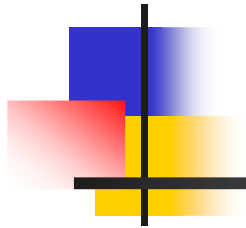
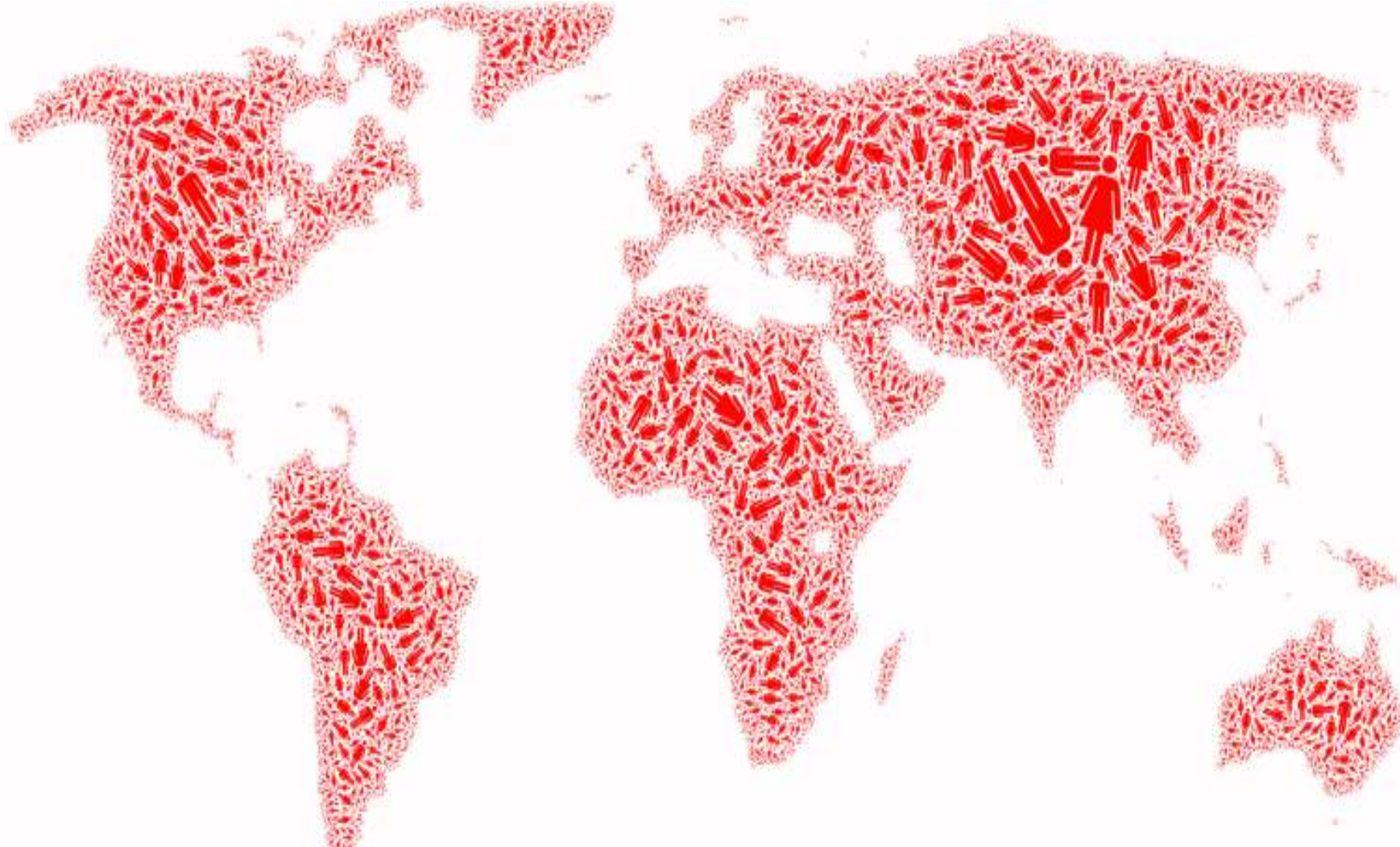


Perché ci interessiamo di Reti Sociali



COMPLESSITA' e Grandi Numeri



The "Day of 7 Billion" has been targeted by the United States Census Bureau to be in July 2012.

http://en.wikipedia.org/wiki/World_population

Complex

[adj., v. kuh m-pleks, kom-pleks; n. kom-pleks]

–adjective

1.

composed of many interconnected parts; compound; composite: a complex highway system.

2.

characterized by a very complicated or involved arrangement of parts, units, etc.: complex machinery.

3.


so complicated or intricate as to be hard to understand or deal with: a complex problem.

Source: Dictionary.com

Complexity, a **scientific theory** which asserts that some systems display behavioral phenomena that are completely inexplicable by any conventional analysis of the systems' constituent parts. These phenomena, commonly referred to as emergent behaviour, seem to occur in many complex systems involving living organisms, such as a stock market or the human brain.

Source: John L. Casti, Encyclopædia Britannica

Complexity



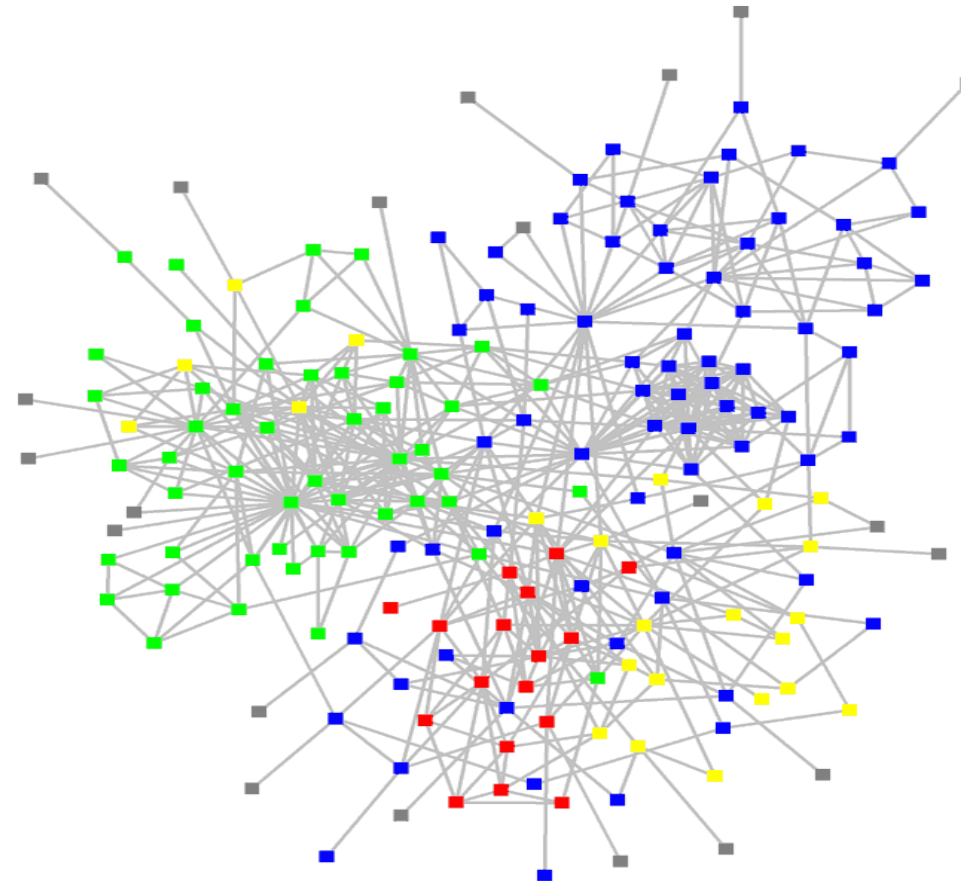
Behind each complex system there is a **network**, that defines the interactions between the component.



