



## Network Optimization Models

**The National Infrastructure Simulation and Analysis Center (NISAC)**, a program under the Department of Homeland Security's (DHS) Infrastructure Protection/ Risk Management Division (IP/RMD), provides advanced modeling and simulation capabilities for the analysis of critical infrastructures, their interdependencies, vulnerabilities, and complexities. These capabilities help improve the robustness of our nation's critical infrastructures by aiding decision makers in the areas of policy analysis, investment and mitigation planning, education and training, and near real-time assistance to crisis response organizations.

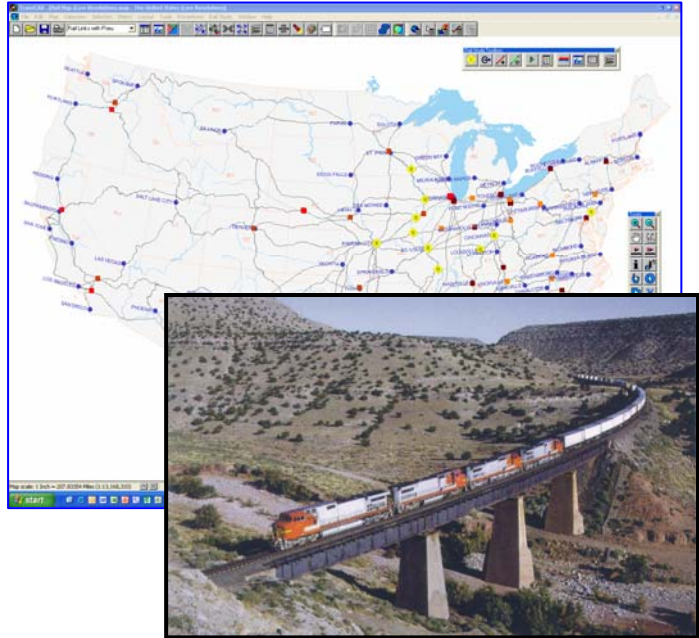
NISAC is a partnership between Sandia National Laboratories (SNL) and Los Alamos National Laboratory (LANL), integrating the two laboratories' expertise in infrastructure disruption/vulnerability modeling and simulation..

### Network Optimization Models

Many critical infrastructures can be represented by a network of interconnected nodes and links. Mathematically sound non-linear optimization techniques can then be applied to these networks to understand their behavior under normal and disrupted situations.

### Railroad Network Analysis System (R-NAS)

Using a detailed layout of the primary rail tracks, yards, bridges, etc. in the continental U.S. coupled with commodity movement data from the Department of Transportation.



R-NAS provides a capability of studying and understanding the flow of commodities over the nation's rail infrastructure. The network flow models predict link flow volumes (by commodity group) over the networks, and the corresponding times and distances that commodities encounter in moving from origin points to destinations.

After disruption of a given rail asset, the model attempts to find alternate routes for the delivery of commodities. Delivery time constraints can be placed by the user to determine acceptable delays in delivery times, and the model can provide breakdowns of the types of commodities that do not move given the specific disruption in a scenario.

The model has been used to examine commodity flow disruptions due to destruction of railroad assets, and it has also been used to study policy options concerning the movement of toxic chemicals by rail.

## Aviation Hubs

For FY05, this same type of network optimization modeling will be applied to the nation's air transport infrastructure. This model will be an effort to examine the consequences of extended (at least a week) outages at the nation's busy hub airports. With a focus on both high-priority air freight (overnight package delivery) and passenger travel, this model will be able to provide insights into these consequences and provide a vehicle for the study of possible mitigation strategies.



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