# University Outreach: RTI Software

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# Outline

- Goals and Objectives
- Federated Simulation Development Kit (FDK)
  - RTI-Kit
  - Jane interface software
- Plans and Schedule

# HLA Outreach to the University Community

Goals

- Support increased research in HLA and HLA-like systems
  - Substantial technical expertise in distributed simulation systems and related technologies in the university community
  - RTI source code is needed to foster research that can be directly applied to the HLA
- Support university laboratory experiences in RTI development
  - Existing RTIs provide experience in developing federations, but not for experimenting with RTI internals
  - Current RTIs not readily accessible: source code generally not available, internals may not be extensively documented

Approach: develop and distribute RTI software to “jump start” HLA research and education

# RTI Research Software: Requirements

Support research and education in HLA RTIs

- Support experimentation with RTI internals
  - Modify, experiment, modify life cycle
  - Focus on time management and data distribution management (initially)
- Must be modular with clearly defined interfaces and replaceable parts
- Must be simple!
  - Large effort to understand and realize an HLA RTI
  - Complete HLA RTI implementation typically not needed (nor necessarily desirable!) for academic research
- Source code and documentation essential

# Typical Usage Scenarios

- Experiment with time management algorithms & approaches
  - TM algorithms optimized for shared memory machines
  - Apples-to-apples comparison of TM algorithms
  - Novel approaches to time management
- Experiment with new approaches to DDM
  - Time synchronized DDM
  - Efficient implementation approaches
- Class projects “dissecting” and modifying an HLA RTI
  - Alternate communication support
  - Improved time management algorithms
  - Specialized RTIs for different applications (e.g., network simulations)

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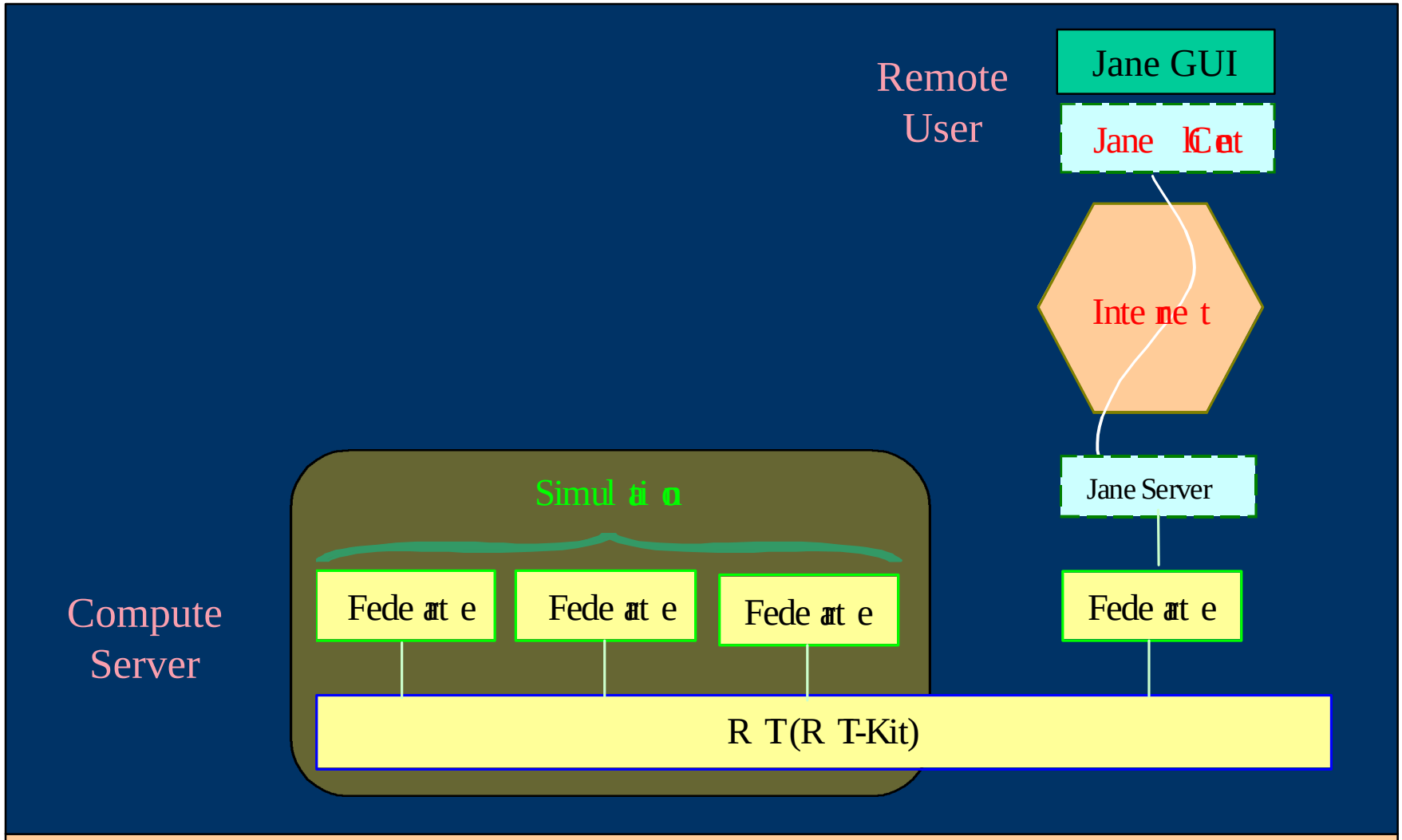
# Federated Simulations Development Kit (FDK)

