Figure 14 shows, as N increases, the performance results look more and more like the standard result for Gaussian noise due to the Central Limit Theorem (which, as noted earlier, only applies to random variables with finite moments).

Figure 15 shows the linear receiver, constant signal, results along with results for the bandpass limiter and the LOBD nonlinearity. First, note that as before, use of nonlinearities for N = 1 gives no improvement over the linear receiver, but, of course, does give improvement for N = 10 and 100. For N = 100, this improvement is only 6 dB, as predicted by L. Note that the LOBD nonlinearity here also is only slightly superior to the bandpass limiter. From Figure 9 for N = 100, the linear receiver operating in Gaussian noise (optimum) requires approximately a SNR of -13 dB for $P_e = 10^{-3}$ and from Figure 15 the LOBD receiver (locally optimum) requires approximately -20 dB SNR for $P_e = 10^{-3}$. This is a 7 dB difference and the limiting difference predicted by L was 6 dB. Next, from Figure 10, N = 100, Hall $\theta = 2$ noise, a SNR of -53 dB is required for $P_e = 10^{-3}$. This is the "31 dB difference" (approximately) between the two Hall noises mentioned above and given by the two corresponding L values (37 dB versus 6 dB). This shows that we cannot arbitrarily say, by inspection, that a noise process which is "tremendously" non-Gaussian can result in "tremendous" improvement over the corresponding Gaussian or linear receiver situation.

Finally, Figure 16 compares performance for a constant signal and a Rayleigh fading signal for N = 10. Note, that while for the $\theta = 2$ case and N = 10, the bandpass limiter began to outperform the LOBD nonlinearity for both constant signal (Figures 6 and 10) and Rayleigh fading signal (Figure 11) as SNR increased. Here ($\theta = 4$) the LOBD nonlinearity appears to be "always" slightly superior to the bandpass limiter.

5. CONCLUSIONS AND DISCUSSION

In the derivation of the LOBD, two essential assumptions are made. That the desired signal is suitably small (see Middleton and Spaulding, 1983) and that the number of independent noise samples increases without limit. The usual means of estimating the performance, once the detectors have been derived, again make use of these two simplifying assumptions. This results in performance measures that are strictly true only in the limit. It has been the purpose here to investigate, via particular examples and computer Monte Carlo simulation, how the LOBD's will actually perform in actual possible operational situations. The results are varied, but in general, the "standard" limiting performance estimates do provide correct performance measures under appropriate conditions (large N and S sufficiently small).

