

4.1 Introduction

In this chapter Matlab software was used to simulate the performance of the three cooperative protocols; amplify and forward, decode and forward and quantize and forward. The simulation scenarios considered both a single relay and a multi-relay.

4.2 System Parameters

The parameters and assumptions considered in the simulation are shown in Table 4.1. The simulation scenarios considered using a single relay and multi-relay in the system.

Table 4.1: Simulation Parameter

Parameters	Specification
Noise	AWGN.
Channel	Rayleigh fading.
Modulation	BPSK, QPSK, 8PSK.
SNR range	0 : 20
Variance	Unity.
Combining strategy	Maximal ratio combining
Destination number	1
Source number	1
Arrangement	Equidistance

4.3 System Flowchart

This section presents the sequence of flowcharts to explain the relay protocols (AF, DF and QF).

4.3.1 Amplify and Forward Protocol

Figure 4.1 shows the flowchart of the Amplify and Forward protocol.

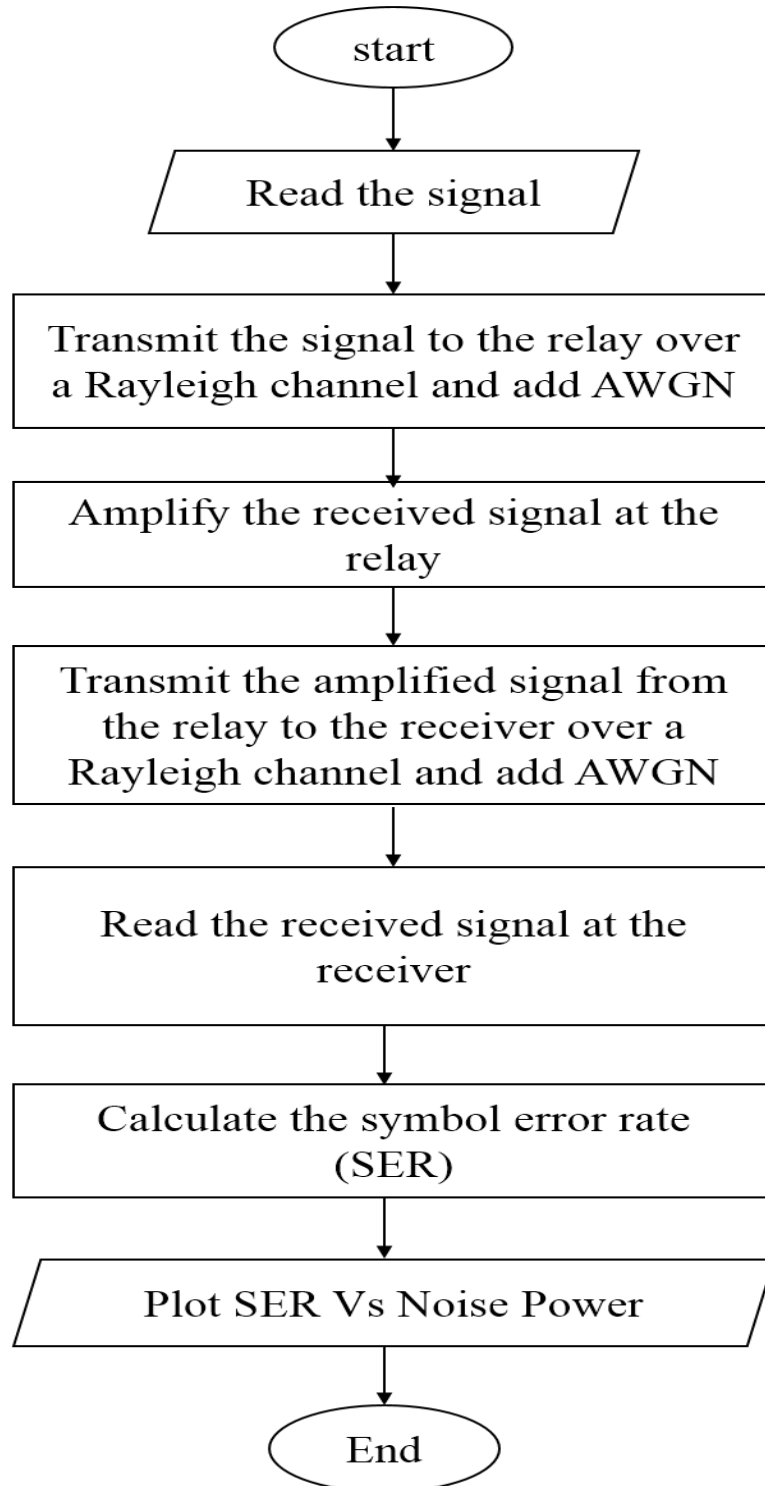


Figure 4.1: AF Algorithm Flowchart

4.3.2 Decode and Forward Protocol

Figure 4.2 shows the flowchart of the Decode and Forward protocol.

