

# Incentives in Transformation – P2P, ABM and (a new kind of) Policy

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# Overview of day

- 09:30 – 11:00 Lecture 1
  - ABM, P2P, Evolution of Cooperation
  - Tags paper / model
- 11:30 – 13:00 Lab 1
- 14:00 – 15:30 Lecture 2
  - Papers in P2P
  - Tags model again
- 16:00 – 17:00 Lab 2

# Who am I?

- Computer scientist (scientist?)
- Finished PhD in Artificial Societies (ABM) in Comp. Sci. Dept. Here (Essex) 2001.
- Interested in self-org software, cooperation, ALife, MAS, ABM (to understand MAS), then P2P, models of P2P, “complex systems” – apps. file sharing, crypto. currency.
- Perpetual postdoc – Essex, Manchester, Bologna, Delft, Milton Keynes, Szeged.

# Agent-Based Modelling

- You already know what ABM is right?
- A set of agents (goals, rules, programs?)
- Some shared environment
- Agents interact producing some outcome
- Hard to predict outcomes
- So run program(s) and see what happens
- How does this relate to “agency” in economics and social science more generally?

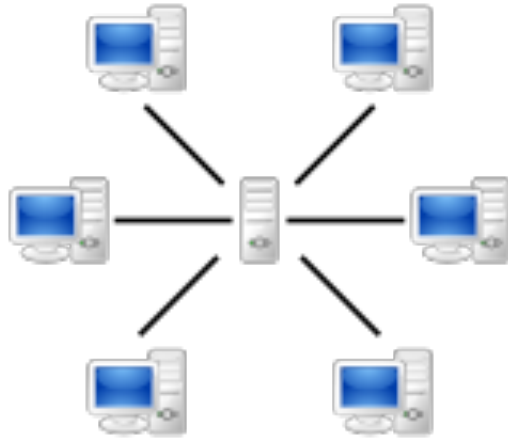
# Peer-to-Peer systems (P2P)

- What are P2P systems?
- Refers to the “architecture” of systems
  - Social architecture “person-to-person” (such as P2P lending like zopa.com) [1<sup>st</sup> wave]
  - Infrastructure architecture “node-to-node” (such as P2P file-sharing protocol bittorrent) [2<sup>nd</sup> wave]
- Going to focus on 2<sup>nd</sup> wave systems – these might be viewed as self-organising software
- Interestingly 2<sup>nd</sup> wave system (I claim) raise interesting policy / legal issues.

# P2P systems

- Traditional systems have *centralised* aspects for:
  - Legal / commercial reasons (control / administration / business model)
  - Technical / efficiency reasons (security / ease of implementation)
- P2P (2<sup>nd</sup> wave) systems have *decentralised* aspects for:
  - Simplicity of set-up (no initial admin or infrastructure outlay required)
  - Resilience / efficiency (avoid attacks on central entities / eliminate bottlenecks)

# Architecture



Traditional Client / Server



Peer-to-Peer

*From: <http://en.wikipedia.org/wiki/Peer-to-peer>*

# Architecture matters!

- Since P2P systems have no central servers
  - No central ownership or control
  - No traditional business model
  - Often open source projects
- This has policy implications (discuss later)
- Also has implementation implications
  - How to ensure peers do the right thing?
  - Distributed incentives, cooperation theory
  - i.e. peers must be programmed using some form of socio-economic theory



# Architecture - aside

- In fact there is no such thing as a fully centralised or fully decentralised system
- It's more of a spectrum
- The social and technical aspects interact
- There is often a tension between central / decentralised
- Historically, things appear to follow a cycle

# P2P Terminology

- Software running on user devices are called *Clients*
- The way the software behaves and communicates is called the *Protocol*
- The dynamic connections clients make between each other forms what is termed an *Overlay Network*
- Clients communicate by passing *messages* over the overlay network

# Bittorrent example

- We are going to take a brief look at the bittorrent filesharing protocol
- Bittorrent *probably* has more active users than youtube and facebook combined
- Uses a major part of all internet bandwidth
- Works by incentivising clients to cooperatively upload files they download from each other
- But first - cooperation theory
- Items in *red italics* on the following pages can be looked-up on Wikipedia for good background