The “Social Graph” behind Facebook

Keith Shepherd's "Sunday Best". <http://baseballart.com/2010/07/shades-of-greatness-a-story-that-needed-to-be-told/>

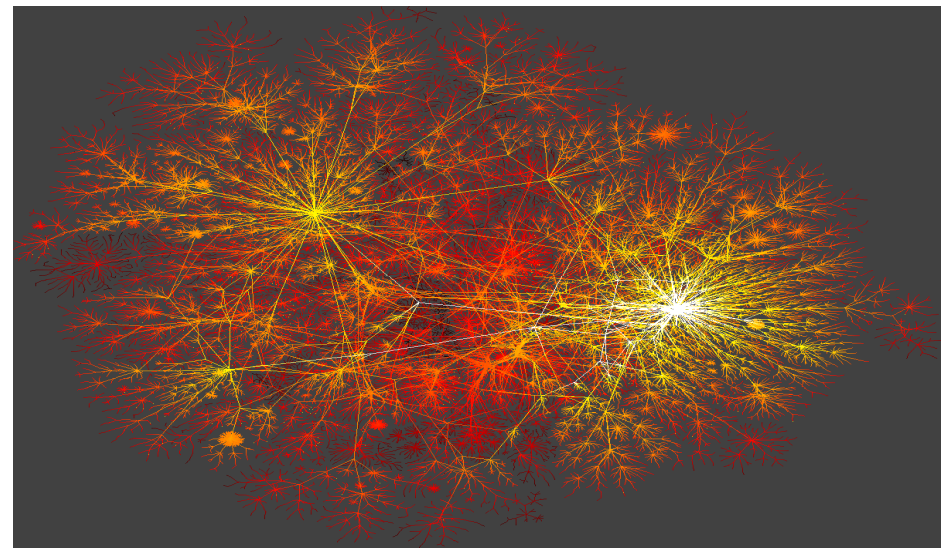
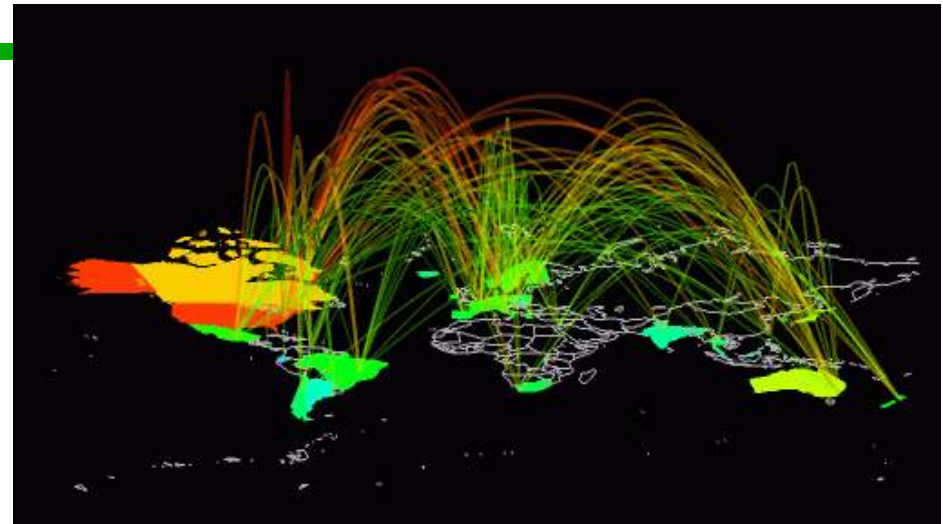
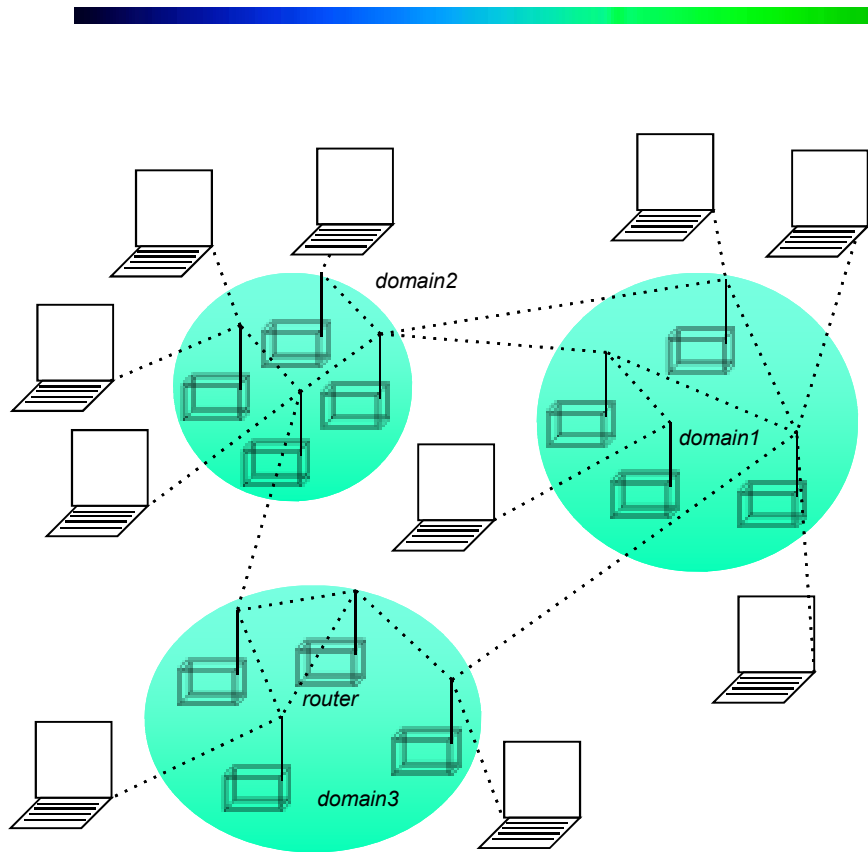
STRUCTURE OF AN ORGANIZATION



