Error correction codes have been successfully implemented in wire-line and wireless communication to offer error-free transmission with high spectral efficiency. The drive for increased transmission capacity in fiber-optic links has drawn the attention of coding experts to implement forward error correction (FEC) for optical communication systems in the recent past. Particularly, the ITU-T G.٩٧٥ recommended Reed-Solomon RS (٢٥٥, ٢٣٩) code, is now commonly used in most long-haul optical communication systems. It was shown that the code offers a net coding gain of around ٤,٣ dB for an output bit-error rate of ١٠-٨ after correction. The Monte-Carlo simulation and theoretical performance analysis for the RS (٢٥٥،٢٣٩) code with ٦,٧٪ redundancy were presented for a completely random distribution of errors over an additive white Gaussian noise (AWGN) channel with BPSK signaling and hard decision decoding. In addition, net coding gain comparison was done between the ITU-T G.٩٧٥ standard and that offered by the RS (٢٥٥, ٢٤٧) and RS (٢٥٥, ٢٢٣) codes with ٣,٢٪ and ١٤,٣٪ redundancy respectively.