# Individualism v. Collectivism

- In socio-economic systems individual interests may conflict with collective interests:
  - e.g. over exploitation of a common resource (a river, a field, the atmosphere etc.)
  - e.g. banks - lending (to those who they know can not repay) to gain a commission by selling on the debt to other banks
  - e.g. P2P file sharing system - downloading more than uploading

# Individualism v. Collectivism

- Consider a P2P file sharing system:
  - It is in the *collective interest* for all to upload to others so everyone gets the file quickly
  - But it is in the *individual interest* to save bandwidth by only downloading and hence free-riding on others
  - Free-riding (or free-loading) is a perennial problem in P2P file-sharing systems
  - Any efficient system needs to tackle it in some way

# The tragedy of the commons

- These kinds of situations have been termed “commons dilemmas” or “common pool resource dilemmas”
- Called “dilemmas” because we would all be better off if we “did the right thing” but there is an individual incentive to do the wrong thing
- G. Hardin (1968) summarized the issue in his famous paper: “The *Tragedy of the Commons*”
- These kinds of situations occur in P2P file-sharing systems like *BitTorrent*

# Avoiding a commons tragedy?

- Central enforcement of correct behaviour
  - require centralised agencies and policing
  - ability to identify and track individuals centrally
  - not suitable for pure P2P (but used with private trackers)
- Decentralised methods
  - self-policing producing incentives for cooperation
  - do not require centralised coordination
  - more suitable for pure P2P
  - can apply ideas from “*game theory*”

# What is game theory?

- A way to mathematically analyse games assuming we know:
  - number of players
  - possible moves they can make (strategies)
  - outcome of game based on players moves (pay-off)
  - desirability of game outcomes for each player (utility)



# What game are you playing?

- Games can be categorised into two types:
  - 1) Zero-sum games
    - when one player wins another loses
    - summing the final utilities of players = 0
    - e.g. poker, chess, monopoly etc.
  - 2) Non-zero-sum games
    - utilities do not always sum to zero
    - both players may lose or both may win
    - considered to capture social / economic realities
    - e.g. tragedy of the commons examples

# Capturing a commons tragedy with a simple game

- Consider a game composed of two players:
  - each player:
    - has choice of one move (C or D)
    - makes a single move then the game ends
    - does not know how the other will move
    - gets a payoff (or utility) based on how they moved and how the other player moved
  - for certain payoff values this game can, minimally, capture a form of commons tragedy (or dilemma)
  - a classic such game is called the *Prisoner's Dilemma*

# The Prisoner's Dilemma - "payoff matrix"

Game is a PD when:  $T > R > P > S$  and  $2R > T + S$

		Player 1	
		C	D
Player 2	C	R (3) / (3) R	S (0) / (5) T
	D	T (5) / (0) S	P (1) / (1) P

# The Prisoner's Dilemma - example games

Players =>	P1	P2	P1	P2	P1	P2	P1	P2
Moves =>	C	C	C	D	D	C	D	D
Payoffs =>	R	R	S	T	T	S	P	P
Values =>	3	3	0	5	5	0	1	1
Total =>	6		5		5		2	

A contradiction between collective and individual interests

# Game theory says defect!

- Game theory assumes players are:
  - rational - attempt to maximise *their* utility
  - selfish - don't care about the other guy
  - knowledgeable - have complete information
  - clever - have unlimited computational time
- Given these assumptions it can be proved:
  - agents will select equilibria where no player will improve by changing strategy unilaterally
  - many games have such equilibria - by the famous John Nash (so-called *Nash Equilibrium* - NE)
  - the NE for the PD is DD (all defect)

# Iterated Prisoner's Dilemma

- Previous example “one-shot” PD but:
  - real world interactions often repeated
  - might meet the guy you just ripped-off in the future
  - allows for more complex sequence of strategies based on past interactions with others
  - can punish someone tomorrow for defecting against you today - “the shadow of the future”
- Iterated PD (IPD) captures this and, as we will see, maps well onto P2P file-sharing protocols like BitTorrent

