INTRODUCTION TO NETWORK ANALYSIS

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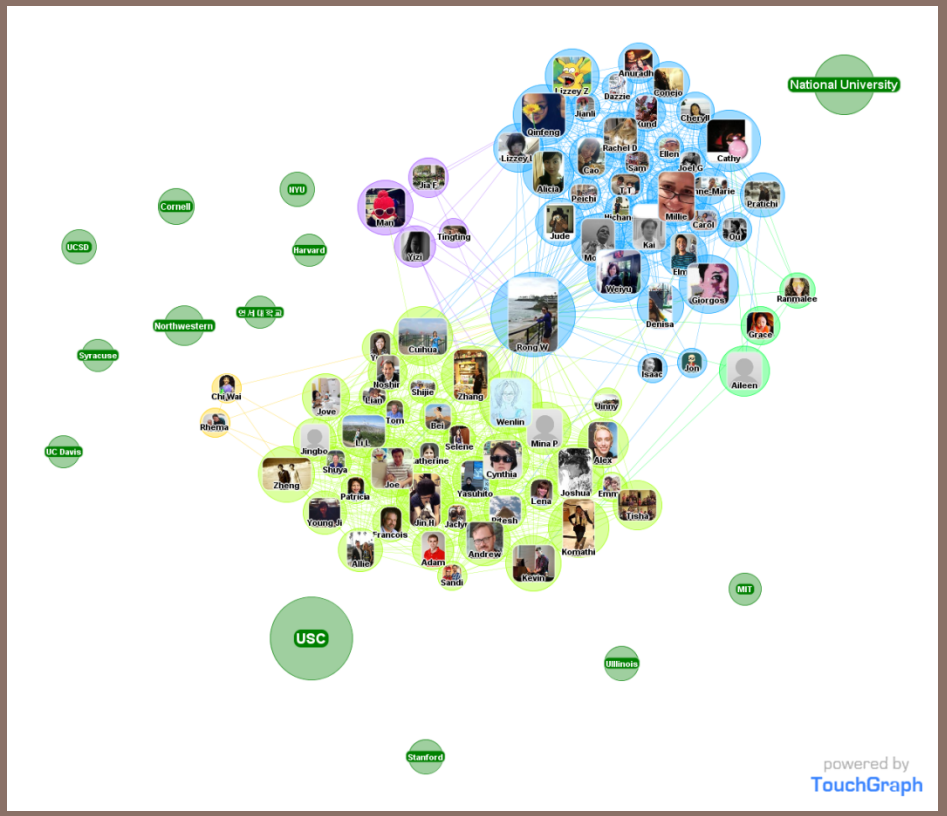

Outline

- Basics of Network Analysis
- Examples of Networks
- Network Analysis for Evaluation & Intervention
- Application of Network Analysis to Open Development Data

What do we mean by network?

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Network

From Wikipedia, the free encyclopedia

Network and **networking** may refer to:

Biological, biosocial, electric, and electronic [edit]

- Artificial neural network
- Biological network
- Business networking
- Computer network
- Electrical network
- Neural network
- Radio network
- Social network
- Telecommunications network
- Television network
- Universities network

Mathematics [edit]

Network = nodes + relations

- **Nodes (vertices/ points)**
  - People
  - Groups
  - Events
  - Organizations
  - Communities
  - Nation-states
- **Relations (links/ties/edges)**
  - Evaluation of one person by another (friendship, liking)
  - Transfers of material resources (lending, donations)
  - Associations or affiliation (membership, attendance)
  - Behavior interaction (communication)
  - Movement between places or statuses (migration, mobility)
  - Formal relations (authority, supply chain)
  - Biological relations (kinship, descent)

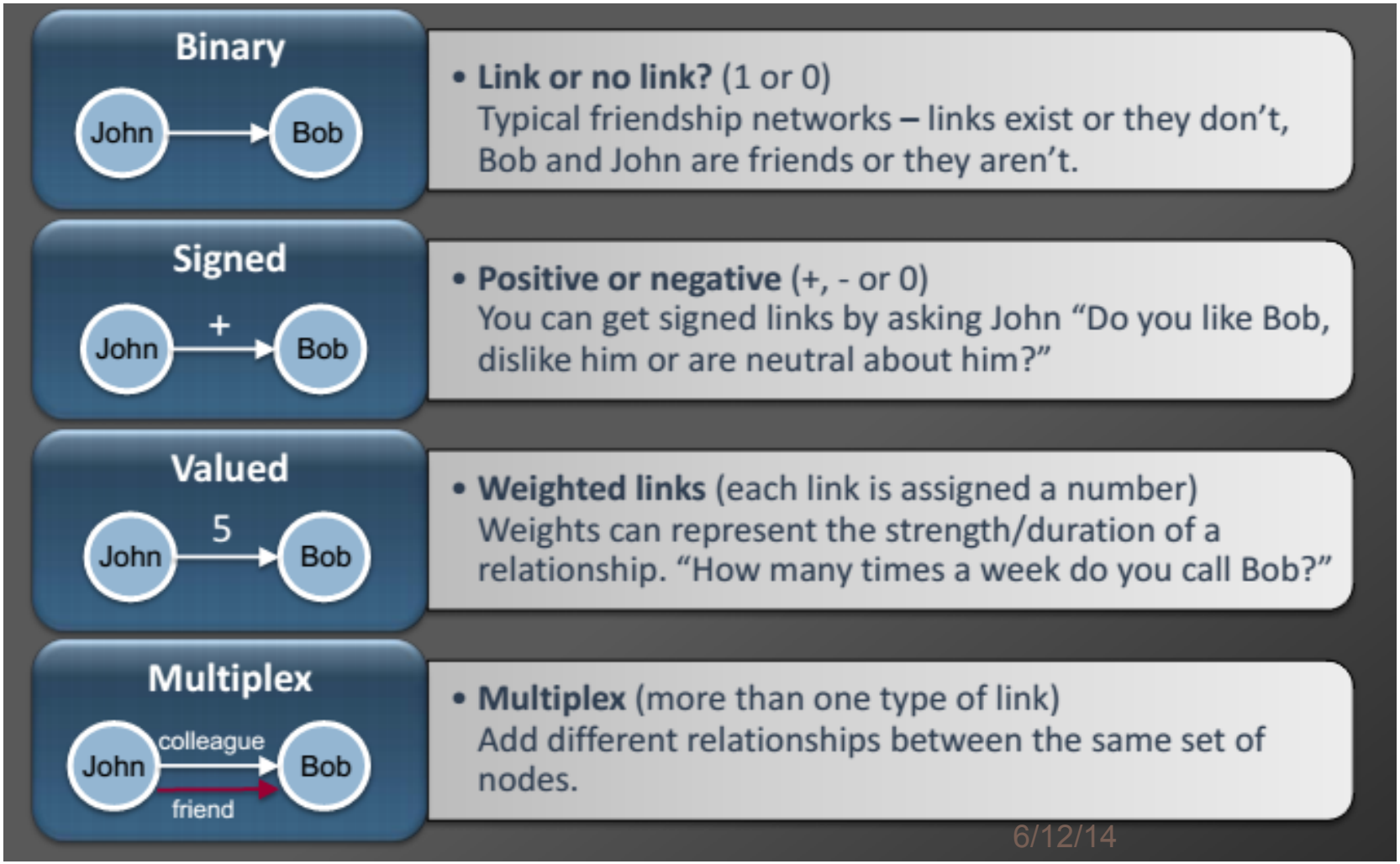
Network analysis

- Not just a methodology
- A unique perspective on how society functions
- Focus on interconnectivity and interdependence between individuals, groups, or social institutions.
- Network perspective is not new, but widespread availability of data and analytical advances have made it much easier now to apply it to a range of problems.

