Abstract: The dynamics of perfectly harmonic chains, linear arrays of masses joined by ideal springs, may be described in terms of normal modes which coexist with no exchange of energy among them. Anharmonic terms, such as a cubic perturbation in the force between neighboring masses, would in principle couple the modes and set the stage for equilibration. However, for certain thermodynamically isolated chains, equilibration is hindered and takes place over long time scales. Using molecular dynamics simulations in conjunction with Langevin heat baths applied to the chain ends, we relax the isolation condition and find significantly reduced equilibration times. The latter are singular in the coupling to the environment, in the sense that equilibration times converge in the bulk limit as long as there is a finite coupling to the heat baths at the chain termini. To explain this convergence phenomena, we discuss a possible two stage mechanism in which the rapid excitation of high frequency modes due to the thermal noise affecting the chain ends then aids in the transfer of energy from low lying modes to the rest of the system for a more rapid equilibration process.