The Non-hydrostatic Icosahedral Model (NIM) is a NOAA dynamical core for global NWP. We use NIM to examine MPI performance of thousands of GPUs running on ORNL’s Titan supercomputer. This talk will present our complete re-write of the NIM message passing (exchange) algorithm to eliminate packing and unpacking and thereby reduce the exchange time. The talk will include scaling numbers and timings of the various parts of the exchange.