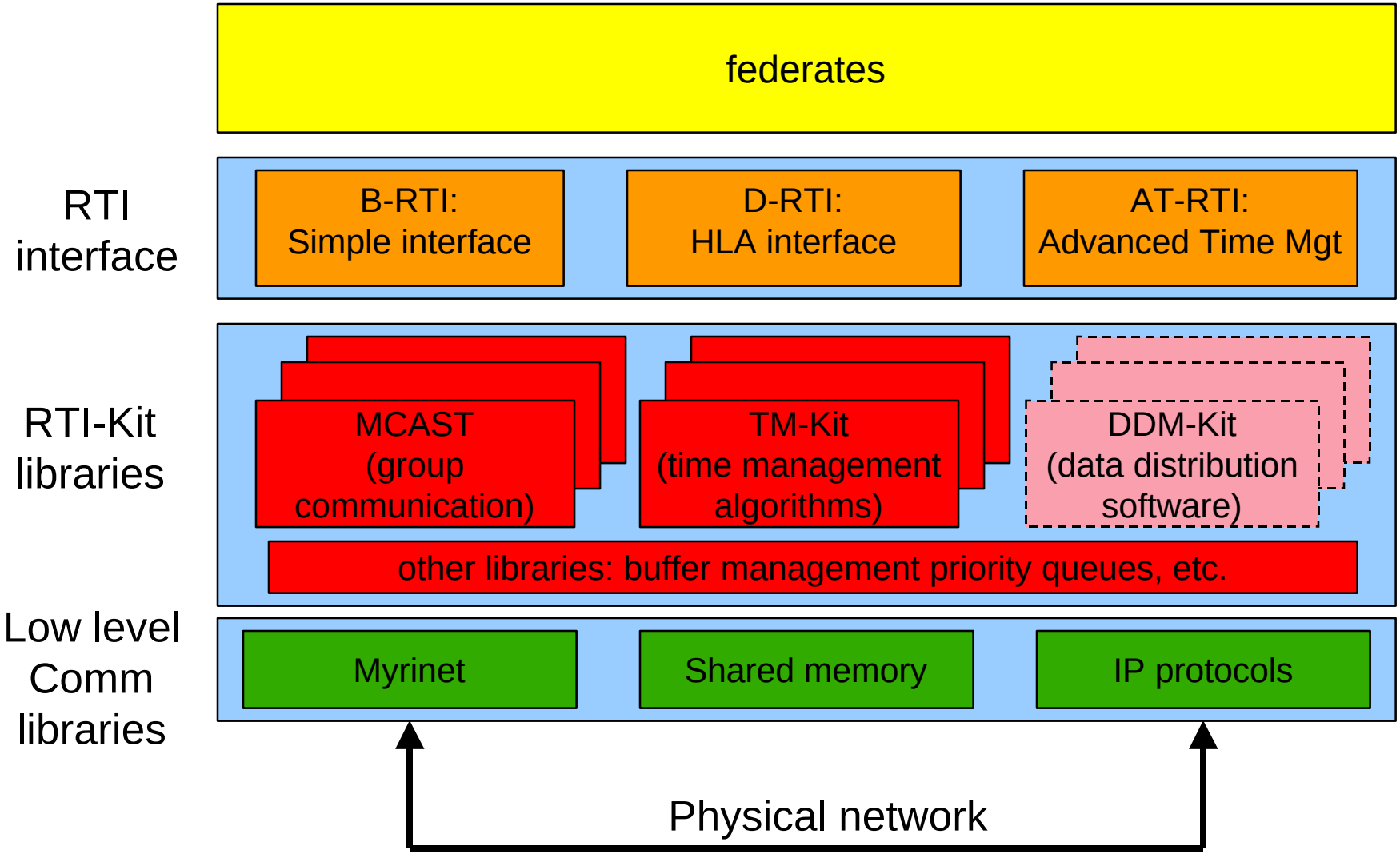



- RTI-Kit: software for experimental research in RTIs
- Jane: interactive simulation monitoring and control

# RTI-Kit

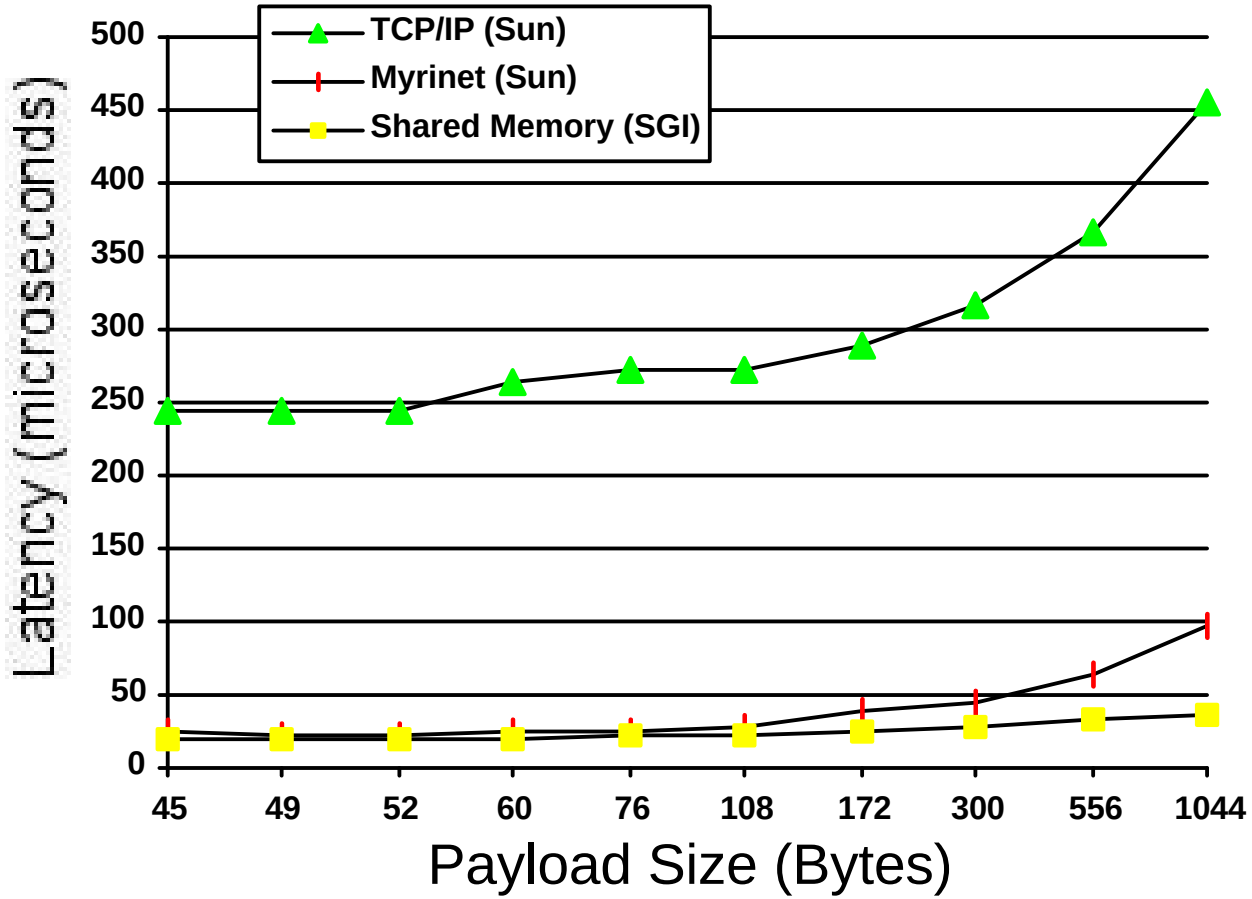
- collection of libraries; enhance existing RTIs / develop new ones
- each library can be used separately, or with other RTI-Kit libraries
- implemented over multiple platforms: compute clusters (Myrinet), shared memory multiprocessors (SGI), IP networks
- current libraries
  - MCAST: group communication software
    - distributed group management, name server functions
    - current implementation built over unicast
    - application-defined buffer allocation to minimize data copying
  - TM-Kit: algorithms for implementing time management
    - fast distributed snapshot algorithm
    - scalable (O(log N) time for global reduction operations
  - buffer management, priority queues, random number libraries
- RTIs using RTI-Kit
  - UK-RTI (DERA)
  - B-RTI, D-RTI, AT-RTI (Georgia Tech)

