

A light gray world map is centered in the background of the slide. The map shows the outlines of continents and is rendered in a low-contrast, semi-transparent style.

# **Critical Infrastructure Dependency A View from NSF**

---

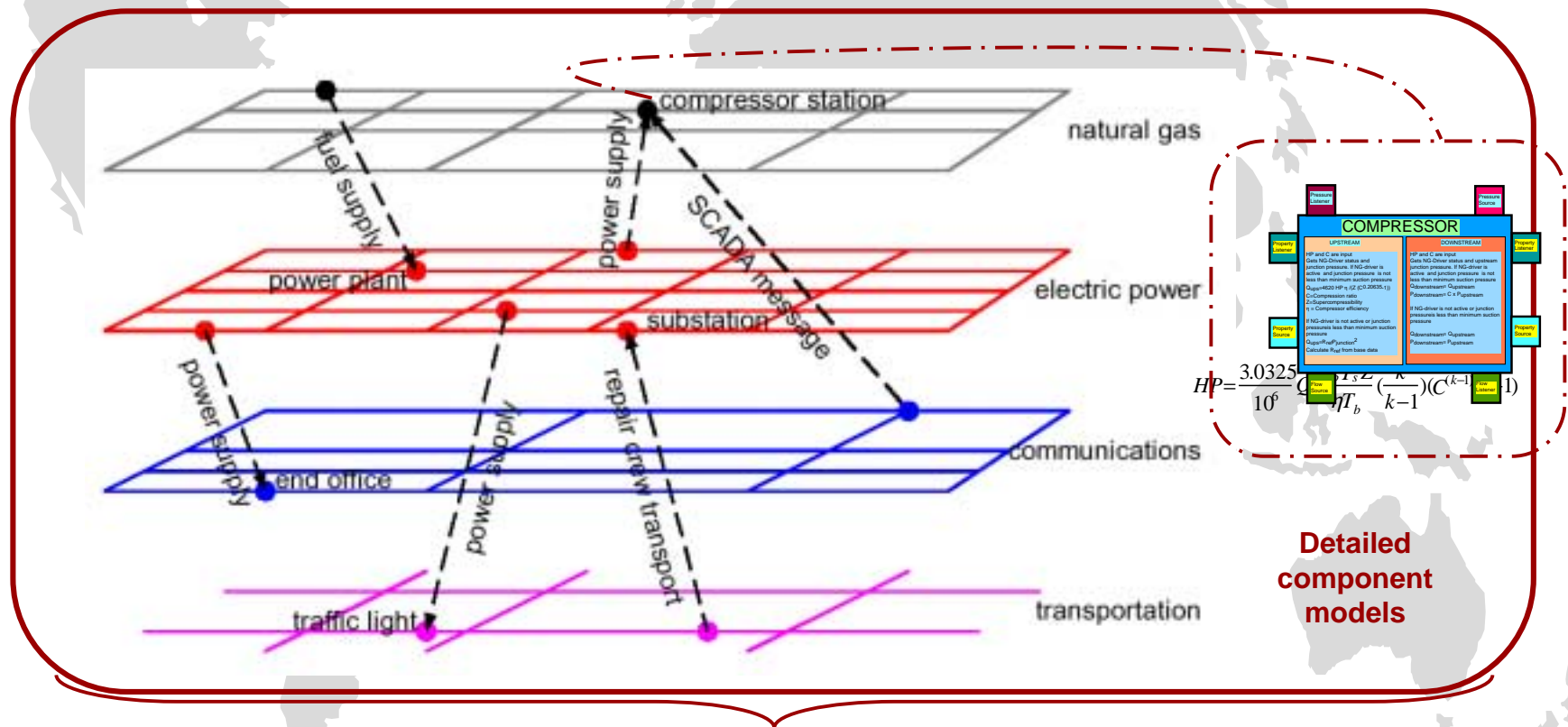
Professor Saifur Rahman  
Virginia Tech

# Complex Interactive Networks and Systems



- ◆ Complex interactive networks are omnipresent
  - Energy infrastructure
  - Telecommunication
  - Transportation and distribution
  - Banking and finance

# Innovative Approaches Are Being Explored to Analyze Interdependent Infrastructures



- *Critical system components*
- *Interdependence propagation pathways and degree of coupling*
- *Benefits of mitigation options*
- ...

# Cascading, Dependencies, Interactions, Large-scale

**Many nodes** +

**Very many links** +

**Vulnerability to cascading failures**

(owners, operators, sellers, buyers, customers)

- ◆ Multi-layered, multi-resolutional intertwined grids.
- ◆ Too complex for single central entity to evaluate, monitor, and manage in real time.
- ◆ Too complex for conventional mathematical methodologies.

# PITAC

- ◆ **Presidential Information Technology Advisory Committee (PITAC) points to Software as central product and problem**
- ◆ **<http://www.ccic.gov/>**
- ◆ **Major Recommendation: “Make fundamental software research an absolute priority”**
- ◆ **Four major research priorities:**
  - 🕒 **Software**
  - 🕒 **Scalable Information Infrastructure**
  - 🕒 **High-End Computing (including software R&D)**
  - 🕒 **Socio-Economic & Workforce Impacts**

# Federal Response

- ◆ **PITAC - Recommended spending on *basic research* to assure strong IT and strong economy**
- ◆ **President's Initiative "Information Technology for 21<sup>st</sup> Century"**
  - IT<sup>2</sup> called for \$366M in *new* research funding in FY2000**
  - Asked for \$146M new money to NSF in FY2000**
- ◆ **Congressional appropriation for NSF:**
  - \$90M for basic IT Research**
  - \$36M for development of a terascale computing facility**

# NSF-ITR Funding Structure

- ◆ About 30% for center-level activities of \$2-\$4M/yr
- ◆ About 40% for multi-PI activities of \$1M/yr
- ◆ About 30% for single-PI activities up to \$150K/yr

# ITR Topics

- ◆ Software (including security and scalability)
- ◆ IT Education and Workforce
- ◆ Human-Computer Interface (extend human capability)
- ◆ Information Management (massive, long-term, real-time)
- ◆ Advanced Computational Science (empower scientists, engineers, forecasters,...)
- ◆ Scalable Information Infrastructure (very large networked systems, including network security)
- ◆ Social and Economic Implications of IT (values, co-evol)
- ◆ Revolutionary computing (DNA, quantum, molecular,...)

## Selected NSF Funding-FY99 (\$16.8M)

◆ Security of Computing Systems	\$0.78
◆ Reliability of Computer Systems	\$4.22
◆ Reliable Communications Systems	\$3.70
◆ Secure Communications Systems	\$0.48
◆ Verific., Validation, & Assurance of Comp Sysys	\$1.42
◆ Verification Technologies	\$1.00
◆ Encryption Technologies	\$0.40
◆ System-Level Security	\$0.40
◆ Network Management	\$1.50
◆ Distributed and Mobile Database Systems	\$2.00
◆ Electronic Commerce Research	\$0.30
◆ Risk Management, Modeling, and Simulation	\$0.60