Network perspective is not new

- Six degree of separation
- The strength of weak ties
- Social capital

Conceptualizing your network



Examples of networks

Global media networks

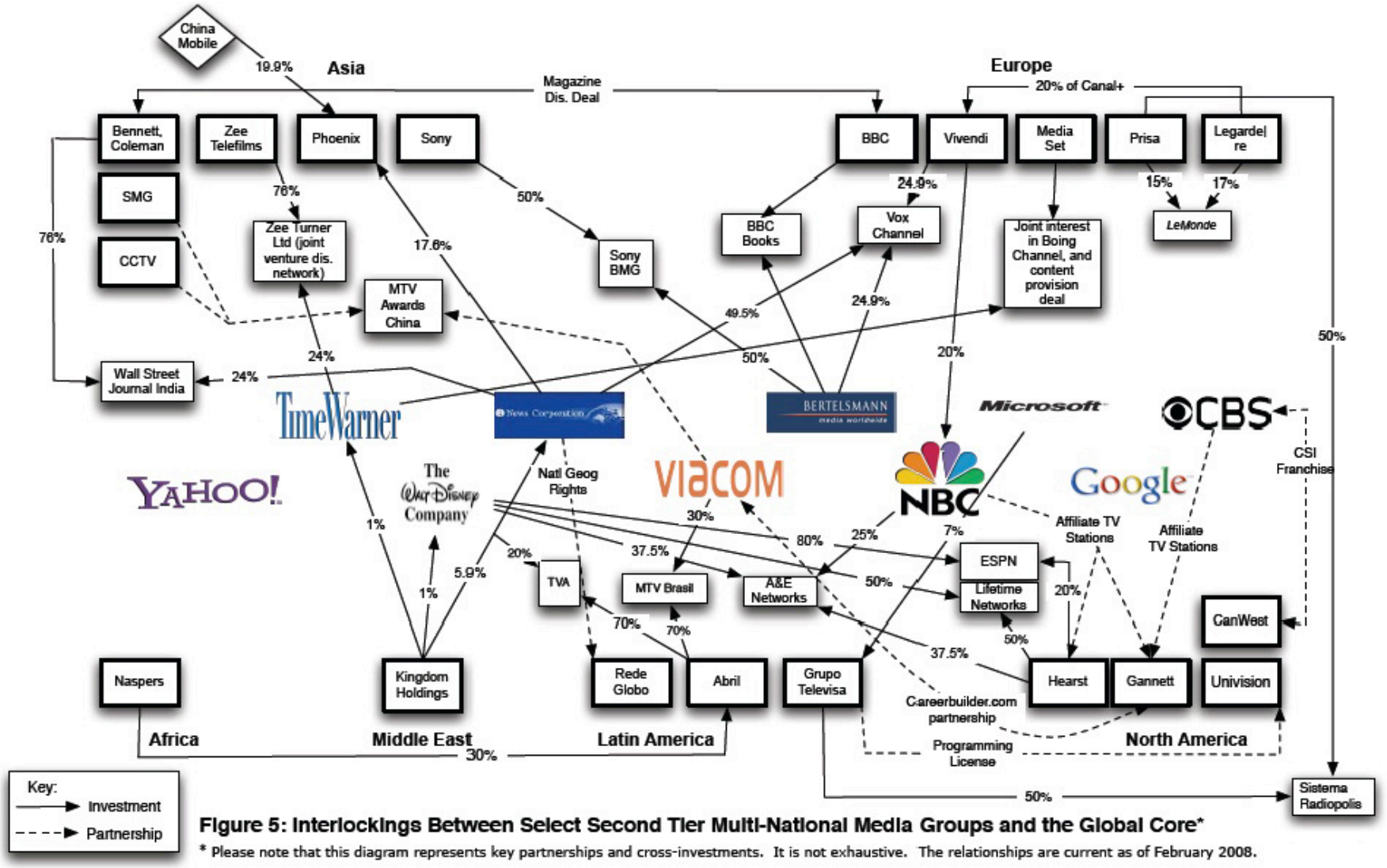
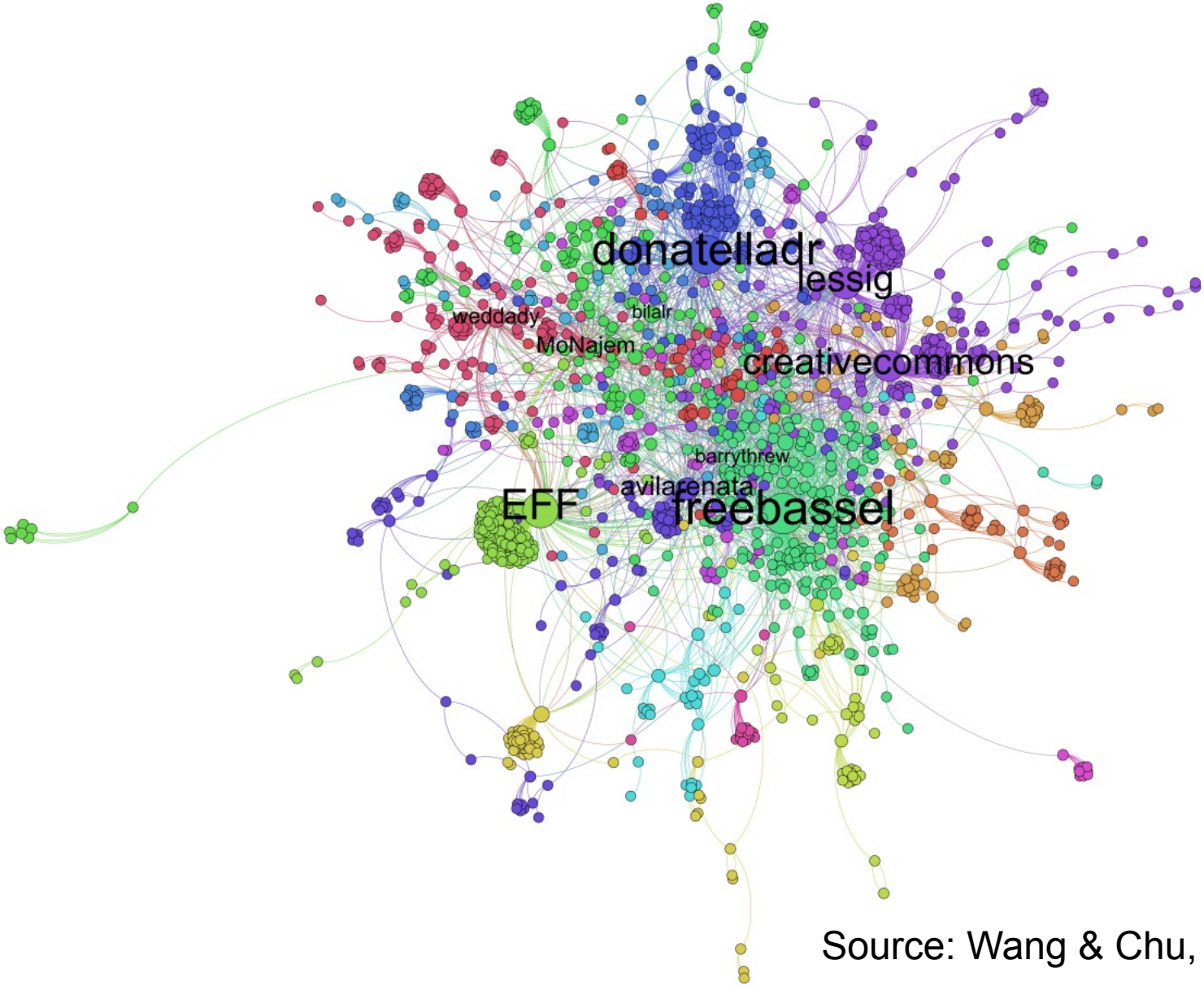