- : departments
- : consultants
- : external experts

www.orgnet.com

INTERNET

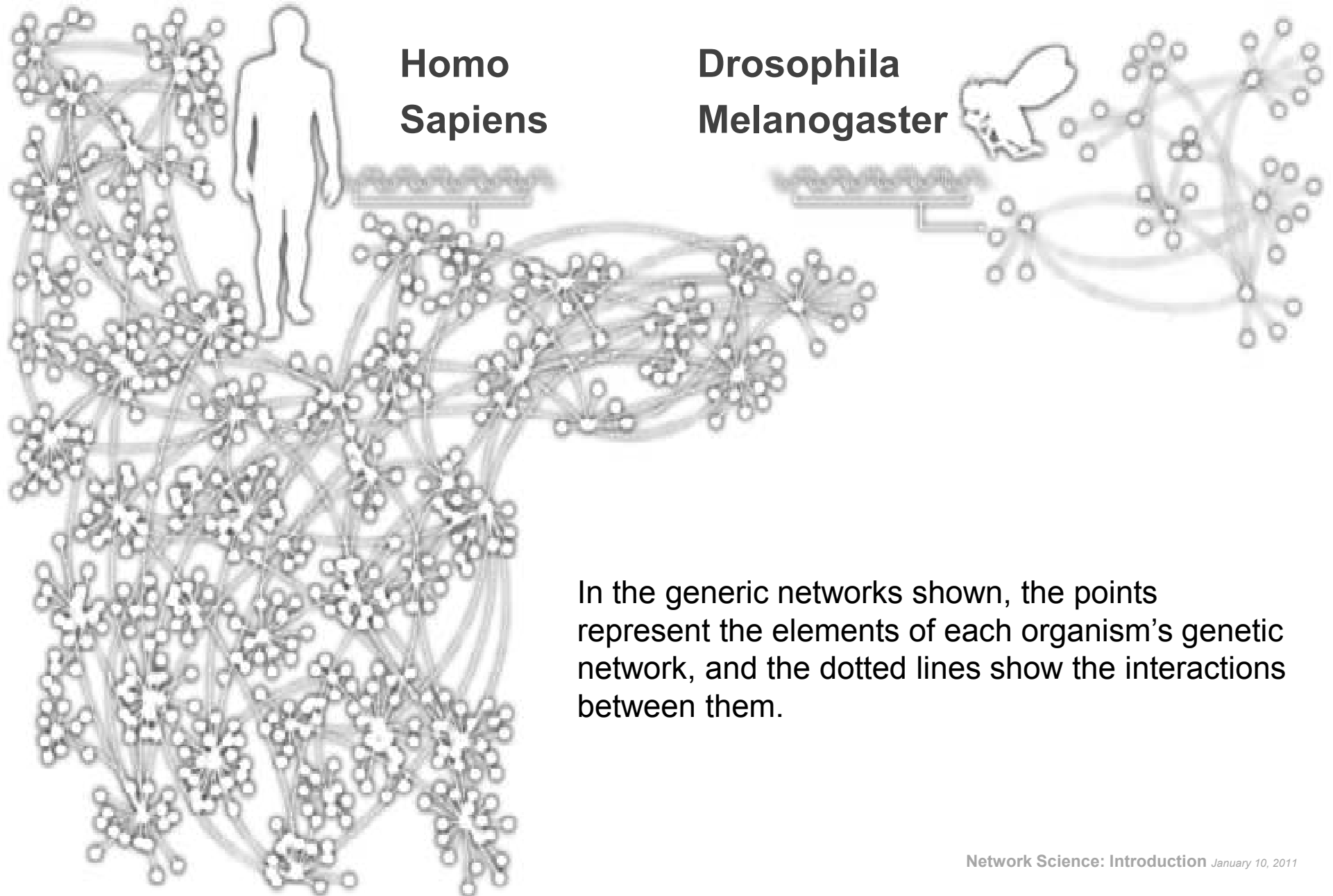


HUMANS GENES



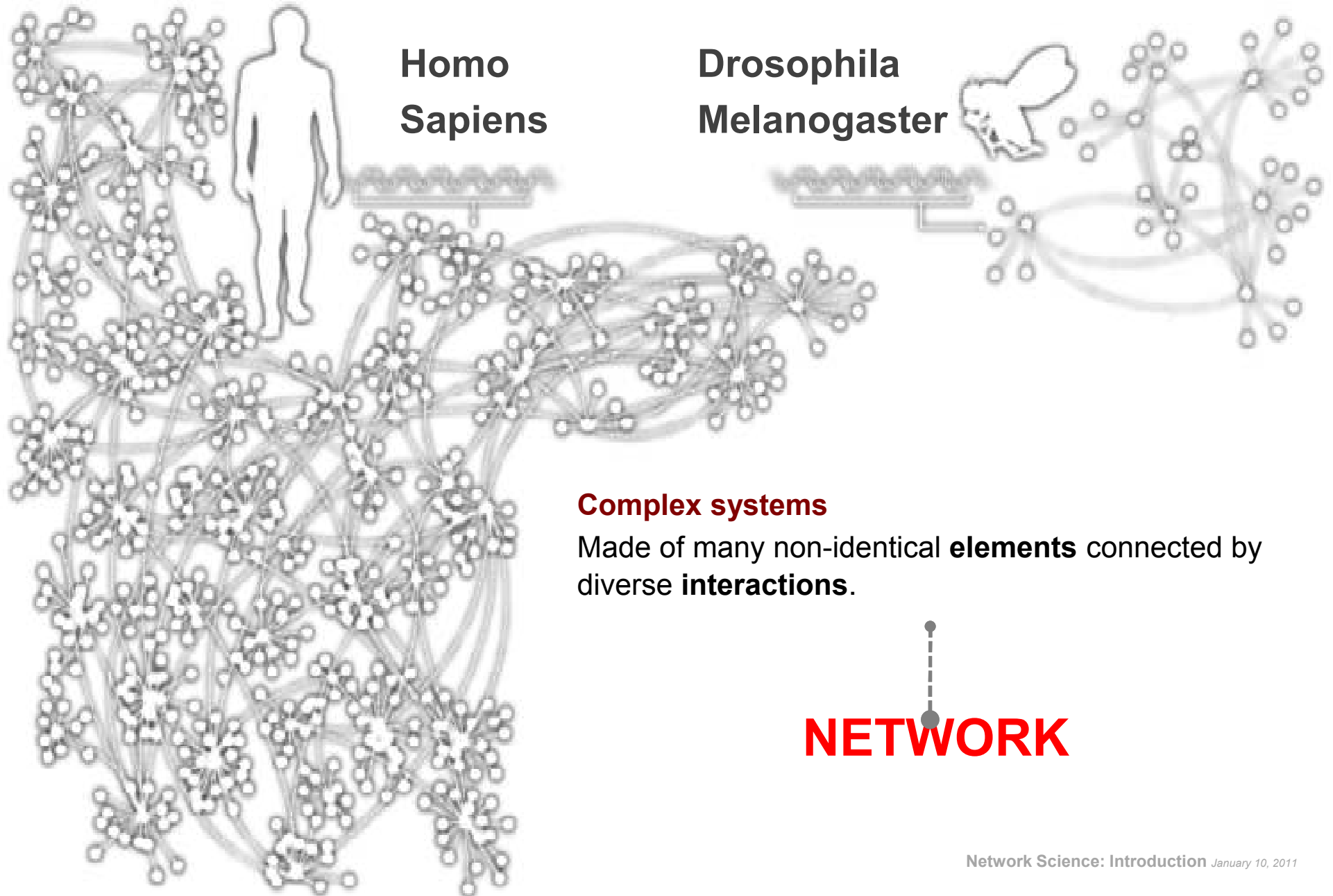
Humans have only about three times as many genes as the fly, so human complexity seems unlikely to come from a sheer quantity of genes. Rather, some scientists suggest, each human has a network with different parts like genes, proteins and groups.

HUMANS GENES




In the generic networks shown, the points represent the elements of each organism's genetic network, and the dotted lines show the interactions between them.

HUMANS GENES



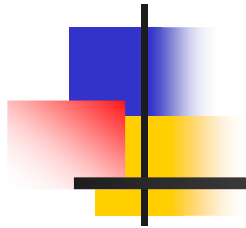
THE ROLE OF NETWORKS



Behind each system studied in complexity there is an intricate wiring diagram, or a **network**, that defines the interactions between the component.

We will never
understand complex
system unless we map
out and understand the
networks behind them.

Quali tipi di reti



Society

Nodes: individuals

Links: social relationship
(family/work/friendship/etc.)



S. Milgram (1967)

John Guare

Six Degrees of Separation

Social networks: Many individuals with diverse social interactions between them.