# What is the rational thing to do in the IPD?

- Traditional game theory has trouble here:
  - cooperative equilibria exist in infinitely repeated games but not in finite games of known length
  - many equilibria exist and it is not clear which one would be chosen by rational agents
  - In all cases defection on every round is still a equilibrium even when cooperative equilibria exist
- For these reasons *Robert Axelrod* (political scientist), in the late 70's, decided to find out what kinds of strategies worked well in the IPD by using computer simulation

# Axelrod's Tournament - programs as strategies

- Axelrod organised an open IPD tournament:
  - Academics were asked to submit programs (BASIC or FORTRAN) that would play the IPD against each other
  - Nobody knew competitors code
  - The only input would be the on-going past history of the game (a string of C's and D's)
  - The aim was to get the highest score (utility) based on round-robin playoffs between all pairs of programs
  - Axelrod's aim was to see which programs did best against all the others and understand why
  - He wrote-up his results in the famous book "*the evolution of cooperation*"



# Axlerod's Tournament - what happened?

- Basic results were:
  - many strategies were submitted (complex and simple)
  - the one with the highest overall score turned out to be simple: *tit-for-tat* (TFT) or “look back”
  - starts playing C, then “looked back” at the last move made by opponent and copied that move
  - submitted by Psychologist Anatol Rapoport
  - didn't “win” against each strategy but did better overall on average against all strategies
  - TFT mechanism an example of “*reciprocal altruism*” (Robert Trivers)

# What has this got to do with BitTorrent?

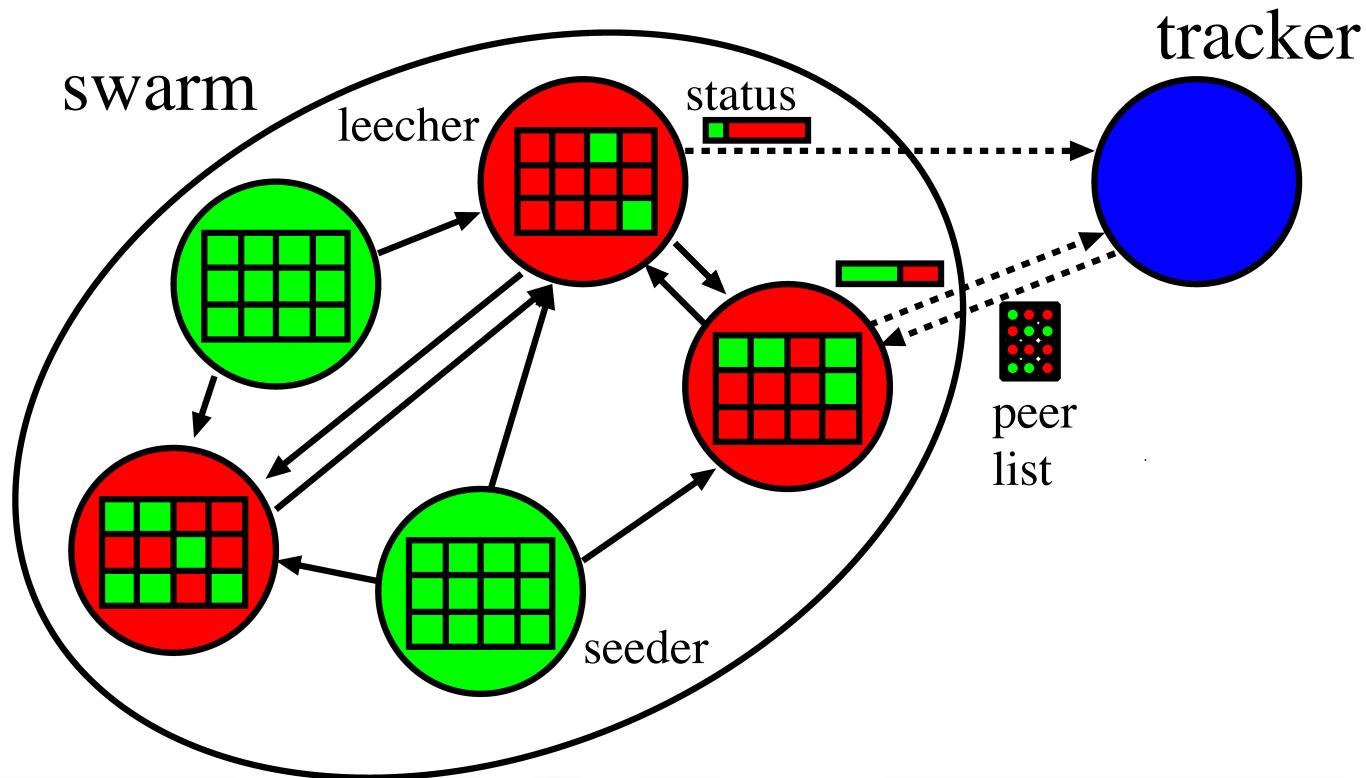
- In the *BitTorrent protocol*:
  - TFT-like method used for sharing files
  - nodes form groups interested in a particular file (swarms) and swap or “barter” pieces with each other
  - if a node does not upload data then this can be compared to defection
  - it is punished in the future by being “choked” - not getting upload from others
  - even if you hack your client to be selfish the chances are the standard TFT-like protocol will do better overall
  - *Bram Cohen* - original BT designer - inspired by Axelrod’s tournaments (I believe)