Figure 5: Interlockings Between Select Second Tier Multi-National Media Groups and the Global Core*

* Please note that this diagram represents key partnerships and cross-investments. It is not exhaustive. The relationships are current as of February 2008.

Source: Amelia H. Arsenault & Manuel Castells, 'The Structure and Dynamics of Global Multi-Media Business Networks', *International Journal of Communication* 2, 2008, p. 723.



An online advocacy campaign network

Source: Wang & Chu, 2014

High school romance network

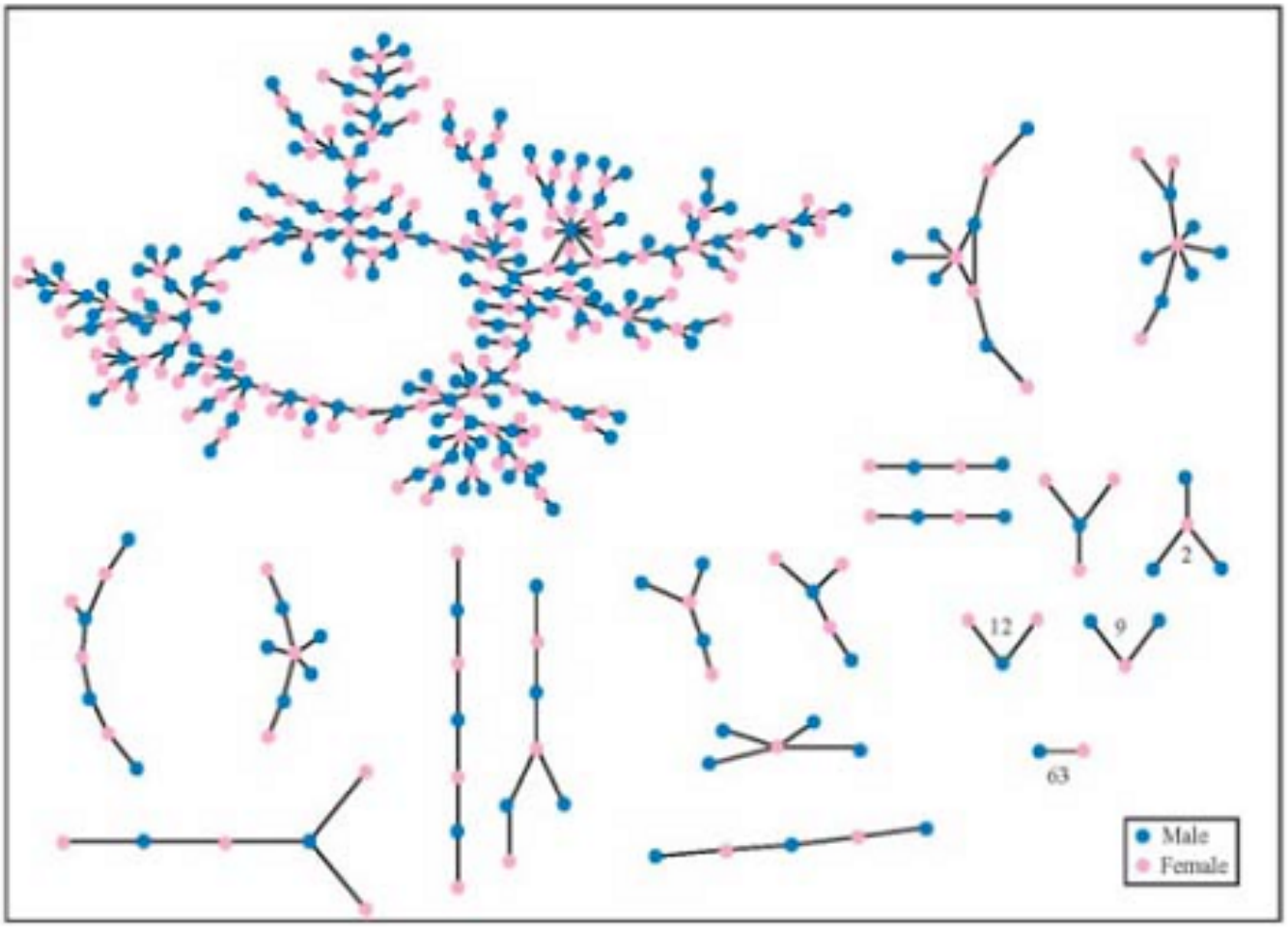


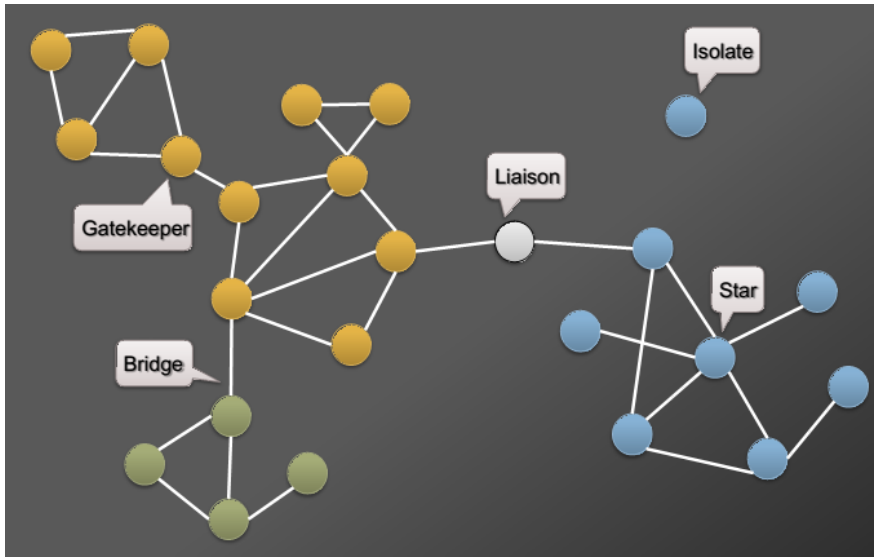
Figure 2.7: A network in which the nodes are students in a large American high school, and an edge joins two who had a romantic relationship at some point during the 18-month period in which the study was conducted [50].