Social networks: Actor Connectivity

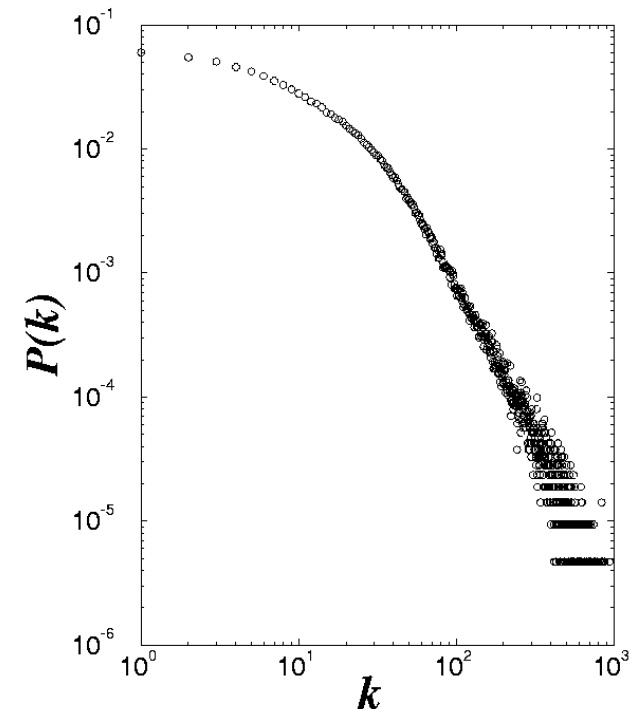


← Days of Thunder (1990)
Far and Away (1992)
Eyes Wide Shut (1999) →

N = 212,250 actors
 $\langle k \rangle = 28.78$

$P(k) \sim k^{-\gamma}$
 $\gamma = 2.3$

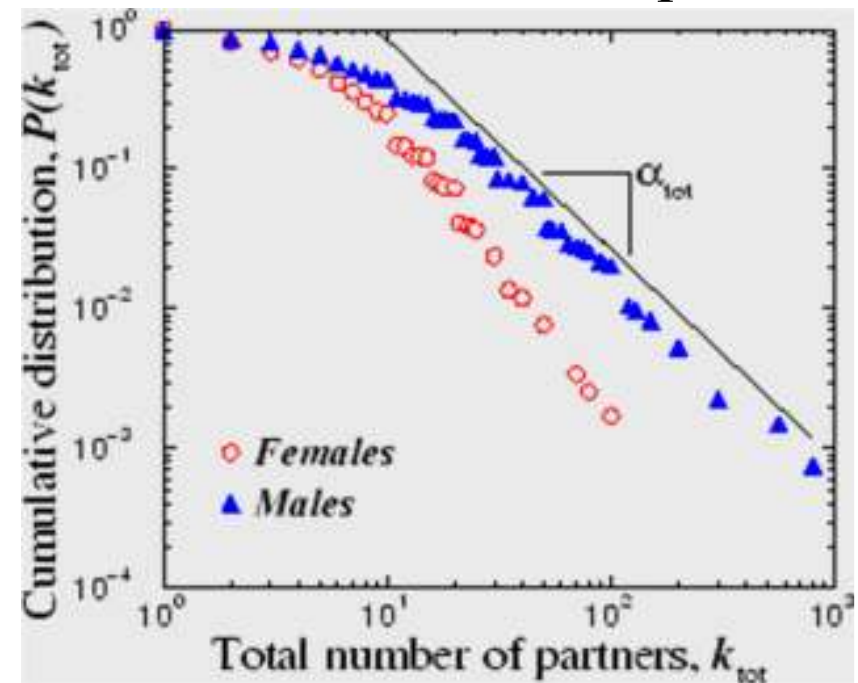
Nodes: actors
Links: cast jointly



Social networks: Sex-Web

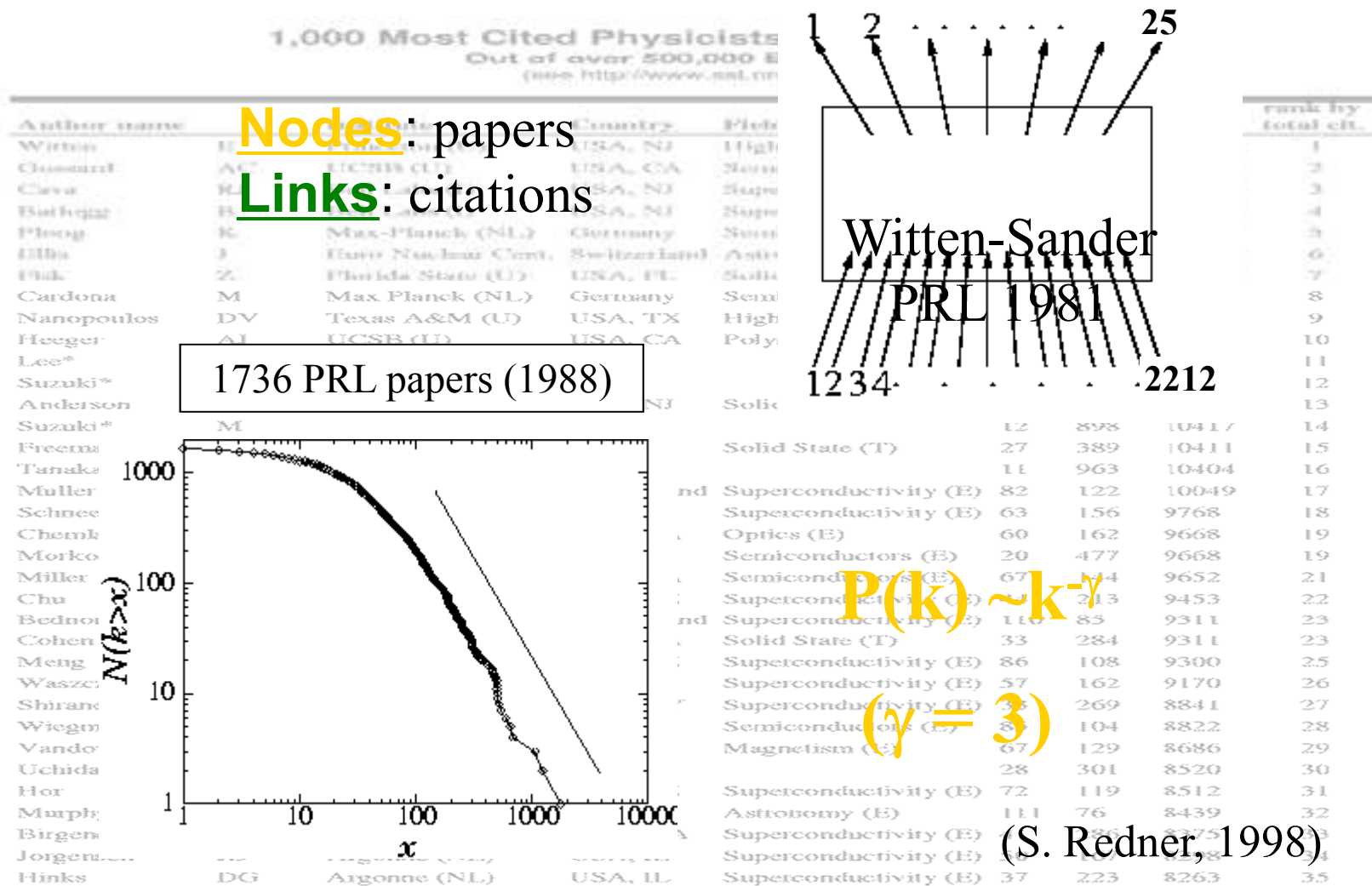


Nodes: people (Females; Males)
Links: sexual relationships



4781 Swedes; 18-74;
59% response rate.
Liljeros et al. Nature 2001

Information networks: Science Citation Index

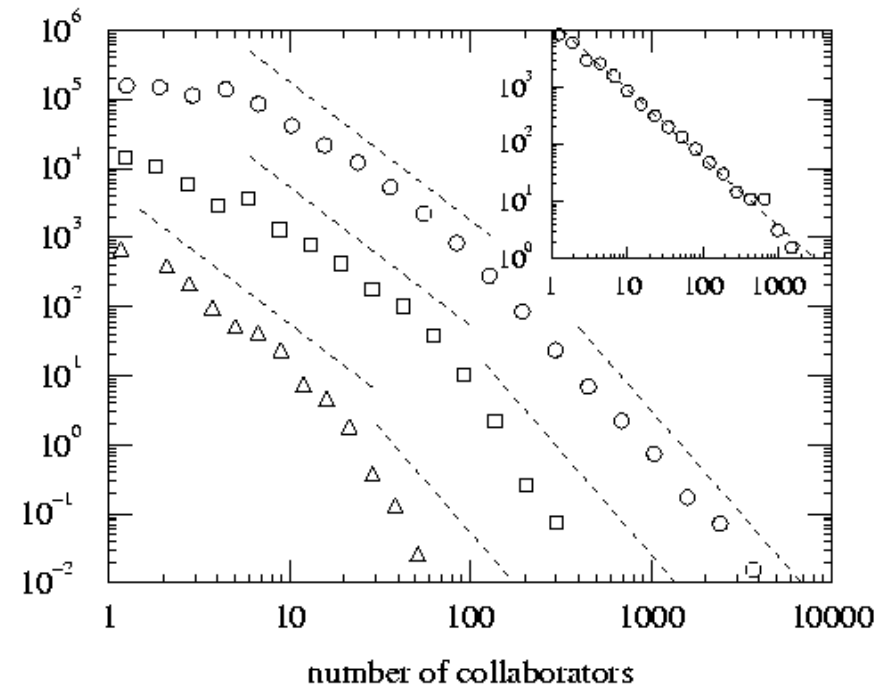
