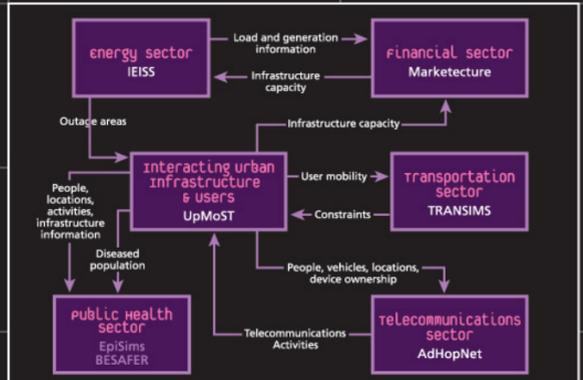


URBAN INFRASTRUCTURE SIMULATIONS

SIMULATION SCIENCE HELPS PROTECT OUR CITIES

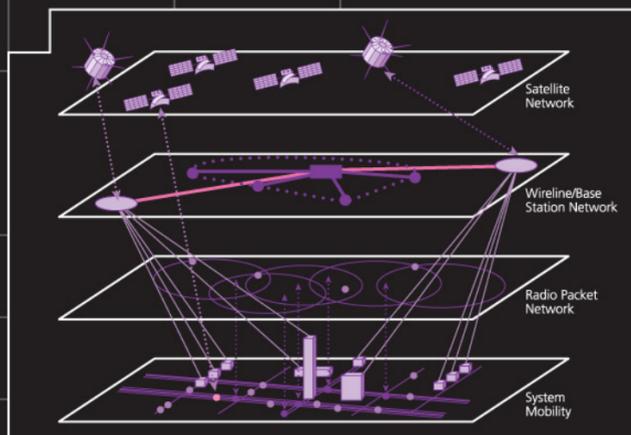
Effects of the September 11, 2001, terrorist attacks extended beyond the losses associated with the World Trade Center, the Pentagon, and Flight 93. Our nation's urban infrastructure—health, transportation, communication, financial, and other sectors—was also affected. As a result, the Department of Homeland Security asked Los Alamos and Sandia National Laboratories to examine the interdependencies among critical urban sectors as part of the new National Infrastructure Simulation and Analysis Center. In response, the Basic and Applied Simulation Science Group at Los Alamos is building the Urban Infrastructure Suite—a modular set of simulations that represent those interconnected sectors. This tool has already been used to study possible anthrax and pneumonic plague attacks and natural disasters, such as Hurricane Isabel, in several urban regions.

We know that demographics, movements, and reactions of individuals are critical to understanding infrastructure operation. Population mobility is modeled by generating synthetic populations and simulating the movement and activities of each person throughout the urban region second by second. Thus, we can track cars and buses, cell phone users and usage, and the spread of biological agents and contagious diseases. We combine population mobility with detailed models of the physical infrastructure in “what if” analyses to determine the cascading effects of natural disasters and terrorist attacks on the transportation, telecommunications, public health, and electrical power systems of various cities. Federal and local agencies are using the results of such studies to better understand urban vulnerabilities and to develop prevention and consequence management plans.



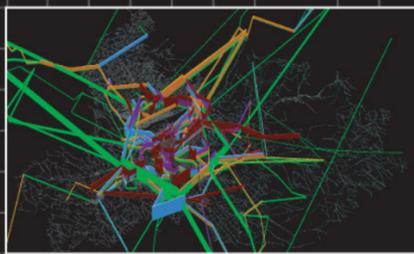
urban infrastructure suite of simulations

The Urban Infrastructure Suite has five interconnected simulations: TRANSIMS (transportation), Marketecture (commodity market), IEISS (energy), EpiSims (public health), and AdHopNet (telecommunications). A sixth module, UPMoST, provides each simulation with population mobility data—the locations and characteristics of every individual and structure in the city.



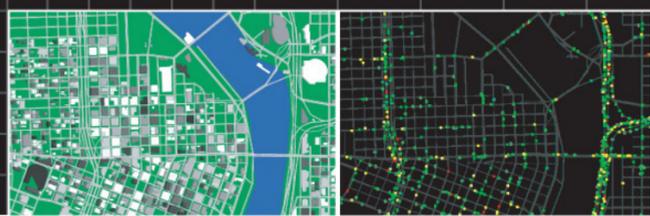
AdHopNet: simulating mobile cell phone usage

Using output from UPMoST and TRANSIMS, we can “assign” individuals telecommunication devices and track their usage and movement. AdHopNet includes the telecommunications infrastructure (base stations, wire lines, satellites) as well as individual users. Terrorist attacks can cause immediate changes in demand on, and potential shutdown of, the communication network.