Source: Easley, Kleinberg (2010) Networks, Crowds and Markets

Nicholas Christakis:
The hidden influence of social networks
TED2010 · 20:59 · Filmed Feb 2010
Subtitles available in 30 languages
View interactive transcript
The Spread Of Obesity
1971
TED

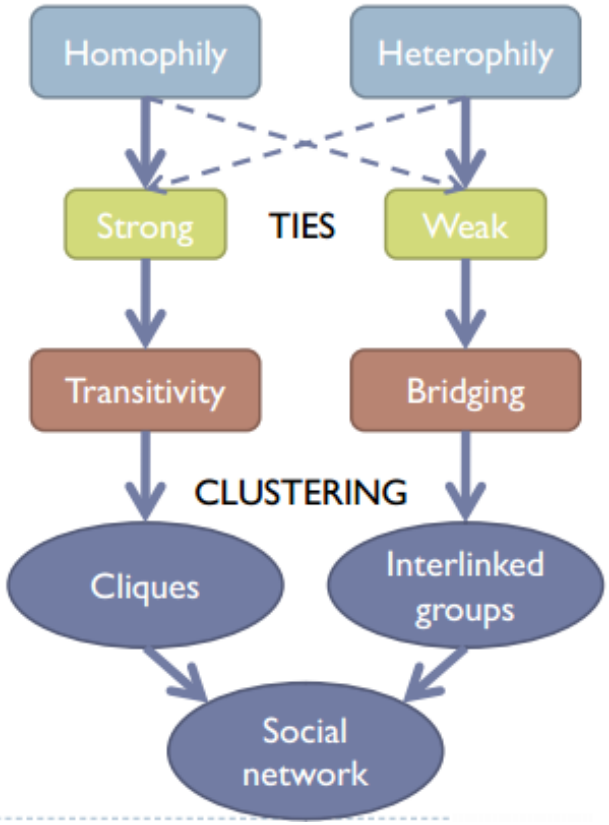
Categorizing nodes by roles

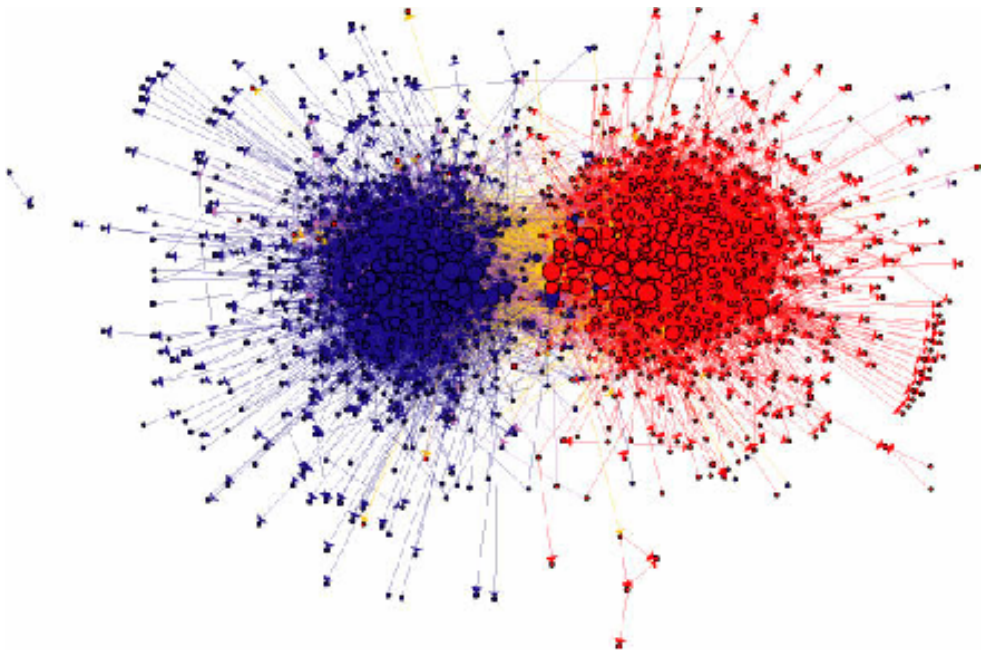
- **Star:** an actor who is highly central (has many connections)
- **Liaison:** An actor who has links to two or more groups that would otherwise not be linked, but is not a member of either group.
- **Bridge:** An actor who links/belongs to two or more groups (strict definitions may require that no other link between the two groups exists)
- **Gatekeeper:** An actor who mediates or controls the flow (is the single link) between one part of the network and another
- **Isolate:** An actor who has no links to other actors



Network logic1: Homophily

"birds of a feather flock together" (McPherson, *et al.*, 2001)

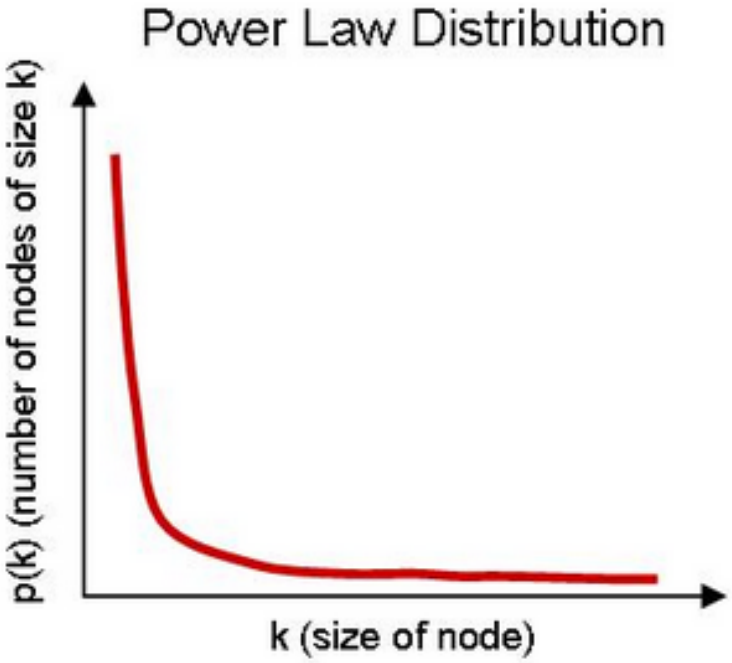




Network logic2: Preferential attachment

- **Strategic selection** (Barabási, 2002; Powell, *et al.*, 2005)

"Rich become richer"