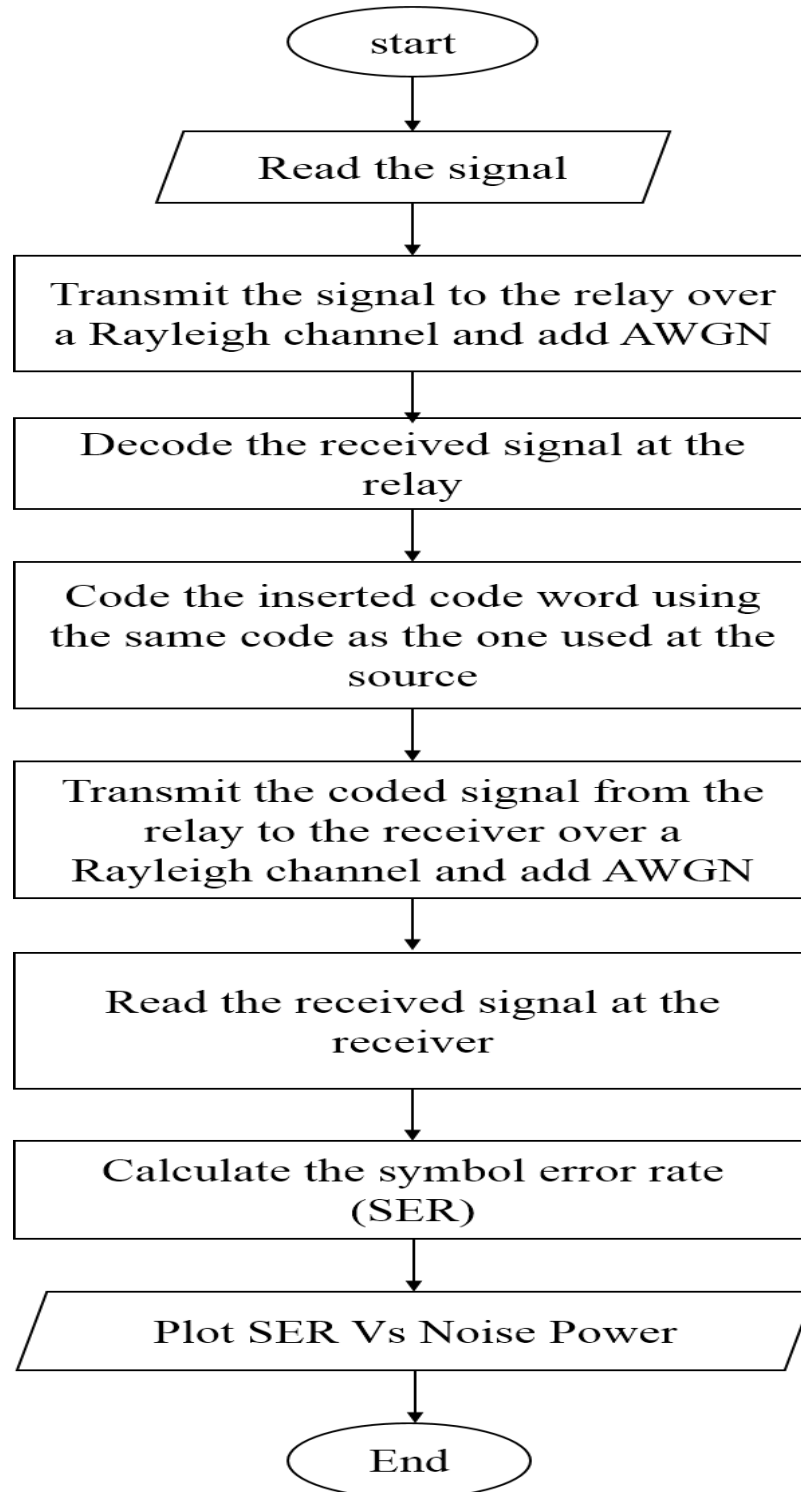


Figure 4.2: DF Algorithm Flowchart

4.3.3 Quantize and Forward protocol

Figure 4.3 shows the flowchart of the Quantize and Forward protocol.