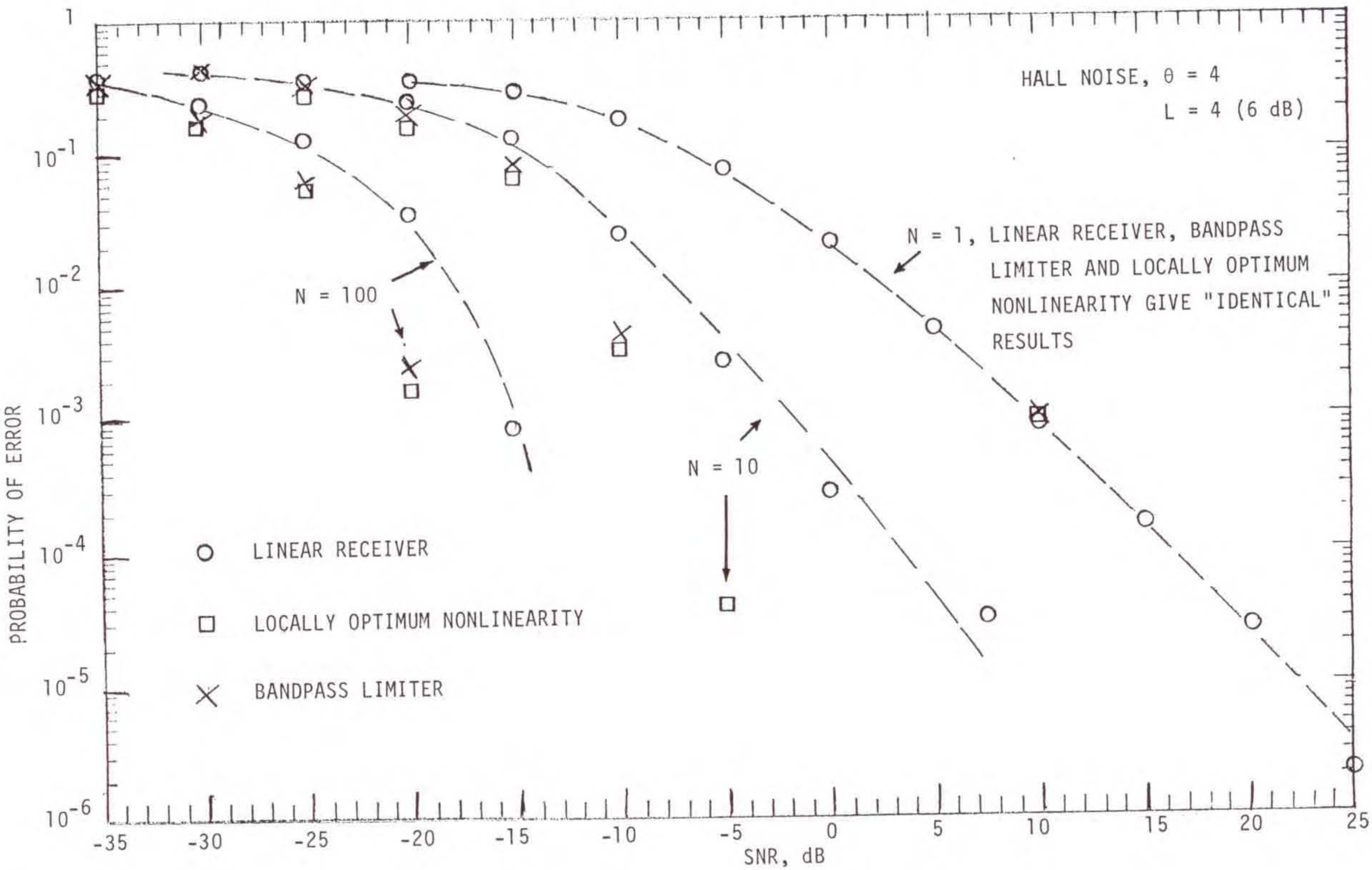

Figure 15. Simulation results for Hall noise, θ = 4, for a linear receiver and for the LOBD and bandpass limiter nonlinearities.

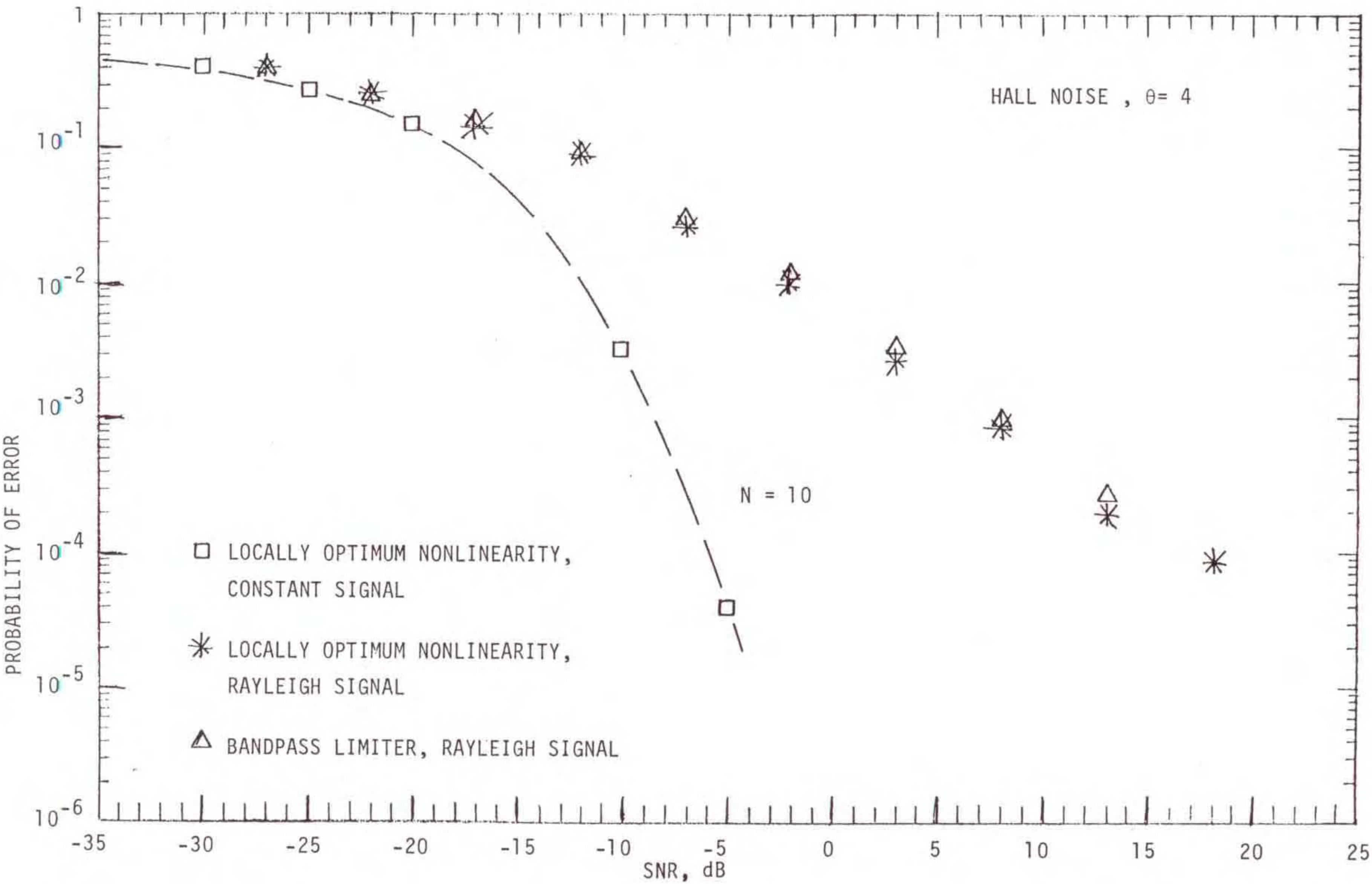

Figure 16. Simulation results for constant and Rayleigh fading signal, Hall noise, $\theta = 4$, $N = 10$.

The simulation results demonstrated that the LOBD's actually perform as advertised. One example was shown where the LOBD departed from being "close to optimum" as the signal level increased (N = 10) and was eventually outperformed by the ad hoc bandpass limiter. In all cases, the LOBD outperformed (in the limit) "reasonable" nonlinearities, e.g., the hard-limiter, only by a small amount (<3 dB) for Class B interference. The corresponding situation for Class A interference still needs to be investigated. Also, it was demonstrated that one cannot be assured of always obtaining "great" improvement over the linear receiver by using nonlinear processing. One Class B, highly non-Gaussian example ($\theta = 2$), gave 37 dB improvement whereas another Class B, highly non-Gaussian example ($\theta = 4$), gave only 6 dB improvement.

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