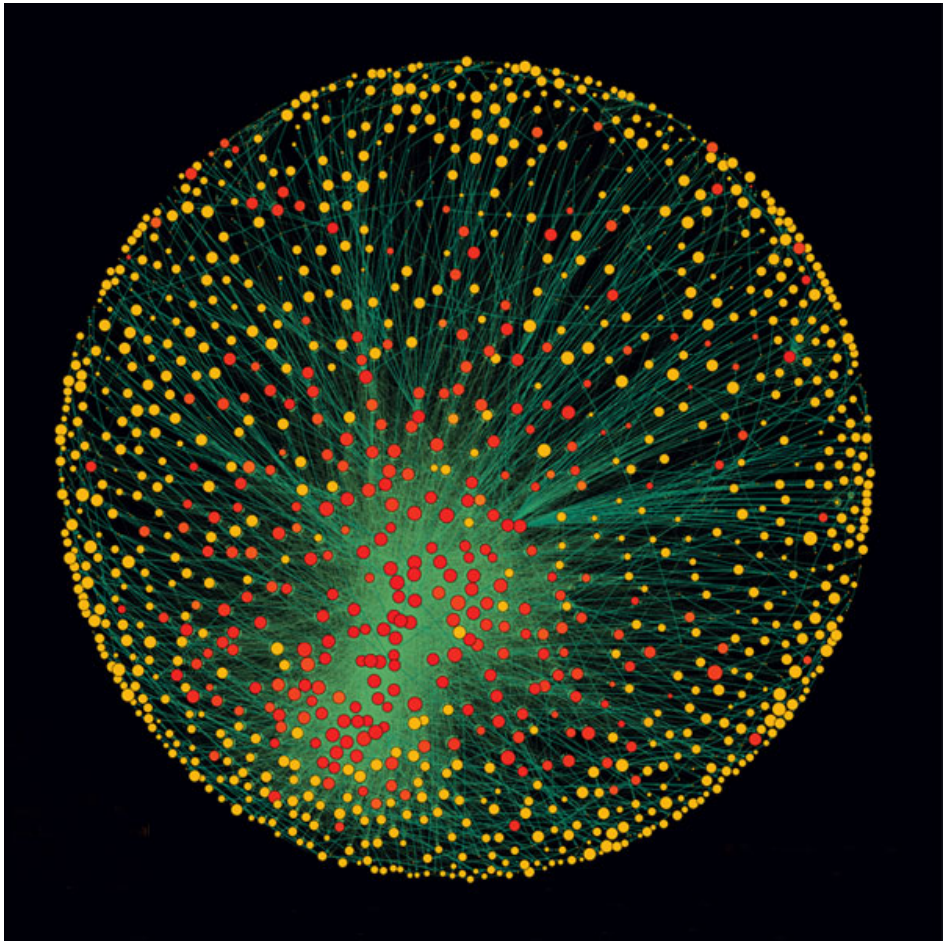
"the capitalist network that runs the world"

The 1318 transnational corporations that form the core of the economy.

Superconnected companies are red, very connected companies are yellow. The size of the dot represents revenue

Less than 1% of the companies were able to control 40% of the entire network. Most were financial institutions. The top 20 included Barclays Bank, JPMorgan Chase & Co, and The Goldman Sachs Group.

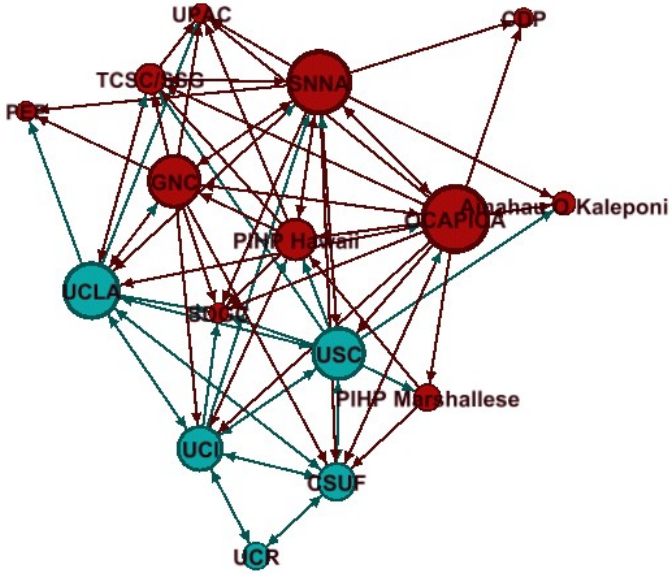
Source: Glattfelder, 2011



Network analysis for project evaluation (Wang & Valente, 2014)