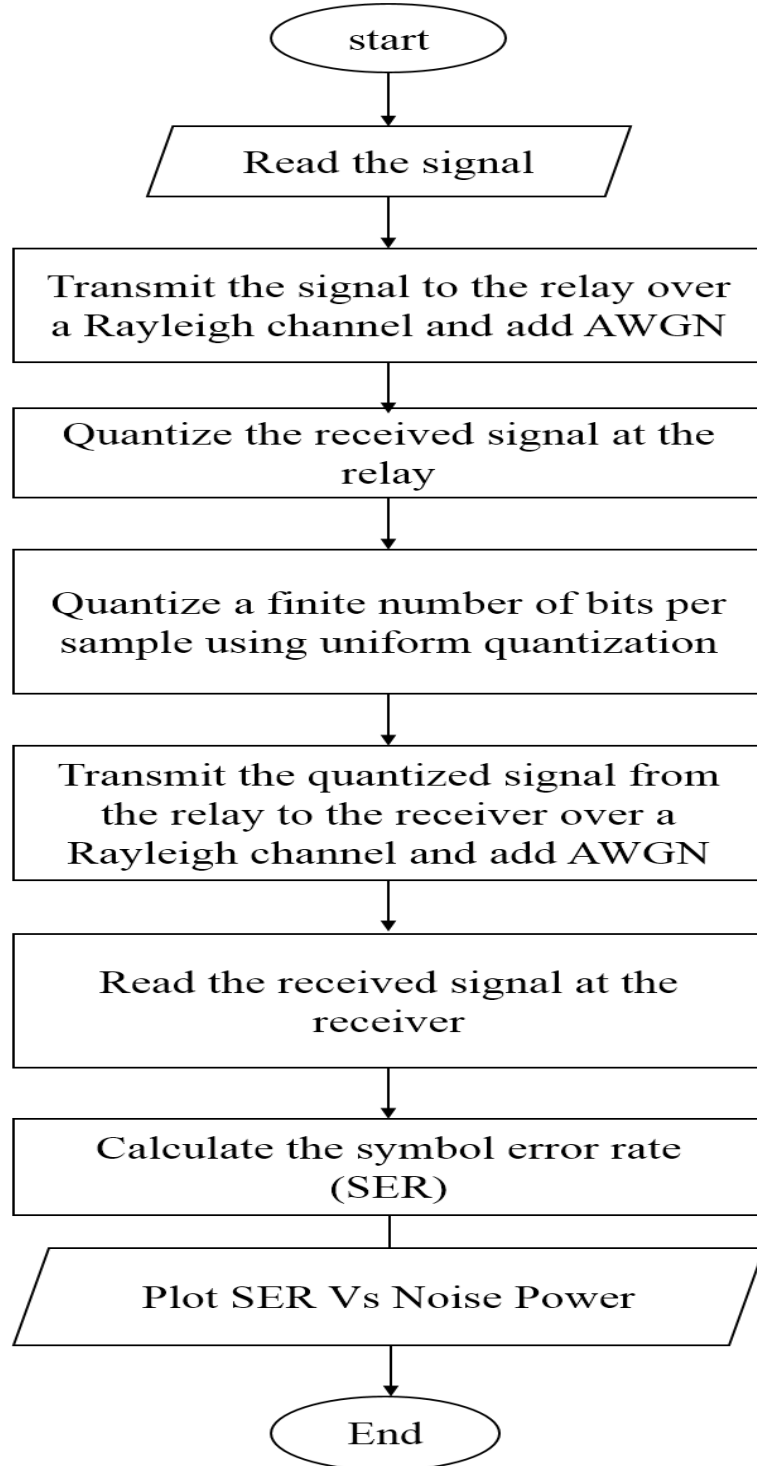


Figure 4.3: QF Algorithm Flowchart

4.4 Results and Discussion

This section presents the performances of Amplify and Forward (AF), Decode and forward (DF) and Quantize and Forward (QF) simulated for a single relay and multi relay in Rayleigh fading channel, using M-ary Phase Shift Keying (M-PSK).