# Some BitTorrent Terminology

- Swarm: set of peers interested in a file
  - file is split in smaller chunks called pieces
  - seeder: holds a full copy of the data
  - leecher: holds only a part of the data (initially nothing)
- Tracker: *centralized (!)* manager
  - keep track of all peers in the swarm
  - return list of current peers in swarm
- Torrent file: meta-data
  - contains pointer to tracker hosting the swarm
  - details about the file - hash, no. of pieces, size etc.

# BitTorrent Protocol

- Get a list of other peers in the swarm from the tracker
- Ask peers their list of pieces and tell them what is yours
- Exchange pieces with appropriate peers



# The Global Ecology of BitTorrent Clients

- Many *bittorrent clients* exist in “the wild”
  - Bittorrent 6 (from Bittorrent.com, formally utorrent)
  - Others: Azureus, ABC, Transmission, many others...
  - bad guy clients: BitThief, BitTyrant
- Hence:
  - The current bittorrent ecosystem is a ***global on-going experiment***, like Axelrod’s, but with huge user base and rich interactions (not just TFT) incredible strategy sophistication
  - This is unprecedented and will surely lead to new economic theory – (perhaps in general!)

# BitTorrent Clients

BitTorrent client ▲	FOSS ☒	Linux/Unix ☒	Windows ☒	Mac OS X ☒	IPv6[1] ☒	Programming language ☒	Based on ☒	Interface ☒	Spyware/Adware /Malware-free ☒
ABC	Yes	Partial	Yes	No	buggy[2]	Python	BitTomado	GUI and web	Yes
Acquisition	No	No	No	Yes	?	Objective-C and Cocoa	Limewire	GUI	Yes
Anatomic P2P	Yes	Yes	Yes	Yes	No	Python	BitTomado	GUI and old CLI	Yes
Arctic Torrent	Yes	No	Yes	No	No	C++	libtorrent	GUI	Yes
aria2	Yes	Yes	Yes	Yes	?	C++	-	CLI	Yes
Azureus	Yes	Yes	Yes	Yes	Partial[3]	Java and SWT	-	GUI, CLI, Telnet, Web, XML over HTTP remote control API	Yes
BitComet	No	No	Yes	No	No	C++	?	GUI	Yes [4]
BitFlu	Yes	Yes	No	Yes	Yes	Perl	-	Telnet and Web	Yes
BitLet	Planned	Yes	Yes	Yes	?	Java and JavaScript	-	Web XHTML	Yes
BitLord	No	No	Yes	No	No	C++	BitComet	GUI	Adware
BitPump	No	No	Yes	No	No	C++	-	GUI	Yes
Bits on Wheels	No	No	No	Yes	No	Objective-C and Cocoa	-	GUI	Yes
BitSpirit	No	No	Yes	No	No	C++	BitComet	GUI	Yes
BitThief	No	Yes	Yes	Yes	?	Java	?	GUI	Yes
BitTomado	Yes	Yes	Yes	Yes	Yes	Python	BitTorrent	GUI and CLI	Yes
BitTorrent 5 / Mainline	Yes	Yes	Yes	Old version	No	Python	-	GUI and CLI	Yes
BitTorrent 6	No	No	Yes	No	Yes	C++	µTorrent	GUI and CLI	Yes
BitTyrant	Yes	Yes	Yes	Yes	Partial[3]	Java and SWT	Azureus	GUI, CLI, Telnet, Web, XML over HTTP remote control API	Yes
Blizzard Downloader	No	No	Yes	Yes	?	?	BitTorrent client for early version	GUI	Yes
Blog Torrent	Yes	No	Yes	Yes	?	?	BitTorrent client for early version	GUI	Malware-Status: unknown
BTG	Yes	Yes	Partial[5]	Yes	No	C++	libtorrent	CLI, GUI and web	Yes