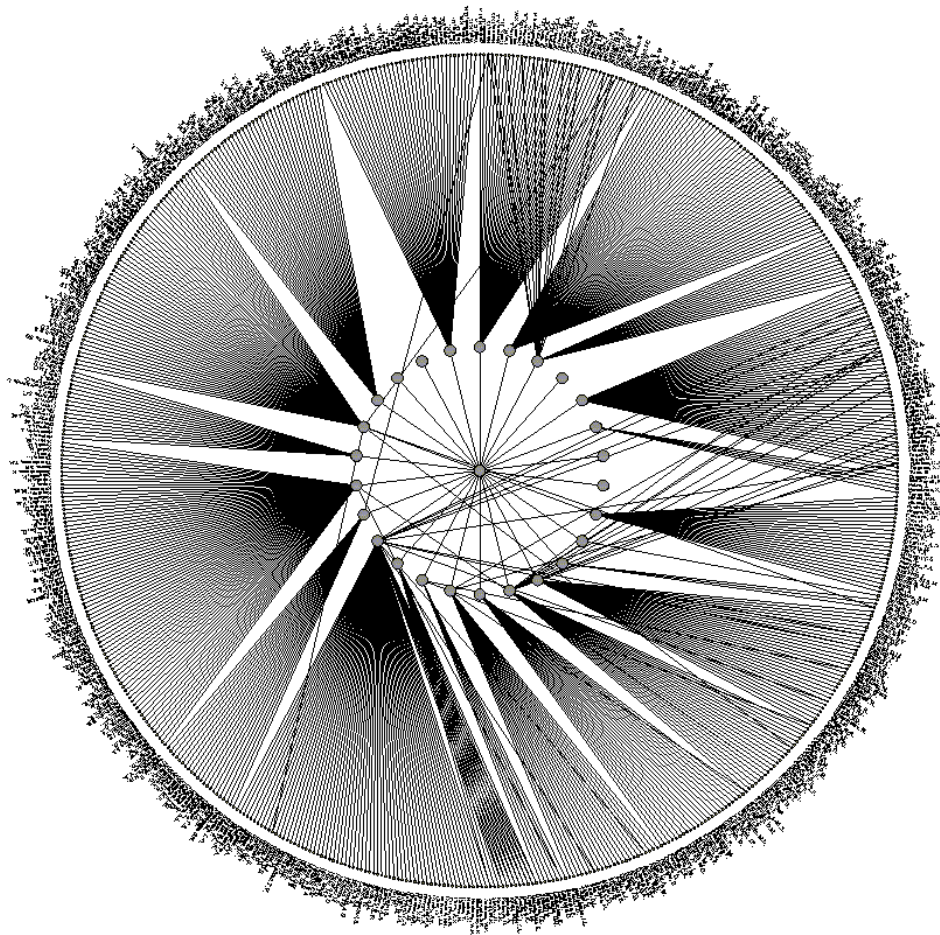


* citation total may be skewed because of multiple authors with the same name

Information network: Science Coauthorship

Nodes: scientist (authors)

Links: write paper together



(Newman, 2000, H. Jeong et al 2001)

Communication networks

The Earth is developing an electronic nervous system, a network with diverse nodes and links are

-computers

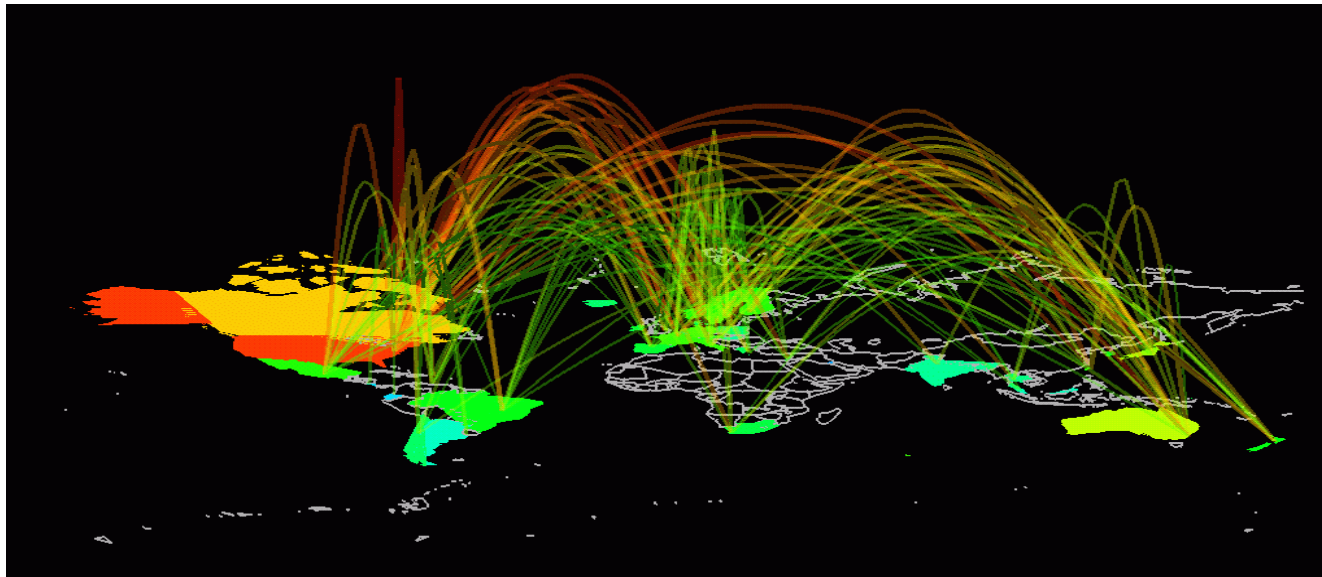
-routers

-satellites

-phone lines

-TV cables

-EM waves

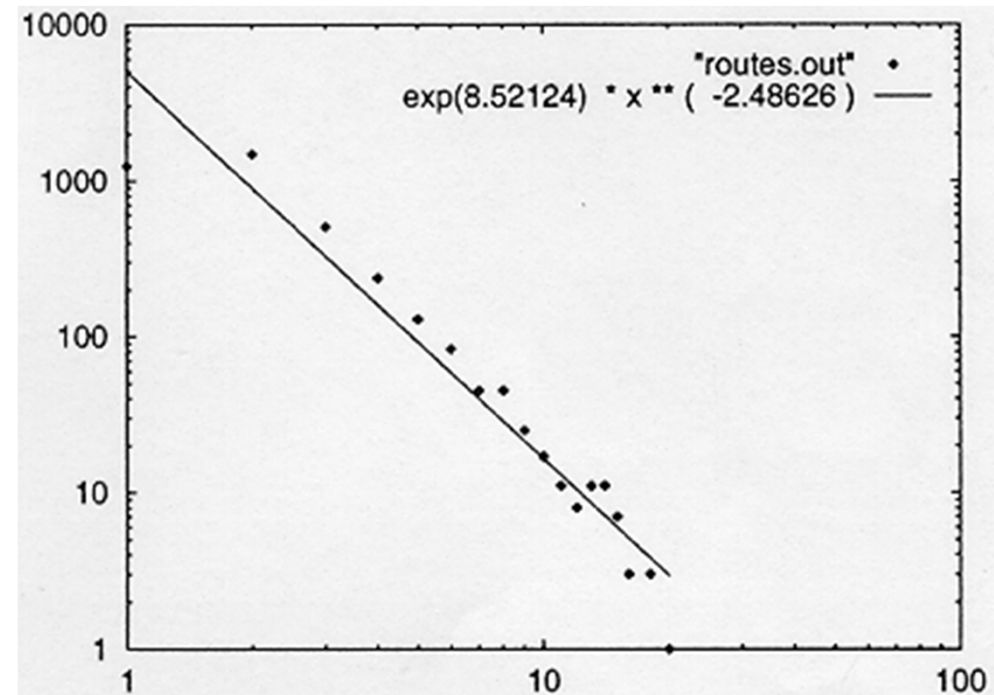
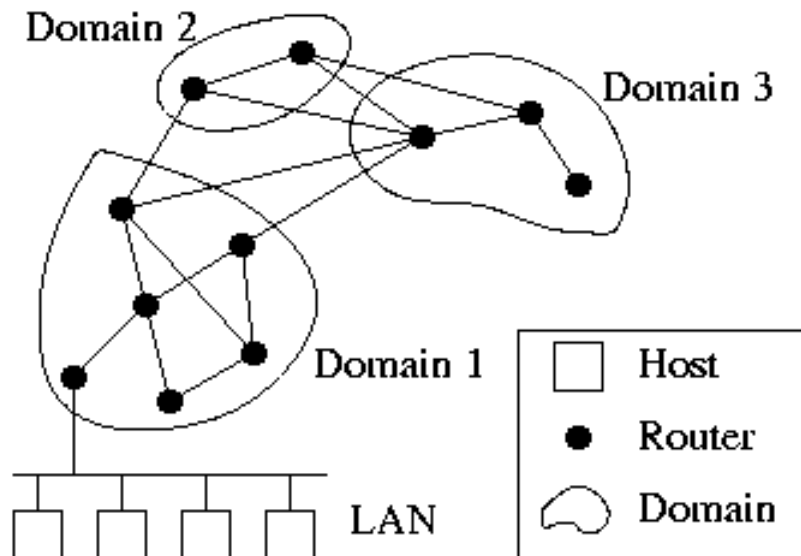