- **Case study of WINCART**

  - An initiative designed to reduce cancer disparities among Pacific Islanders in Southern California
  - Encourages cross-sector collaboration between all partners to achieve mutual benefits
  - **Three types** of organizations involved:
    - Community-based organizations
    - National health organizations
    - Academic institutes
  - **Multiple network data collected over time:**
    - Communication, formal agreement, client referral, event participation, cancer/non-cancer related training, advocacy, education, outreach, and research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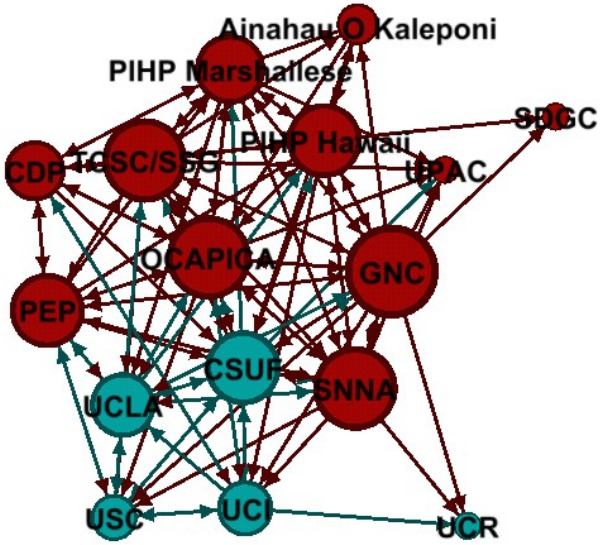
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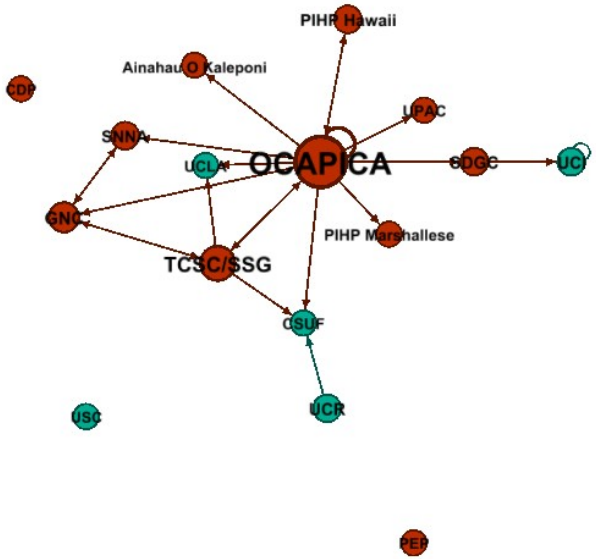
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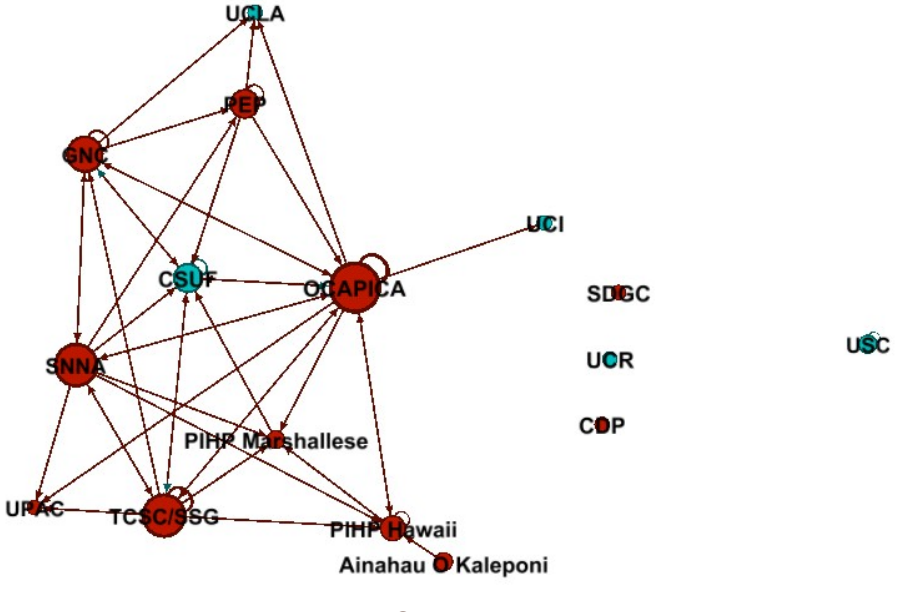
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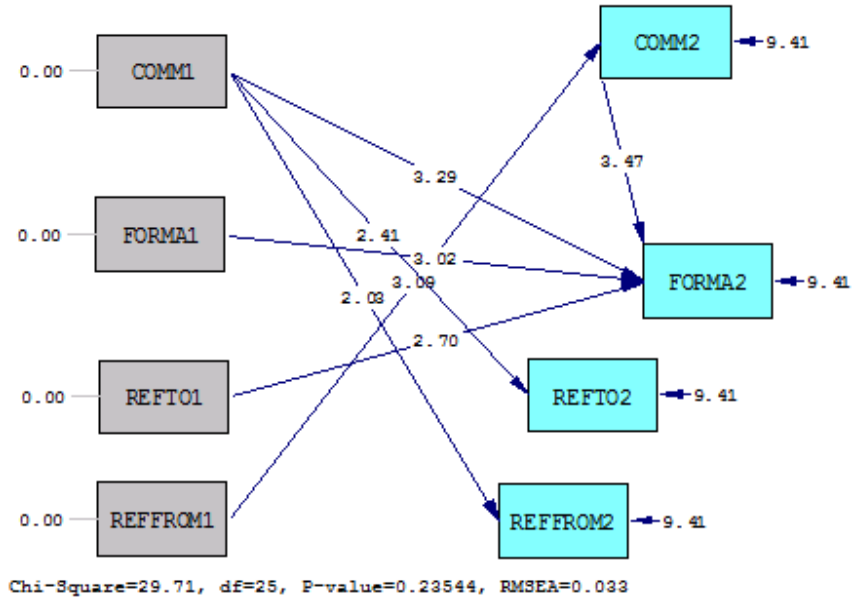
Summary of the WINCART analysis

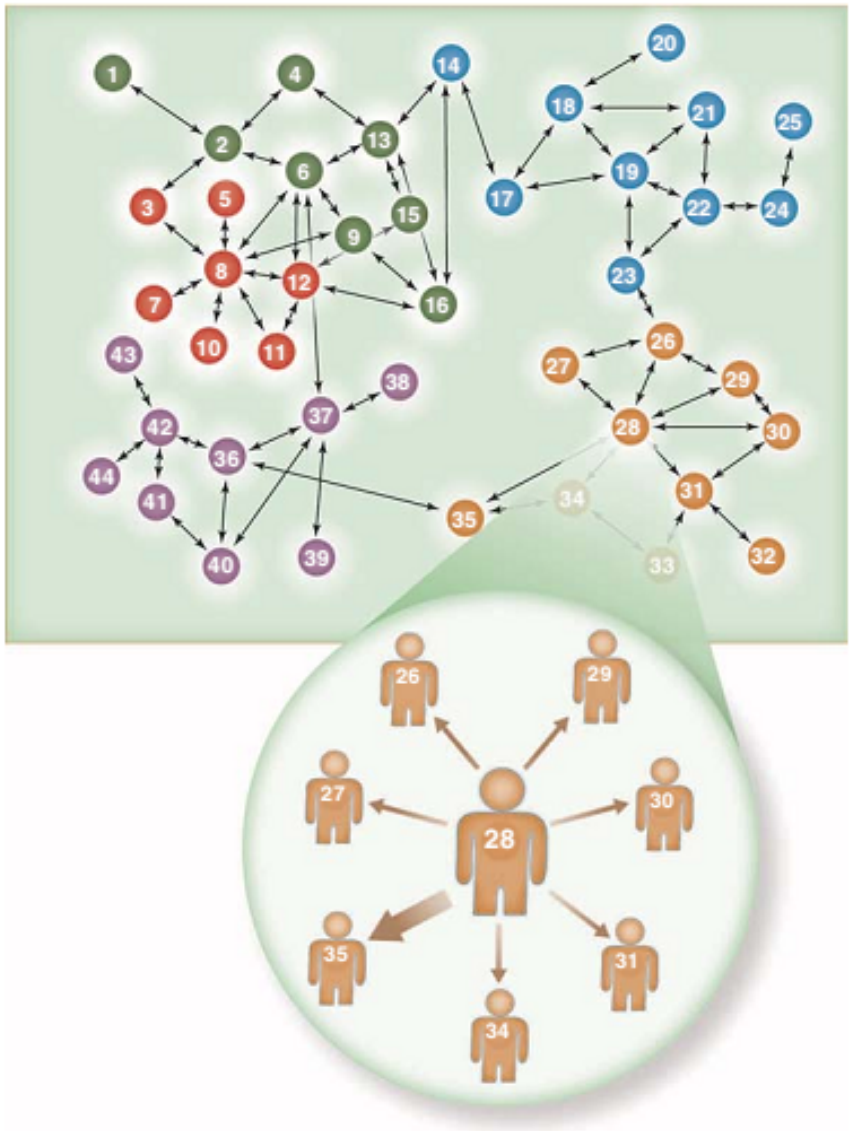
- Strong evidence of homophily
- No evidence of strategic selection
- Partner's partner matters for networking
- Communication network drives partnerships



Network intervention

- the process of using social network data to accelerate behavior change or improve organizational performance (Valente, 2012)
- Four strategies:

Identifying individuals (called "nodes" within the network) who are selected on the basis of some network property
Segmentation, in which the intervention is directed toward groups of people
Induction, in which excitation of the network occurs such that novel interactions between people (links in the network) are activated
Alteration, interventions that change the network



Network segmentation, with each group represented by a distinct color (top).

