGN channel has received considerable attention due to their low error rate, high flexibility, low cost, and high speed.

II. RELATED WORKS

[5] In their paper, presented why BPSK is normally used for high speed data transfer application, and that it provides a 3dB power advantage over the BASK modulation technique and is robust and simple in implementation. It also provides small error rates than any other systems.

[6] in his paper compared the Bit Error Ratio performance when the input of Reed-Solomon (RS) Encoder- Decoder is Integer and Binary to the M-ary frequency shift keying (MFSK) under AWGN, multipath Rayleigh and Rician fading channels. The results show the binary input RS encoder has best BER performance under Rayleigh fading when the value of M is 2.

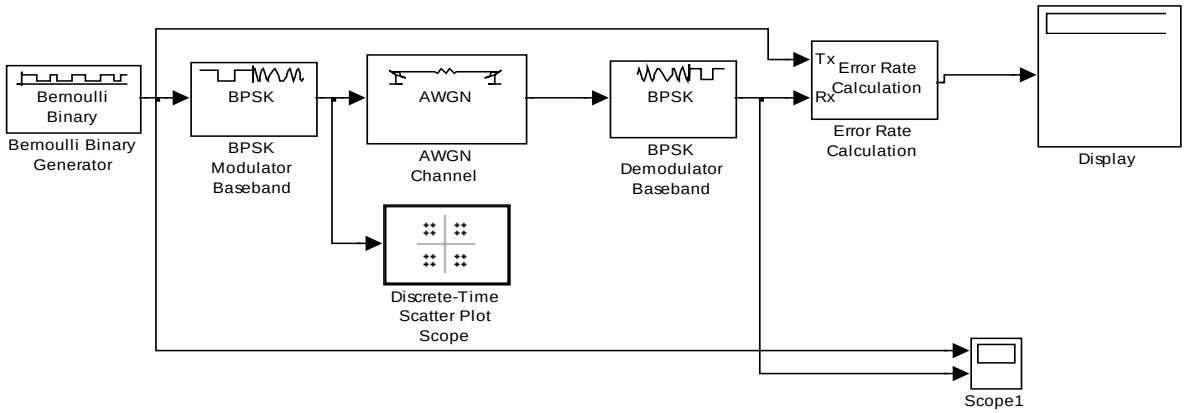

Fig. 1: A TYPICAL BPSK MODEL (Math works, 2009)

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[7] In their paper, the Design of Digital Modulators: BASK, BPSK and BFSK using VHDL, demonstrated the functionality of these digital modulators through simulations using the Quartus II software and experimental measurements of the real-time modulated signal via an oscilloscope [8][9][10].

III. METHODOLOGY

The following steps were taken to analyse the BPSK model alongside the other M-PSK models;

- Simulation was run in intervals of 50 Matlab seconds
- Records were taken for Error rate, Number of Errors generated and Number of Samples for the 2-PSK, 4-PSK, 8-PSK and 16-PSK models
- The **bpskdoc** model in Simulink was enabled and duplicated into three more models replacing the BPSK modulator/demodulator with the 4-PSK, 8-PSK and 16-PSK modulators/demodulators as shown in Fig. 2 below
- In each model, the option 'stop simulation' was disabled to allow for runtime analyses in the Bit error rate display.

