Sixth Framework Programme

Project contract no. 043363

MANMADE
Diagnosing vulnerability, emergent phenomena and volatility in man-made networks
SPECIFIC TARGETED PROJECT

NEST PATHFINDER
Sub-Priority Tackling Complexity in Science

Work Package 3 D3.2
Report on the applicability of growth mechanisms of evolving networks and growth strategies to guarantee desired topological features
Revision [0]

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1. Executive Summary

D3.2 Report on the applicability of growth mechanisms of evolving networks and growth strategies to guarantee desired topological features

Summary:

There does not exist so far a theoretically well founded strategy how to characterise general complex networks, like, the Internet, supply networks, or communication communities. However, common approaches focus on topological properties and related performance indicators like the ones linked with catastrophic breakdowns. Widely used quantities are the degree distribution P(k), i.e. the probability that a randomly chosen node is connected to k neighbours, or the degree correlation P(k,k'), i.e. the probability that two connected nodes have degree k and k'. Performance indicators try to link such topological properties with dynamical features, e.g., the vulnerability of the network or the breakdown of network traffic when nodes are becoming congested.

To study such aspects it is desirable to develop algorithms which reproduce topological features, e.g. degree distributions, which can be found in real world networks. We have addressed this issue by topological modelling of large Internet networks (see annex 1). Motivated by the Barabasi Albert preferential attachment algorithm we have modified the rules and proposed a method which grows networks such that degree distributions and degree correlations are reproduced with higher accuracy. In a second contribution networks have been designed which show catastrophic failures such that catastrophic traffic breakdown can be studied in more detail (see annex 2).

Data sets:

To study topological features by statistical methods large networks are desirable. We have based our study on data for networks with about 200.000 nodes. Corresponding data for the Internet are available at www.caida.org.

Dissemination:

The major findings together with a quantitative comparison of growth algorithms and real world networks have been summarised in two scientific articles which have been published in 2007 and 2008 (annex 1 and 2). Furthermore, among related topics, results were presented at a meeting in June 2008 (annex 3).

Impact:

The model studies performed so far may have considerable impact on the understanding of the interplay between the topological structure and the performance of real world networks.

Annex 1

Publication "Topological modelling of large networks", by R.J. Mondragon, Philosophical Transactions of the Royal Society A, vol. 366, pp. 1931-1940, 2008

The paper "Topological modelling of large networks" was prepared by the Department of Electronic Engineering, Queen Mary / University of London (UK).
<MonRSTA2008.pdf>

Annex 2

Publication "Building catastrophes: networks designed to fail by avalanche-like breakdown", by M. Woolf, Z. Huang, and R.J. Mondragon, New Journal of Physics, vol. 9, p. 174, 2007

The paper "Building catastrophes: networks designed to fail by avalanche-like breakdown" was prepared by the Department of Electronic Engineering, Queen Mary / University of London (UK).
<njp7_6_174.pdf>

Annex 3

Presentation "Manmade Networks"

The presentation was delivered on 9 June 2008 at the 4th MANMANDE Management Committee Meeting and subsequently made available to the public on the project website (http://www.manmadenet.eu).
<Helsinki.pdf>