4.4.1 Case 1: Using Single Relay

In this case, the BPSK, QPSK and 8PSK modulation techniques were used to compare the performance of AF, DF and QF relay protocols using single relay.

a) BPSK

Figure 4.4 shows the performance of the cooperative protocols using BPSK

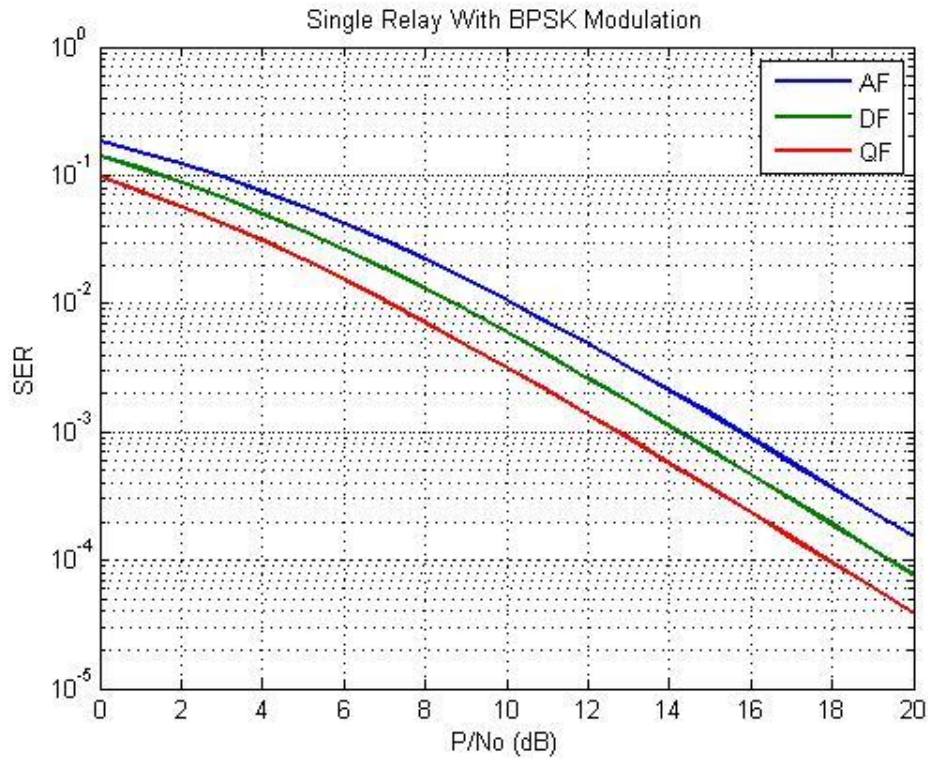


Figure 4.4: SER versus SNR (P/N_0) for single relay with BPSK.

Figure 4.4 compares the relayed signal for the three protocols AF, DF, and QF. It is obvious from the figure that the relayed signal for QF is comparatively better than AF and DF.

