Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Catastrophic cascade of failures in interdependent networks SERGEY V. BULDYREV, Yeshiva University, SHLOMO HAVLIN, RONI PARSHANI, Bar-Ilan University, GERALD PAUL, H. EUGENE STANLEY, Boston University — Many complex systems are coupled together and therefore should be modeled by multiple interdependent networks. For example, a power network in which the nodes are power stations and a communication network in which the nodes are computers, are interdependent. In interdependent networks, failure of nodes in one network, cause failure of dependent nodes in another network. This may happen recursively and can lead to a cascade of failures: a failure of a very small fraction of nodes in one network may lead to the complete fragmentation of a system. We provide a framework for understanding the robustness of interacting networks subject to such cascading failures and provide a basic analytic approach that may be useful in future work. We present exact analytical solutions for the critical fraction of nodes that upon removal will lead to a failure cascade and to a complete fragmentation of two randomly connected interdependent networks in terms of the generating functions of their degree distributions. Surprisingly, networks with broad degree distributions are more vulnerable to random failures than networks with narrow degree distributions.

Sergey V. Buldyrev
Yeshiva University

Date submitted: 17 Nov 2009 Electronic form version 1.4