The Laplacian matrix, $L$, of a graph, $G$, contains degree and edge information of a given network. Solving a Laplacian linear system $Lx = b$ provides information about flow through the network, and in specific cases, how that information orders the nodes in the network. I propose a novel way to solve this linear system by first partitioning $G$ into its maximum locally-connected subgraph and a small subgraph of the remaining so-called "teleportation" edges. I then apply optimal multigrid solves to the locally-connected subgraph, and linear algebra and a solve on the teleportation subgraph to solve the original linear system. I show results for this method on real-world graphs from the biological systems of the *C. Elegans* worm, Facebook friend networks, and the power grid of the Western United States.