Communication networks: Many non-identical components with diverse connections between them.

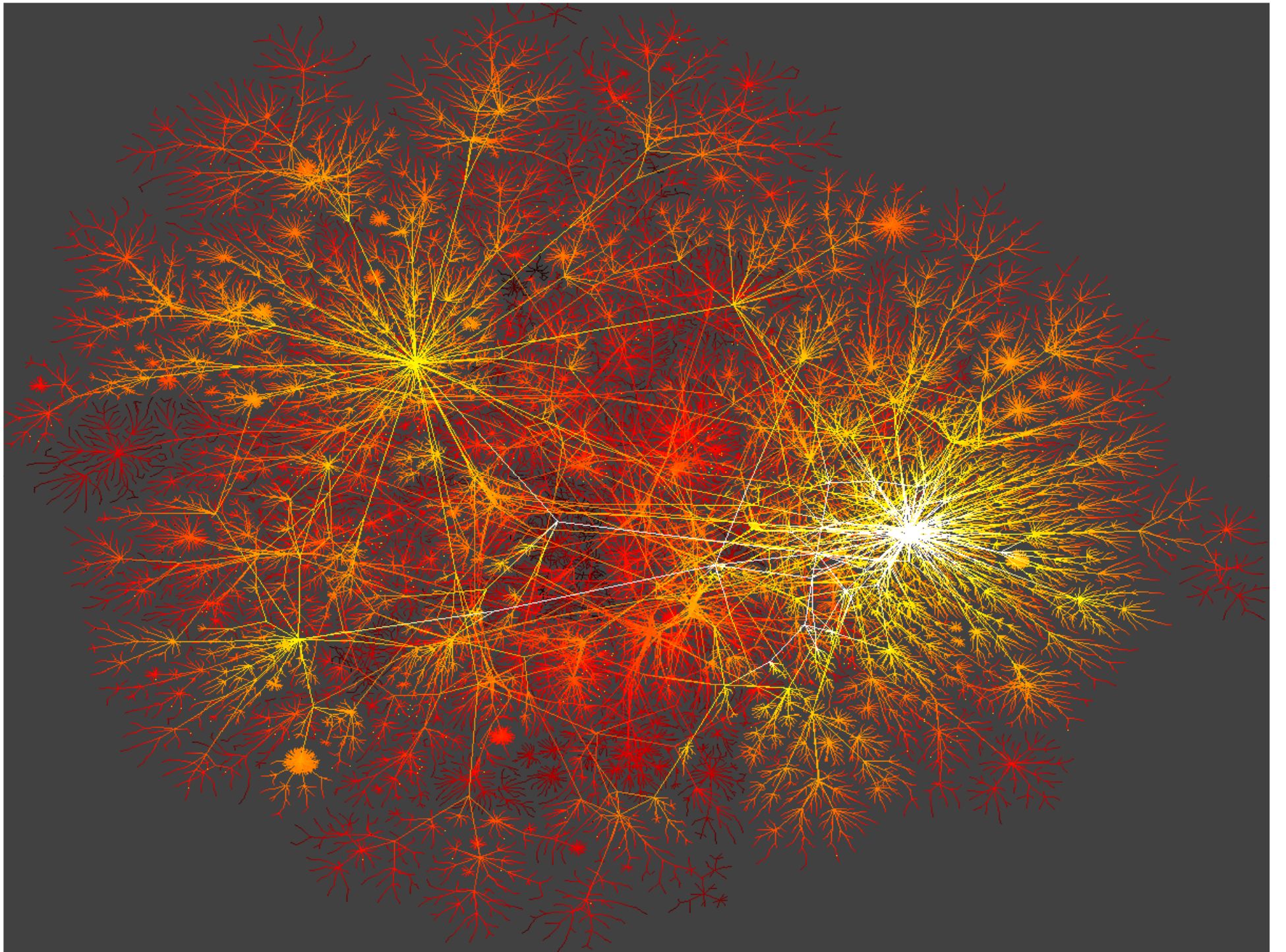
Tech. networks: Internet Backbone

Nodes: computers, routers

Links: physical lines



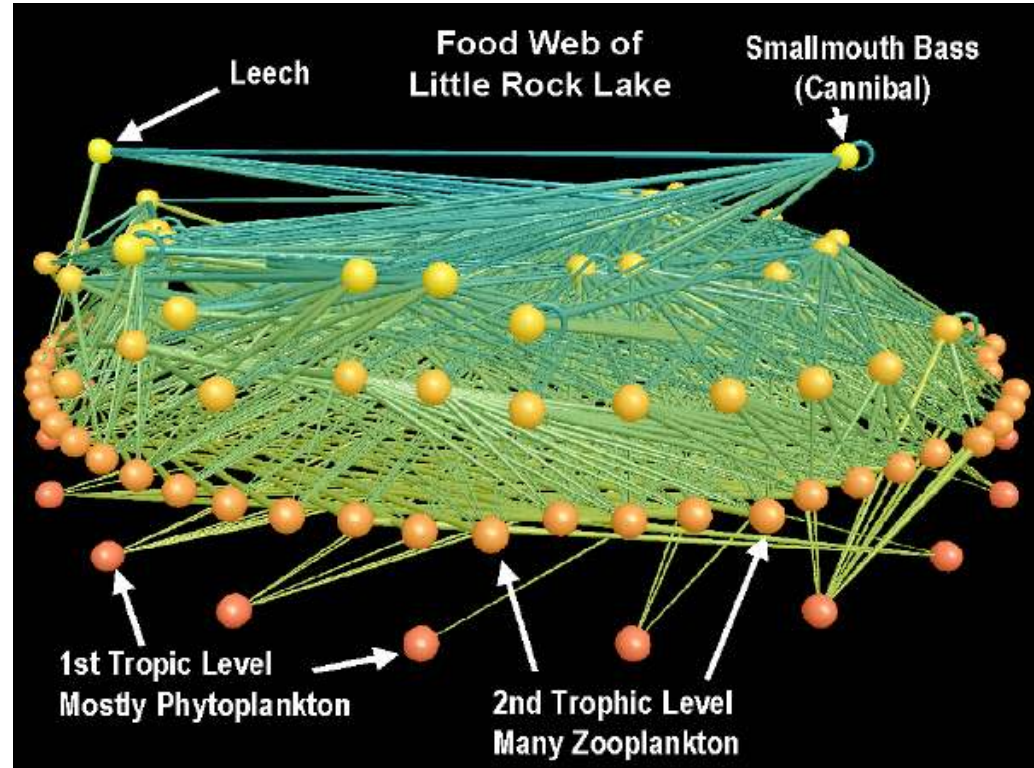
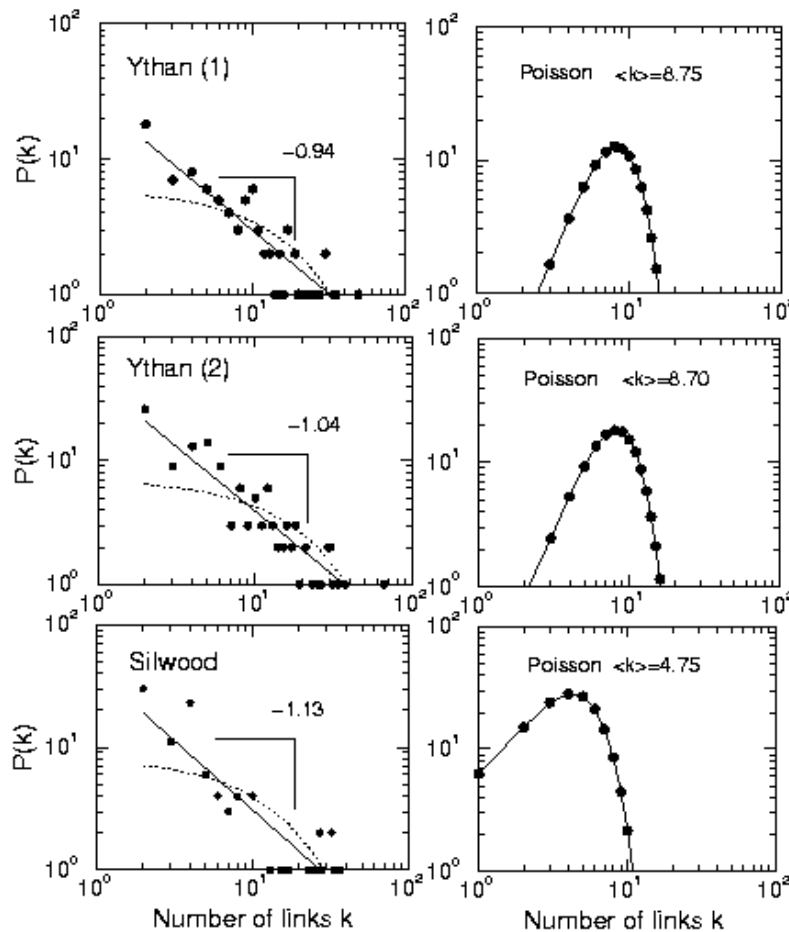
(Faloutsos, Faloutsos and Faloutsos, 1999)



Biological networks: Food Web

Nodes: trophic species

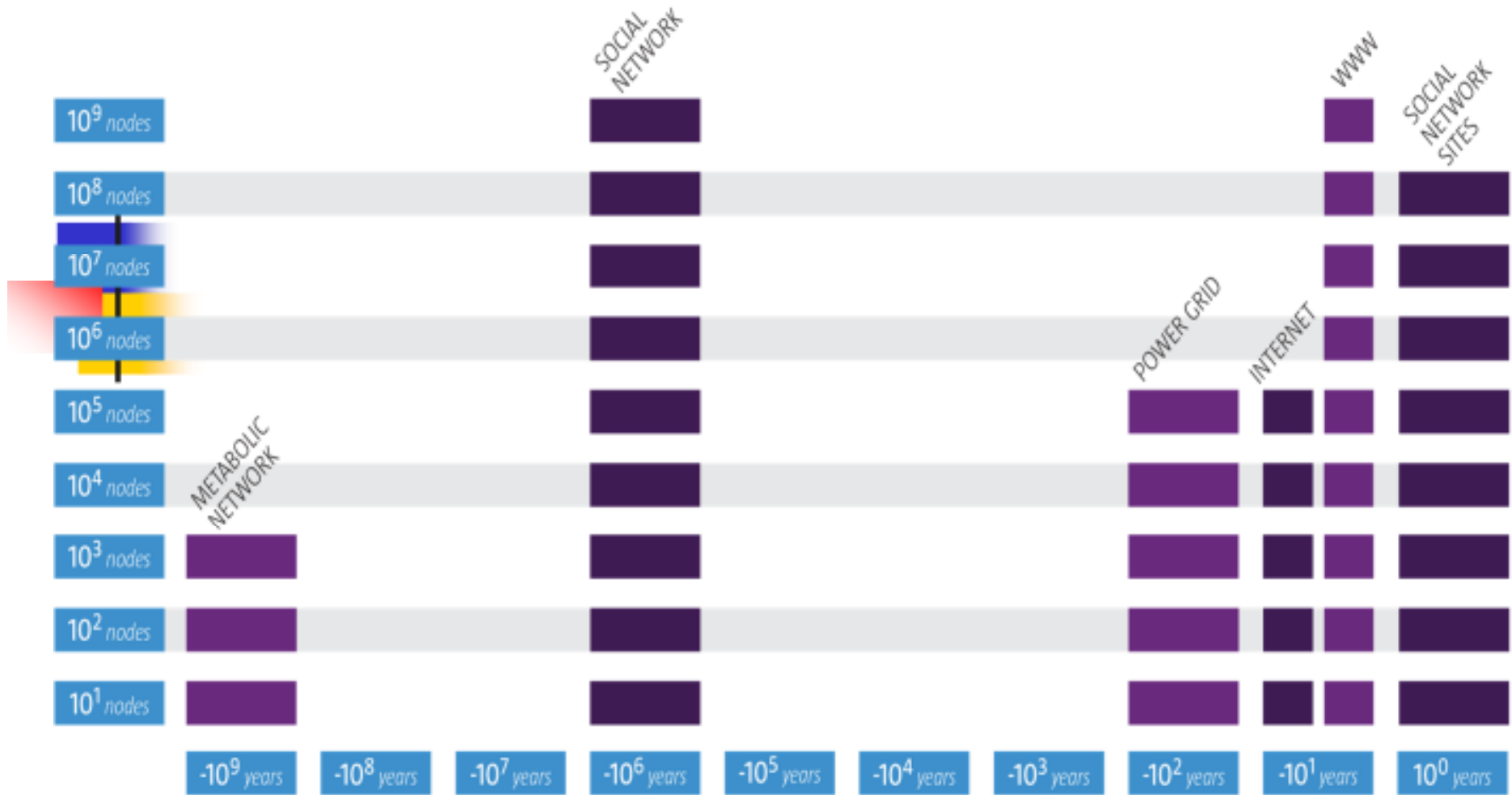
Links: trophic interactions



R. Sole (cond-mat/0011195)

R.J. Williams, N.D. Martinez *Nature* (2000)

THE LIFE OF NETWORKS



THE EMERGENCE OF NETWORK SCIENCE

Data Availability:

Movie Actor Network, 1998;
World Wide Web, 1999.
C elegans neural wiring diagram 1990
Citation Network, 1998
Metabolic Network, 2000;
PPI network, 2001



Universality:

The architecture of networks emerging in various domains of science, nature, and technology are more similar to each other than one would have expected.