b) QPSK

Figure 4.5 shows the performance of the cooperation protocols using QPSK

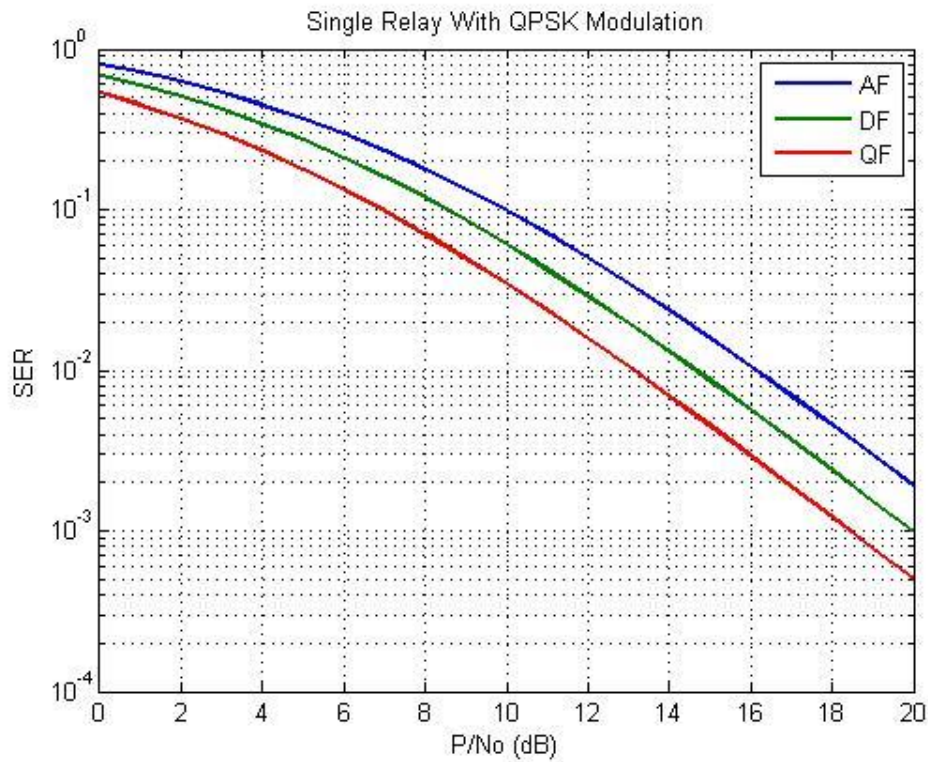


Figure 4.5: SER versus SNR (P/N_0) for single relay with QPSK.

Figure 4.5 show that using QPSK increases the SER of the system. Compared to Figure 4.4, the results show that using BPSK allows the SER to be improved in a noisy channel, at the expense of the transmission data capacity.

c) 8PSK

Figure 4.6 shows the performance of the cooperation protocols using 8PSK

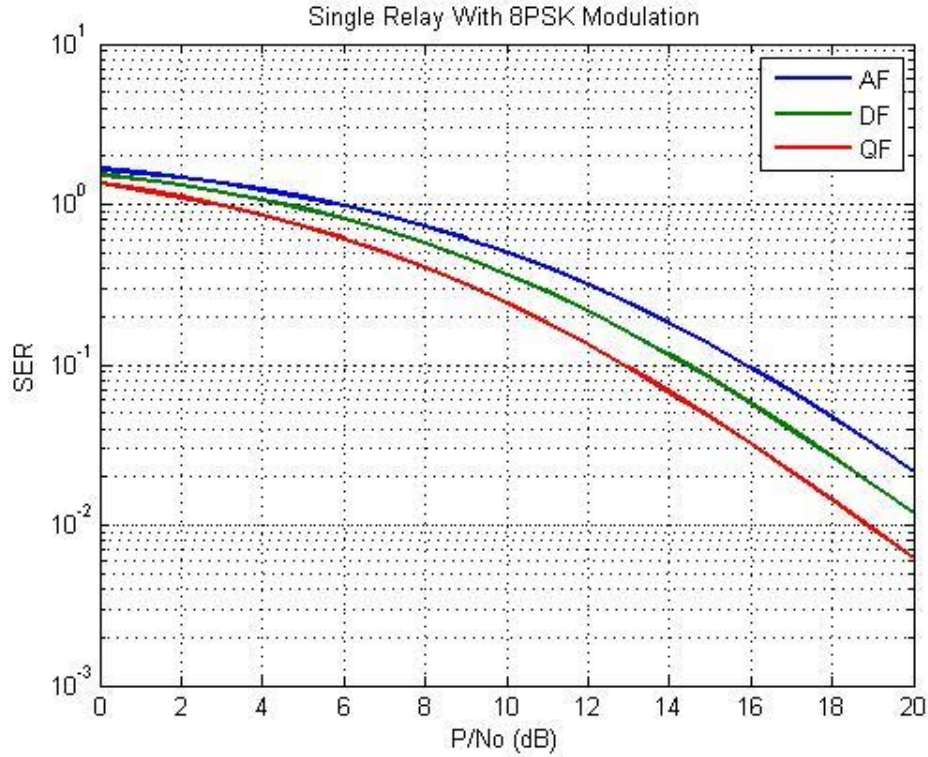


Figure 4.6: SER versus SNR (P/N_0) for single relay with 8PSK.

Figure 4.6 shows the graph that compares the symbol-error rates of AF, DF and QF using 8PSK. It was noticed that using a higher-order modulation exhibit higher error-rates; in exchange however they deliver a higher raw data-rate. It triples the data capacity compared to BPSK.