For **induction,** each group has a leader, and that leader influences the other group members (bottom).

Node 28 can directly influence those immediately connected to him/her. Indirect influence will be required to reach those not directly connected to a leader. Different colors represent mutually exclusive groups

(Valente, 2012, Network Intervention, Science)

Application of network analysis to Open Data on development

1. **World Bank**
   - **World Development Indicators**

   http://data.worldbank.org/data-catalog/world-development-indicators
   - **Data Visualizer**

   Financial inclusion and poverty

   http://data.worldbank.org/products/data-visualization-tools
   - **e-Atlas of Global Development**

   http://www.app.collinsindicate.com/worldbankatlas-global/en-us

2. **CIDA** (Canadian International Development Agency)

   http://www.acdi-cida.gc.ca/data
3. **Guardian**

   http://www.guardian.co.uk/world-government-data
4. **Gapminder**

   http://www.gapminder.org/data/

   Visualization by Hans Rosling:

   200 Countries, 200 Years, 4 Minutes

Case study: Global human rights regime (Yang & Wang, 2014)

- Research questions:

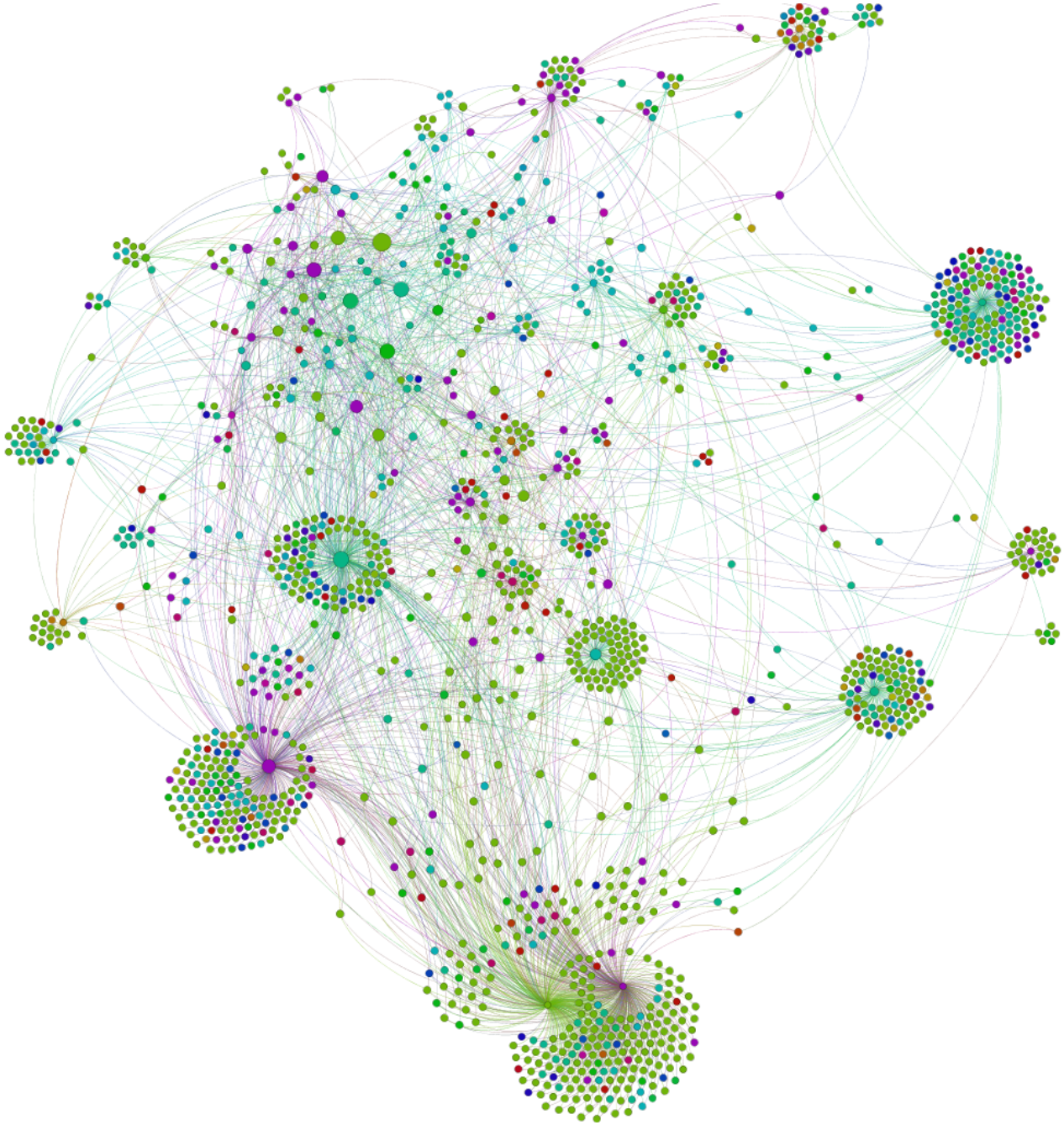
- How do NGOs' human rights efforts affect nation states' human rights performance?
- How does a nation state's communication variables affect its human rights performance?