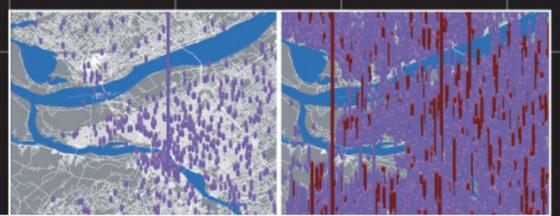
marketecture: simulating an electrical power system and its financial market

The Marketecture simulation shows a regional electrical power system (generator, distribution centers, power lines) and its controlling financial market activities (suppliers, buyers, independent system operators). Both the electrical power system and the financial market are vulnerable to terrorist activities and must be part of disaster prevention and mitigation plans.



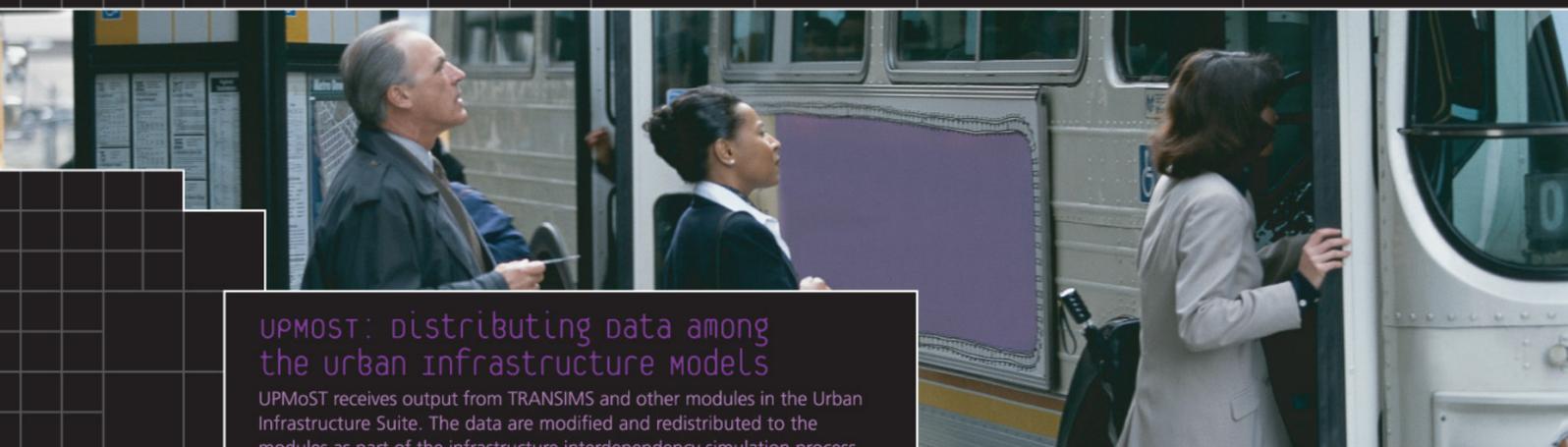
TRANSIMS: simulating movement

(Left) TRANSIMS creates a synthetic urban population, generates activities for all individuals, and moves urban travelers according to their travel plans and modes of transportation. (Right) The dots represent vehicles; the colors represent modes of transportation (car, bus, train, walking). Traffic density and patterns before and after a terrorist event are critical to prevention planning and consequence management.



episims: simulating an urban smallpox attack

The EpiSims simulation of a smallpox attack in the business district of a U.S. city employed output from UPMoST and TRANSIMS. (Left) The purple dots represent individuals exposed to smallpox four hours after the attack. (Right) Here, the disease outbreak is represented 30 days later; no mitigation actions have been taken. Knowledge of the disease spread (direction, concentration, timing) is critical to health and police mitigation.



UPMoST: distributing data among the urban infrastructure models

UPMoST receives output from TRANSIMS and other modules in the Urban Infrastructure Suite. The data are modified and redistributed to the modules as part of the infrastructure interdependency simulation process.

Douglas Anson, CCS-5
anson@lanl.gov, 505-667-7610