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Dr. Riley has been working in the field of large-scale network simulation since his PhD thesis under the direction of Dr. Richard Fujimoto and Dr. Mostafa Ammar. In that work he was the first to show that distributed simulation techniques using conservative synchronization protocols could be applied to the popular ns-2 network simulation tool which resulted in the developemnt and release of "pdns".

However, just breaking a large topology into different logical processes proved to be insufficient for achieving larger simulations. He discovered that routing table models consumed large amounts of systems memory, growing in proportion to N-squared (where N is the total number of network nodes). This problem was alleviated using a novel approach for packet routing called "NIx-Vector" routing, which was applied to the ns-2 distributed simulation and resulted in successful experiments with more than 100,000 nodes.

The lessons learned in the distributed ns-2 work were then applied to a new network simulation environment developed by Dr. Riley called the "Georgia Tech Network Simulator" (GTNetS), which was designed from the outset for scalability and efficiency. Using a large number of CPUs on the Pittsburgh Supercomputer Center, GTNetS was successfully demonstrated to execute a network topology of more than 1 million network elements. This was the first ever simulation experiment with packet-level detail that exceeded the 1 million node threshold.

More recently, Dr. Riley is co-PI on the new ns-3 network simulator development effort. Again, ns-3 has been designed to support distributed simulation using conservative synchronization protocols. The inter-process communications in ns-3 is performed using the ubiquitous MPI message passing interface. Researchers at the Army Research Lab in Aberdeen Maryland have used ns-3 to model networks of more than 100 million network elements, clearly two orders of magnitude larger than has been possible previously.

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