# Take home message

- Previous work in social / economic science (Axelrod's IPD) has provided a basis for protocol design in a P2P system
- Deployed variants of the protocol are creating a massive global economic experiment
- Measurements can be made and these could inform new theory and new protocols

# References

- Nash, John (1950) Equilibrium points in n-person games. Proceedings of the National Academy of Sciences 36(1):48-49.
- John von Neumann and Oskar Morgenstern: Theory of Games and Economic Behavior, Princeton University Press (1944)
- Robert Axelrod (1984) The Evolution of Cooperation, Basic Books
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- Garrett Hardin (1968) The Tragedy of the Commons Science 162, 1243-1248.
- Trivers, R.L. (1971). The evolution of reciprocal altruism. Quarterly Review of Biology. 46: 35-57
- Maynard Smith, J. (1982) Evolution and the Theory of Games. Cambridge University Press



# From swarms to collectives

*Where we start to see things that look a bit like “real economics” emerge*

# Communities have formed around BitTorrent Trackers

Quite a few of these:



Linux tracker



# Public Trackers (e.g. PirateBay)

- BitTorrent uses Trackers to index swarms
- Public trackers let anyone join or create a swarm
- Sharing within a swarm is incentivised via a form of tit-for-tat (as we have seen)
- However there is no incentive for:
  - Seeding (uploading after file is downloaded)
  - Capping (creating and injecting a new file)
  - Maintaining a Tracker in the first instance

# Private Trackers (Many)

- Private Trackers have emerged more recently
- Only allow registered users to join swarms
- May track upload / download of each user
- Some keep centralised accounts for each user
  - When users download much more than upload they may be kicked out
  - Many different schemes: ratio, credits, points etc
- Some rely on users to just be nice with various “gentleman's club” methods

# A little detail on credit systems

- We will give a little detail on credit systems in private BT communities
- Give a flavour of how economic / collective issues are becoming significant
- Present results from a simple (agent-based) model and some measurements of a real private tracker

# Private Trackers - Credit

- Consider a scheme based on credits
  - Uploading 1MB earns one credit
  - Downloading 1MB costs one credit
  - A user with no credits can't download
- Users must be given some initial credit
- In fixed size pop. total credit remains constant
- Similar to a fixed supply of money in an economy (loose analogy!)

# Private Trackers - Credit

- How much credit should be put into the system?
- How would it effect the efficiency of the system?
- When do credit squeezes occur?
- How can they be avoided?

*We define a credit squeeze as a situation in which, due to lack of credit, the efficiency of the system is significantly reduced.*