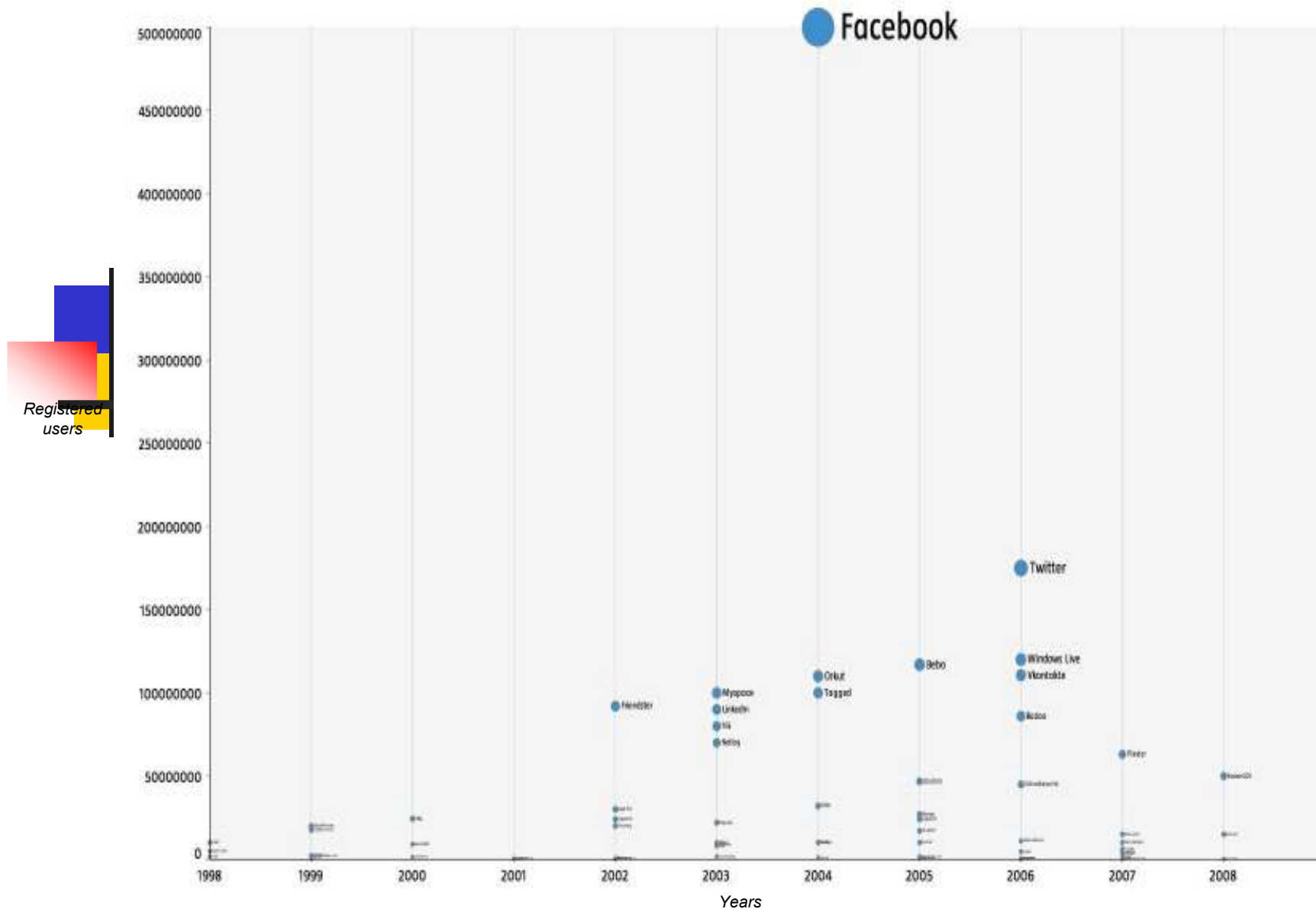
The **(urgent)** need to understand complexity:

Despite the challenges complex systems offer us, we cannot afford to not address their behavior, a view increasingly shared both by scientists and policy makers. Networks are not only essential for this journey, but during the past decade some of the most important advances towards understanding complexity were provided in context of network theory.

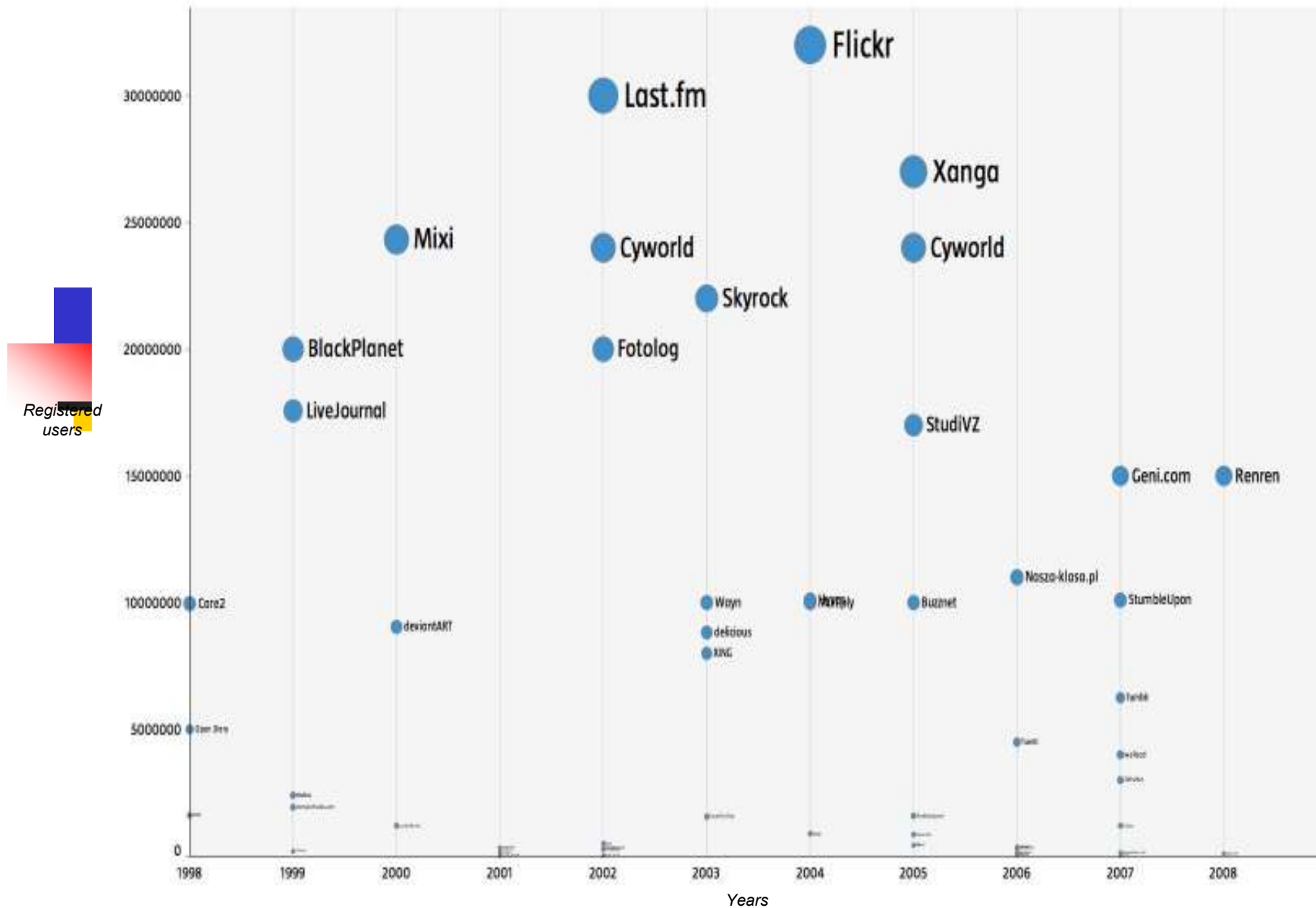
Network data is increasingly available

- · **On-line communities: Facebook (500 million users)**
- · **Communication: Instant Messenger (~1 billion users)**
- · **News and Social media: Blogging (250 million users)**

THE LIFE OF NETWORKS



THE LIFE OF NETWORKS



THE HISTORY OF NETWORK ANALYSIS

Graph theory: 1735, Euler



Social Network Research: 1930s, Moreno

Communication networks/internet: 1960s

Ecological Networks: May, 1979.

THE TOOLS OF MODERN NETWORK THEORY

- > **Graph theory**
- > **Social network theory**
- > **Statistical physics**
- > **Computer science**
- > **Biology**
- > **Statistics**