4.4.2 Case 2: Using Two Relays

In this case, the BPSK, QPSK and 8PSK modulation techniques were used to compare the performance of AF, DF and QF relay protocols using two relays.

a) BPSK

Figure 4.7 shows the performance of the cooperative protocols using BPSK

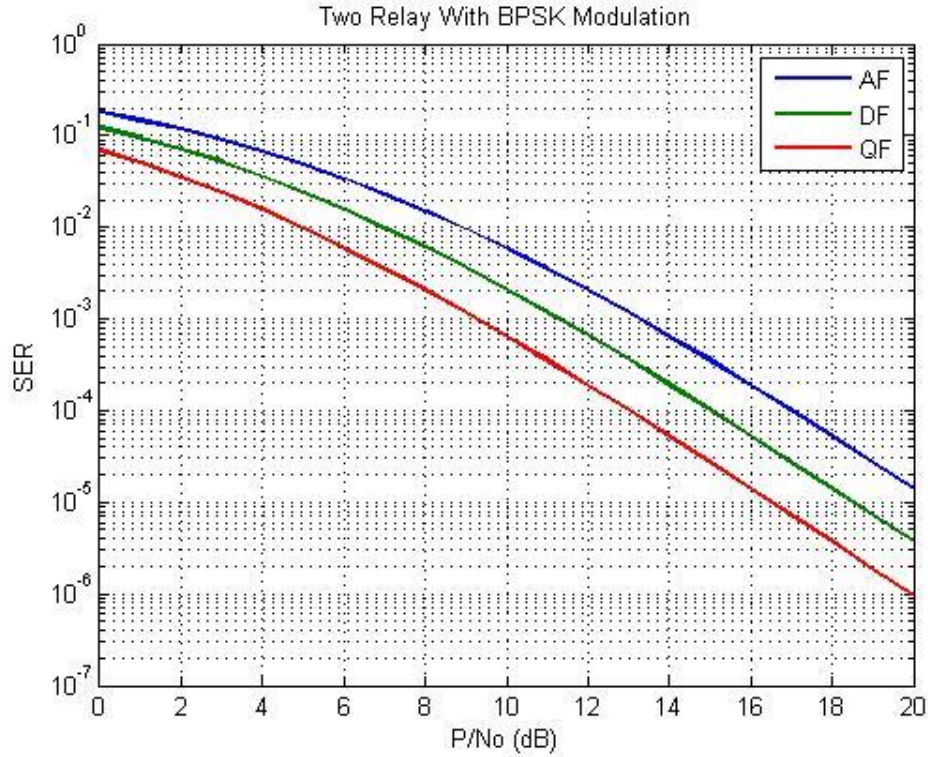


Figure 4.7: SER versus SNR (P/N_0) for two relay with BPSK.

Figure 4.7 compares the relayed signal for the three protocols AF, DF, and QF. It is obvious from the figure that the relayed signal for QF is comparatively better than AF and DF. Using the two relays decreased the SER from 0.097 to 0.069 when compared to single relay.

b) QPSK:

Figure 4.8 shows the performance of the cooperative protocols using QPSK

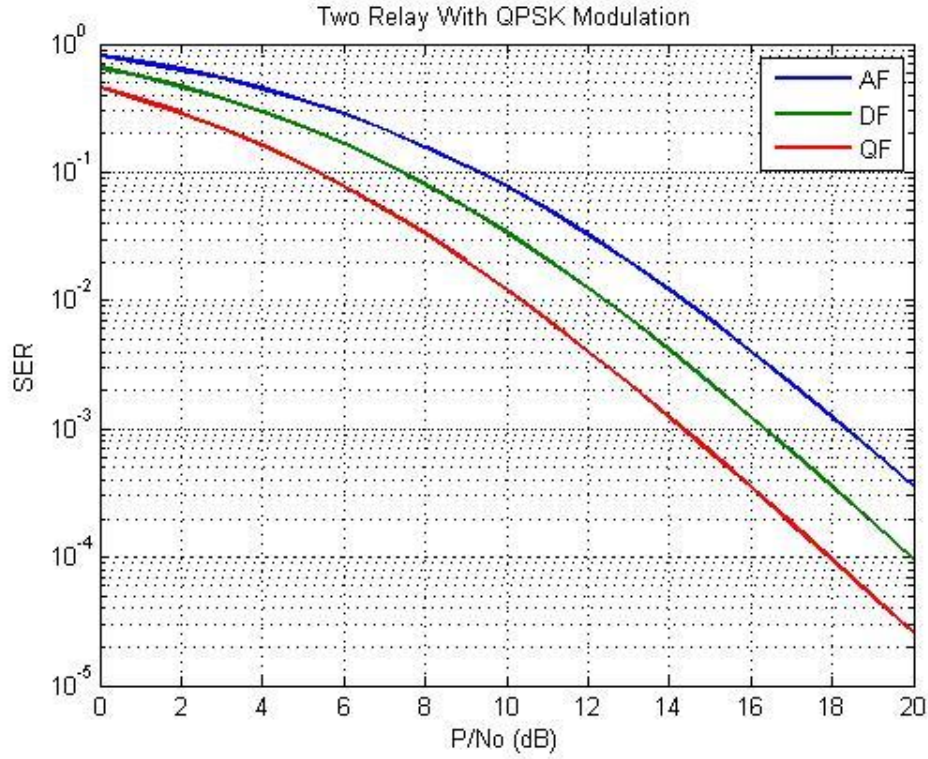


Figure 4.8: SER versus SNR (P/N_0) for two relay with QPSK.

Figure 4.8 show that using QPSK increases the SER of the system. Compared to Figure 4.7, the results show that using BPSK allows the SER to be improved in a noisy channel, at the expense of the transmission data capacity. Using the two relays decreased the SER from 0.535 to 0.456 when compared to single relay.

c) 8PSK

Figure 4.9 shows the performance of the cooperative protocols using 8PSK

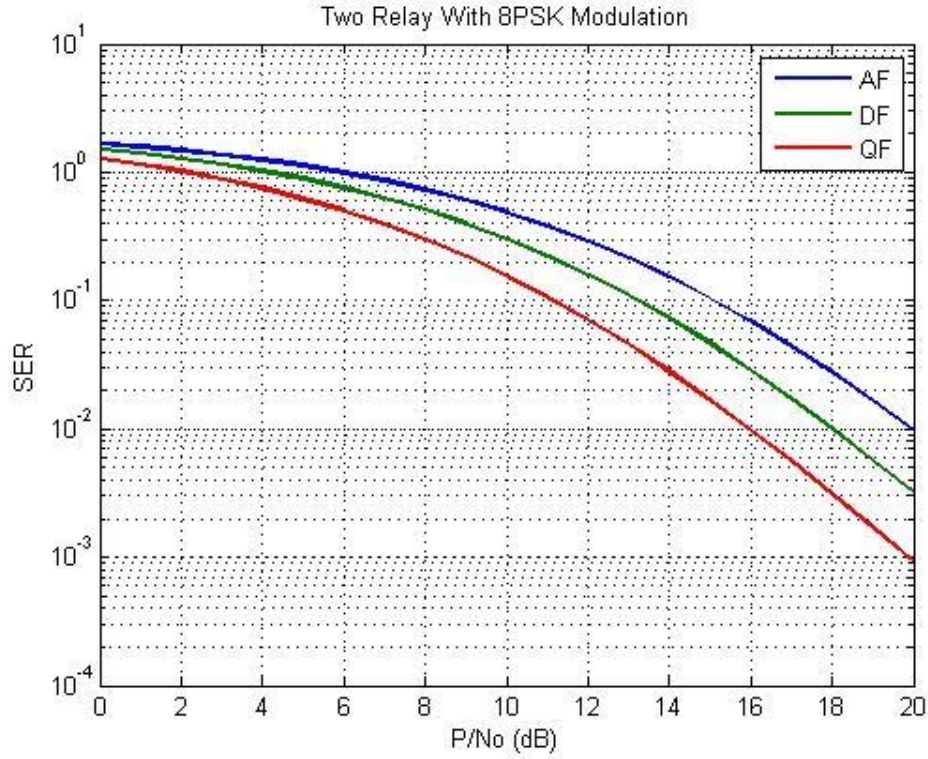


Figure 4.9: SER versus SNR (P/N_0) for two relay with 8PSK.

Figure 4.9 shows the graph that compares the symbol error rates of AF, DF and QF using 8PSK. It was noticed that using 8PSK increases the error-rates but delivers a higher data-rate. Using the two relays reduced the SER from 1.348 to 1.271 when compared to single relay.

From comparison between case one and case two the results obvious that case two had the best performance.