Wide Area Distributed Modeling and Simulation

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National Infrastructure Simulation & Analysis Center

Mission

To securely integrate geographically distributed, heterogeneous models and information sources into a cohesive simulation and analysis environment.

Strategy

High quality infrastructure models exist at universities, industries, and government entities throughout the nation. In addition to directly working with expert modeling and data organizations, NISAC is working to technically combine these disparate modeling capabilities into unified, distributed simulations.

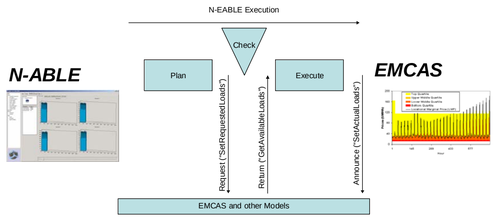
Our integration strategy incorporates concepts from proven modeling and simulation standards like High Level Architecture (HLA) and leverages modern Internet-based integration technologies to open NISAC functionality to the largest possible collection of external models.

This strategy has been field tested over the past year, focusing on appropriate technologies for model and data sharing with our initial collaborators, as shown in the panels to the right.

Example Interactions

Argonne National Laboratory

The first wide-area distributed collaborative simulation realized by NISAC and its collaborators was achieved by linking the Sandia NISAC Agent Based Laboratory for Economics (N-ABLE) with the Argonne Electricity Markets Complex Adaptive Systems Model. These two models communicate via Web Services in a time-step synchronized manner, as illustrated below.

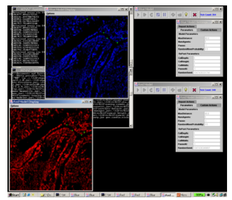


DTRA MIDAS

NISAC and Defense Threat Reduction Agency's (DTRA) MIDAS Engineers established a SOAP-based channel for the exchange of geospatially referenced critical infrastructure data.

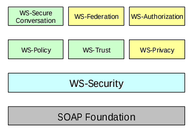
MIT Center for Grid Computing

Researchers at MIT and NISAC investigated using the Open Grid Services Architecture to coordinate disparate agent-based models. This communication method layers Grid functionality on top of SOAP.



NISAC-MIT Agent Model

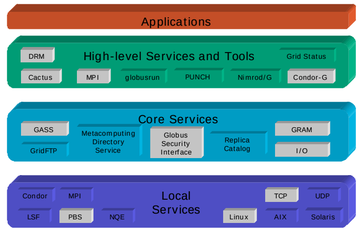
OGSA Security Architecture



UNM HPCERC

Researchers at the University of New Mexico's strategic High Performance Computing, Education and Research Center (HPCERC) and NISAC tested secure hardware-level resource sharing using the Globus Toolkit Version 2.2.

Globus Protocol Stack



Technology

Key Technologies for the open, distributed architecture necessary to allow a diverse community to integrate their resources with minimal effort include:

- *eXtensible Markup Language (XML)*
- *Simple Object Access Protocol (SOAP)*
- *Web Services*
- *Grid Computing*

Further Challenges

Security components must assuage a range of concerns across governmental, commercial, university, and individual resources, including accommodating local security and access control policies, and combining both Public Key Infrastructure (PKI) and Kerberos authentication infrastructures.

Scaling to very large data sets, simulation archive management, and visualization will also be addressed.

Networking issues (firewalls, proxies, protocol mismatches) and model integration issues (time management, semantic API interoperability) will continue to provide opportunities for deeper and more complex solutions.

NISAC's core partners are Sandia National Laboratories and Los Alamos National Laboratory.
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.
Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405 ENG-36.