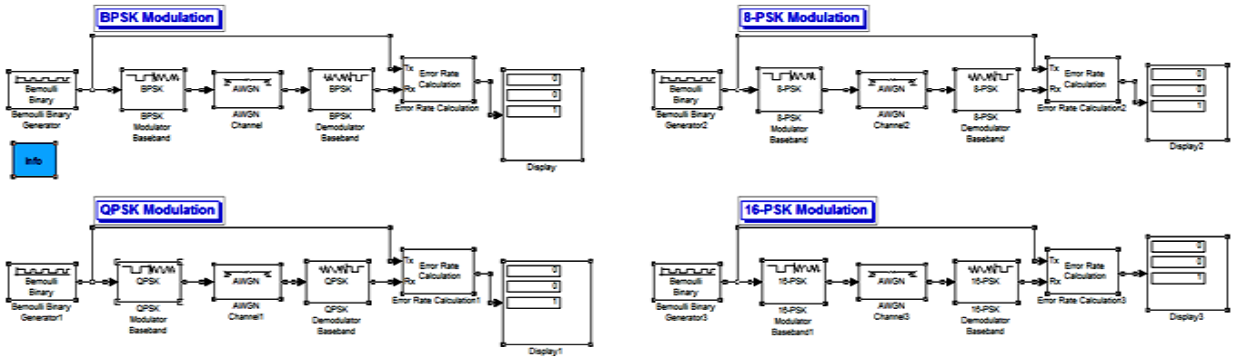

Fig2: Comparative Models for BPSK versus M-PSK

IV. RESULTS AND DISCUSSION

- The BER (Bit error rate) value for the BPSK modulation Technique was found to be very low and stable over long sample times while the other MPSK techniques had higher and fluctuating values over the same periods. These results are noted in Table .1.

Fig .3 shows the relationship in BER of BPSK in comparison to other MPSK.

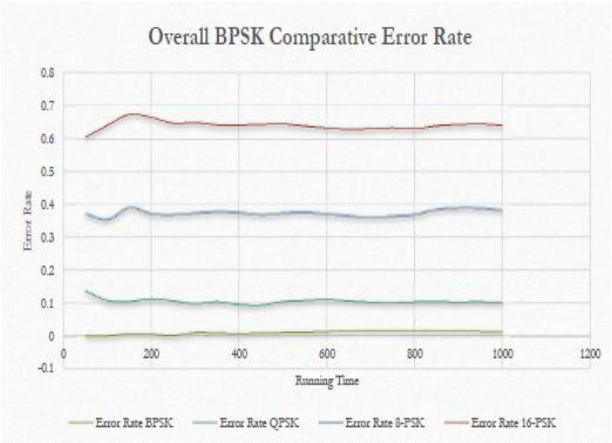

Fig. 3: Overall BPSK Comparative Error Rate

The other MPSK techniques generated errors fasters and in steady growth while the BPSK demonstrated a steady flow generation of errors over long sampling periods.

These results are noted in Table 2.

TABLE 1: BER results for BPSK, QPSK, 8-PSK and 16-PSK modulation model at increasing simulation time

Error Rate				
Run Time	BPSK	QPSK	8-PSK	16-PSK
50	0	0.1373	0.3725	0.6078
100	0	0.1089	0.3564	0.6436
150	0.006623	0.106	0.3907	0.6755
200	0.004975	0.1144	0.3731	0.6667
250	0.001195	0.1076	0.3705	0.6494
300	0.009967	0.09967	0.3754	0.6512
350	0.008547	0.1054	0.3789	0.6439
400	0.007481	0.09726	0.3766	0.6434
450	0.00869	0.09534	0.3703	0.6452
500	0.00998	0.1058	0.3752	0.6467
550	0.01089	0.1089	0.3775	0.6407
600	0.01331	0.1115	0.3727	0.6356
650	0.01536	0.1075	0.3671	0.6313
700	0.01569	0.1041	0.3623	0.6334
750	0.01598	0.1025	0.3662	0.6365
800	0.01496	0.1049	0.3706	0.633
850	0.0141	0.1058	0.3854	0.6416
900	0.01443	0.1043	0.3896	0.6448
950	0.01367	0.1052	0.3891	0.6467
1000	0.01299	0.1029	0.3836	0.6424

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TABLE 2: No of errors generated from BPSK, QPSK, 8-PSK and 16-PSK modulation model at different simulation time

No of Errors				
Run Time	BPSK	QPSK	8-PSK	16-PSK
50	0	7	19	31
100	0	11	36	65
150	1	16	59	102
200	1	23	75	134
250	3	27	93	163
300	3	30	113	196
350	3	37	133	226
400	3	39	151	258
450	4	43	167	291
500	5	53	188	324
550	6	60	208	353
600	8	67	224	382
650	10	70	239	411
700	11	73	254	444
750	12	77	275	478
800	12	84	297	507
850	12	90	328	546
900	13	94	351	581
950	13	100	370	615
1000	13	103	384	643

V. CONCLUSION

From the Analysis of BPSK modulation versus the 4-PSK, 8-PSK, and the 16-PSK methods, it was found that the BPSK method demonstrated very low error generation and Bit error rate potential.

Therefore, the BPSK method proves to be a better technique where distance and error generation are top factors to be considered.

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