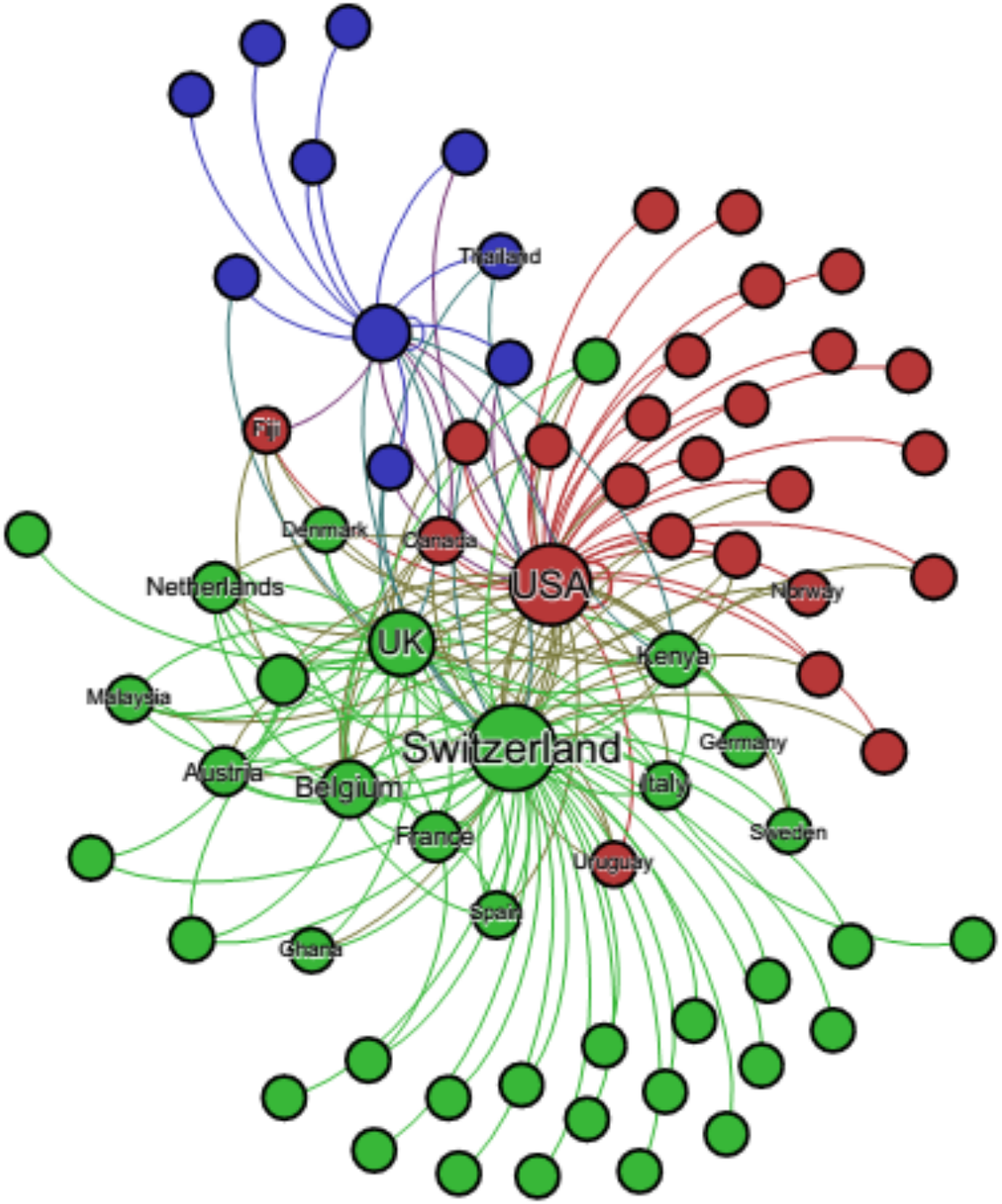
- Data sources:

- World Bank – population, foreign trade, GDP per capita, internet connectivity
- Union of International Associations – mobile subscription
- International Telecommunication Union – NGO's network data
- Other open databases: democracy scores, journalism education…

Analysis

- Unit of analysis: nation state
- Aggregating NGO network to country network
- SIENA (Simulation Investigation for Empirical Network Analysis):
  - Using both network formation and behavior change as dependent variables
  - This study uses communication variables and country demographics to predict the probability of tie formation among countries and their human rights performance

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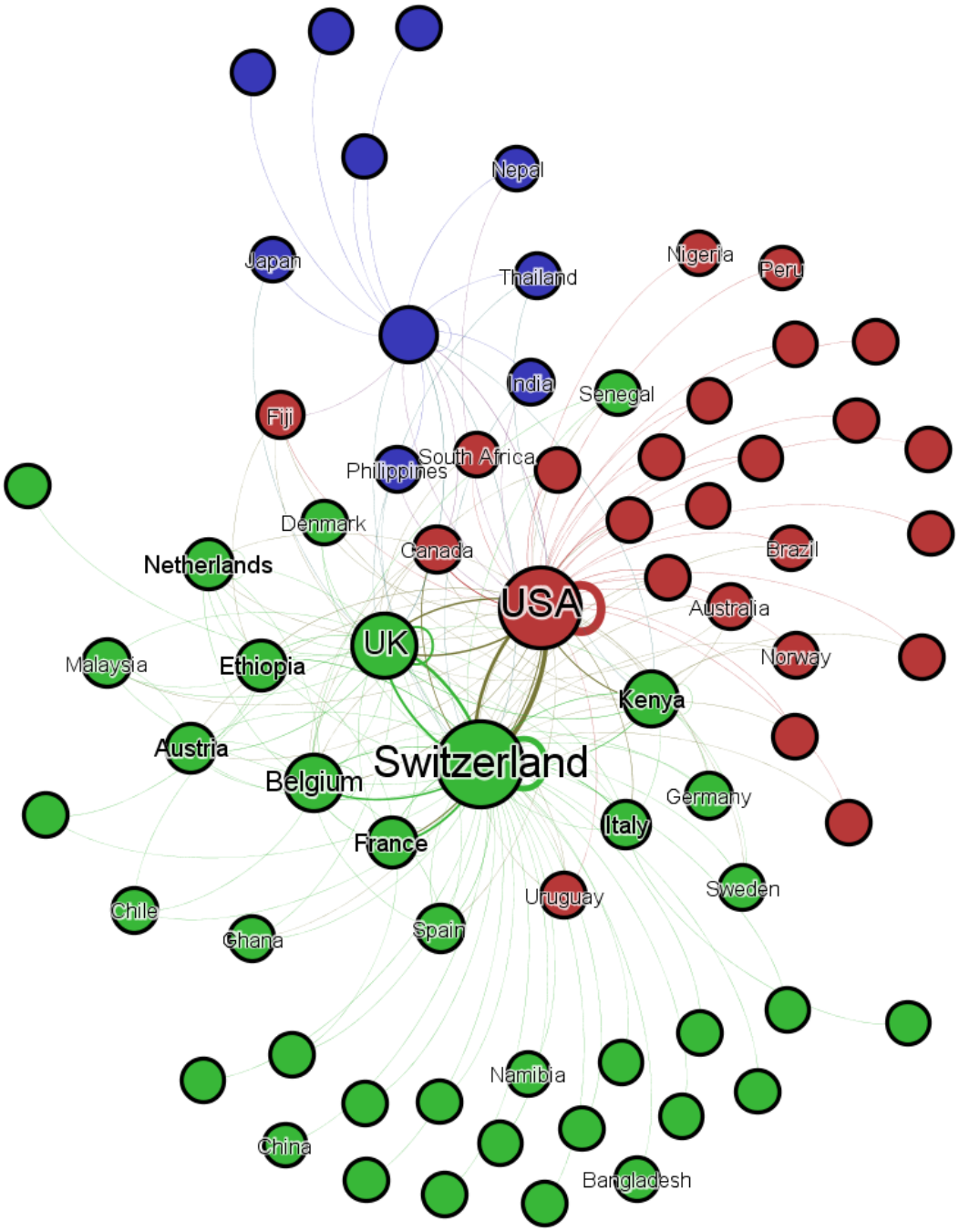
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Summary

- Define your network by nodes and relationships
- Network analysis is a unique perspective on how society functions
- Network analysis does not focus on individuals and their attributes, or on macroscopic social structures; it focuses on interdependence of social actors
- Two network logics: homophily & preferential attachment
- Network analysis can be used by organizations for both process and outcome evaluation, and network intervention
- Network analysis can be used to advance the use of open development data