# RTI-Kit Software



# Update Attribute Value Latency Benchmark

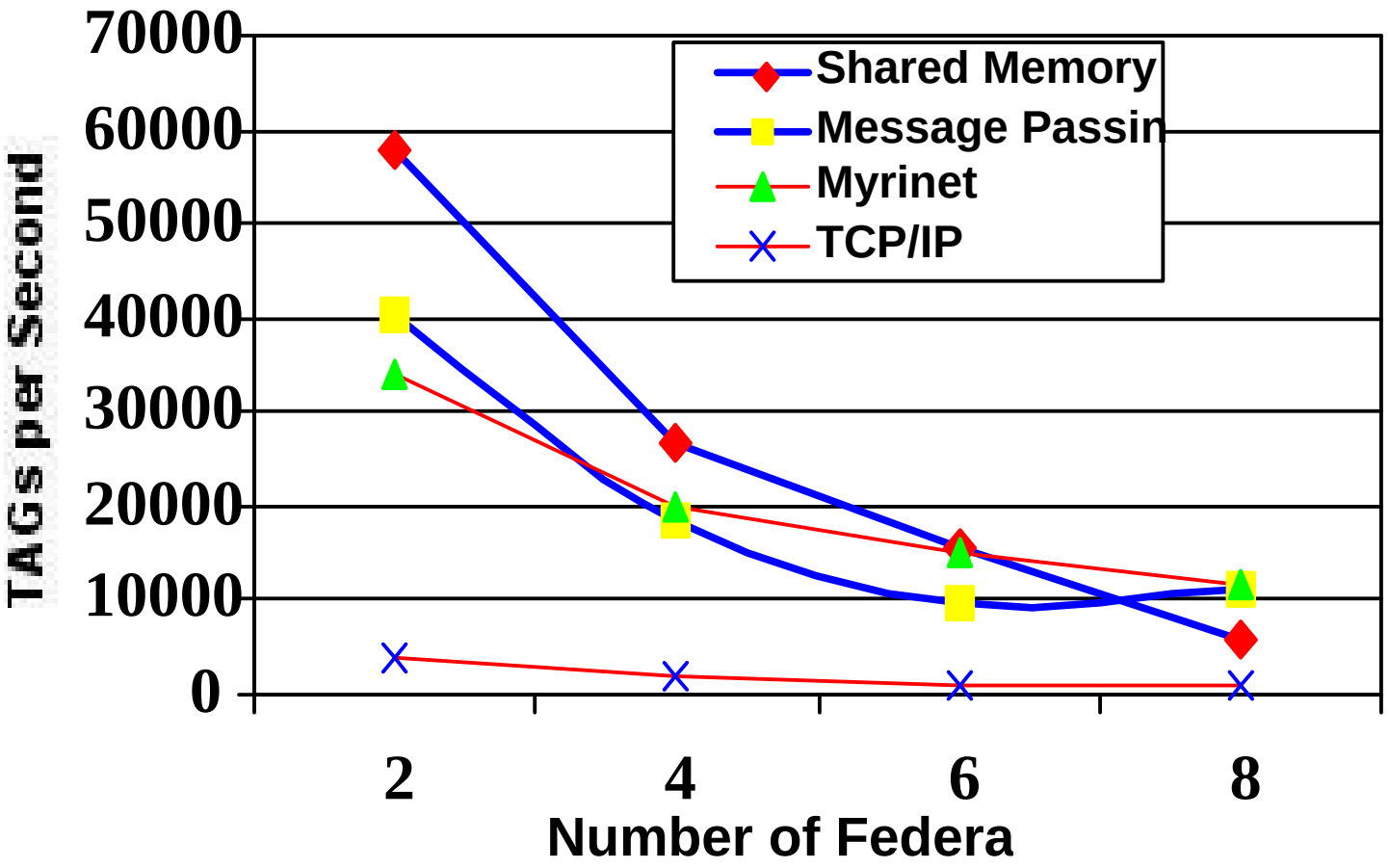
Federate to federate latency using RTI-Kit sending N byte payload




Myrinet and Shared Memory similar performance

Mryinet and Shared Memory about 4 to 9 times faster than TCP/IP

# Time Advance Grant Benchmark




* Blue line indicates experiment performed on SGI Origin 2000
* Red line indicates experiment performed on on network of UltraSparc workstations

# Jane Client-Server Architecture

support interactive monitoring & management of simulation executions

- Graphical interface displays (e.g., performance stats) & control
    - Default views and controls, user-extendable
- Remote interaction over the Internet (e.g., via laptops)
- Collaborative interaction
- Scripting
- Simulation *gateway* to larger design/decision tools
- Pre- & post-simulation analysis
- Plug-N-Play interface to different simulators

# Software Components

- Server written in C
  - tested on Sparc & SGI
- Client written in Java
  - tested on Sparc, SGI, Windows
- Simulators
  - RTIs based on Georgia Tech RTI-Kit
  - GTW, GTW++, TeD
- Model instrumentation API in C/C++
  - at the simulation
- Model view extension API
  - at the client

# Sample Jane Session

# Sample Collaborative Session

# Sample User-defined View

# Summary

- RTI-Kit Software
  - Provides software for HLA RTI research and education to the research community
  - Software base for research in distributed simulation systems at Georgia Tech
- Jane interactive simulation environment
  - Performance monitoring and execution control tool
  - Remote access to parallel/distributed simulations via the Internet
  - Support for user collaborations
  - Extensible for application specific interfaces and displays

additional information:

R. Fujimoto and P. Hoare, “HLA RTI Performance in High Speed LAN Environments,” *1998 Fall Simulation Interoperability Workshop*, September 1998.

S. Ferenci and R. Fujimoto, “RTI Performance on Shared Memory and Message Passing Architectures,” *1999 Spring Simulation Interoperability Workshop*, March 1999.

K. Perumalla and R. Fujimoto, “Jane: An Architecture for Interactive Parallel Simulation,” *WEBSIM '99*, January 1999.

# FDK Milestones and Schedule

- Used in Georgia Tech course (Jan-Mar 99)
- FDK Pre-release (Feb 99)
  - UCLA, Dartmouth, University of Exeter (UK), National Univ. of Singapore
- HLA tutorial, broad FDK 1.0 release at PADS 99 (May 99)
- RTI-Kit software distribution (FDK 1.0)
  - Modules (libraries) w/ algorithms implementing key functions
    - Time management
    - Group communication
  - Sample, simplified RTI (using RTI-Kit libraries), test federates
    - Limit set of services (federation, declaration, object, time management)
  - Source code, documentation provided
  - Free for use in academic or industrial research
  - Platforms
    - Sparc (Solaris 2.5 and 2.7)
    - SGI Origin, O2 (Irix 6.2, 6.3, 6.4)
    - Intel (Solaris 2.5.1, RedHat Linux 2.0.36)

# Future Plans

- Periodic upgrades and new releases
  - Bug fixes, new platforms and OS versions (as needed)
  - Additional HLA services
- DDM software release
- Continued use in research at Georgia Tech
  - Advanced time management techniques and time managed DDM
  - High performance simulation on cluster computers
  - Interactive parallel/distributed simulation systems
  - Modeling telecommunication networks
  - Missile defense applications