# BitCrunch Model

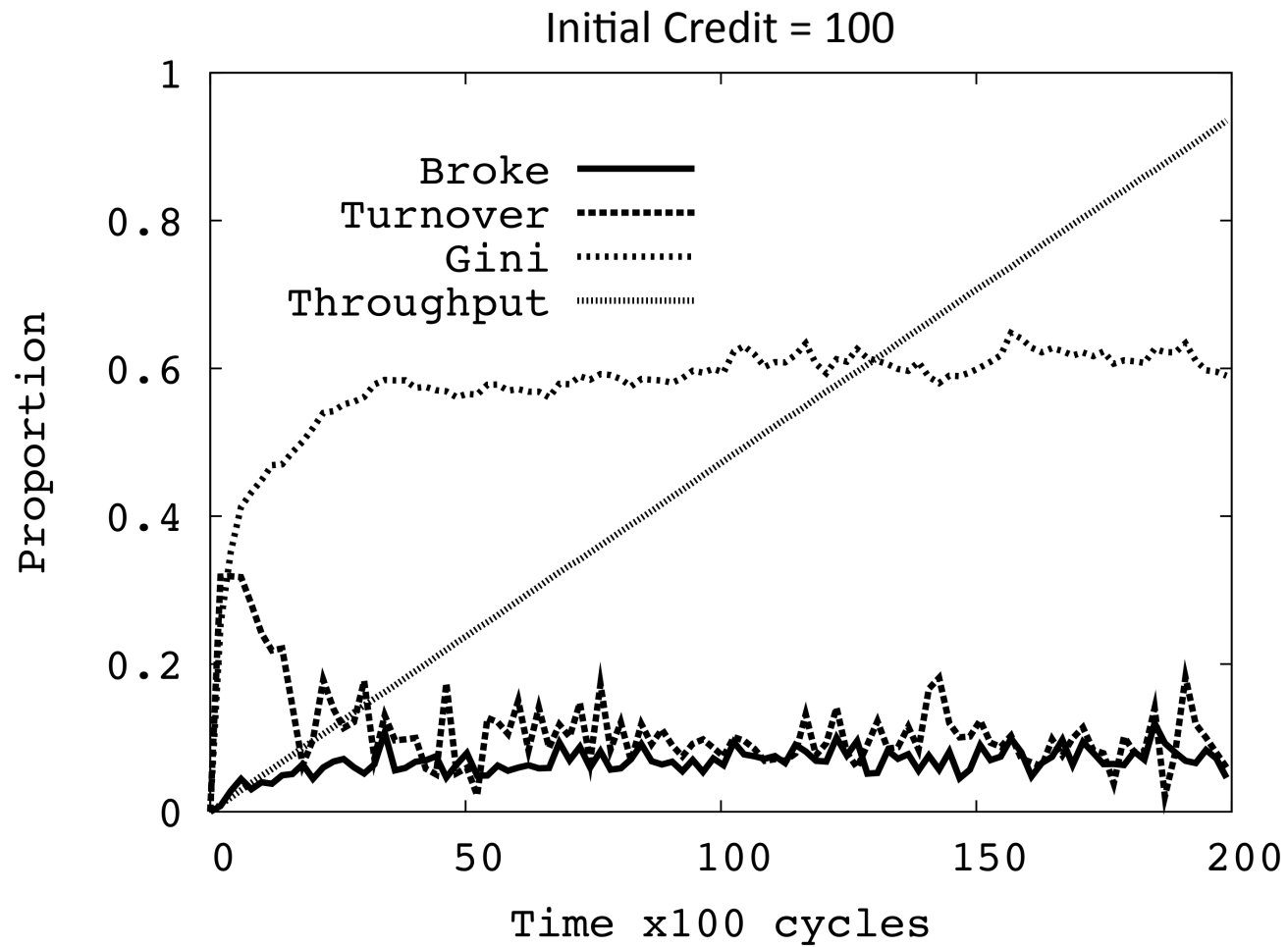
- Highly abstract and simplified model
  - All nodes have equal upload / download
  - Equally interested in all swarms on the tracker
  - Always uploading to one swarm (seeding)
  - Always downloading from another swarm (leeching)
  - No modelling of tit-for-tat or free-riding
  - Always online, fixed population
  - If run out of credit (broke) must wait until earns some via upload before being allowed to download
  - Swarms assumed to share upload “perfectly”



# BitCrunch Model – baseline runs

- Parameters:
  - 500 peers, 100 swarms
  - Peer upload and download capacity = 1 unit
  - Each file shared in each swarm = 10 units size
  - One simulation cycle = each swarm processes one unit of time
  - Run for 20,000 cycles (x10 runs)
  - For initial credit per peer of 1, 10 and 100 units

# Typical baseline simulation run



# Baseline simulation results

$C$	$T$	$\beta$	$G$	$\varphi$
1	0.58	0.36	0.87	0.84
10	0.81	0.20	0.77	0.43
100	0.97	0.06	0.59	0.10

C = initial credit

T = total throughput = total number of units uploaded as proportion of maximum possible (infinite credit)

B = proportion of nodes that are “broke” (zero credit)

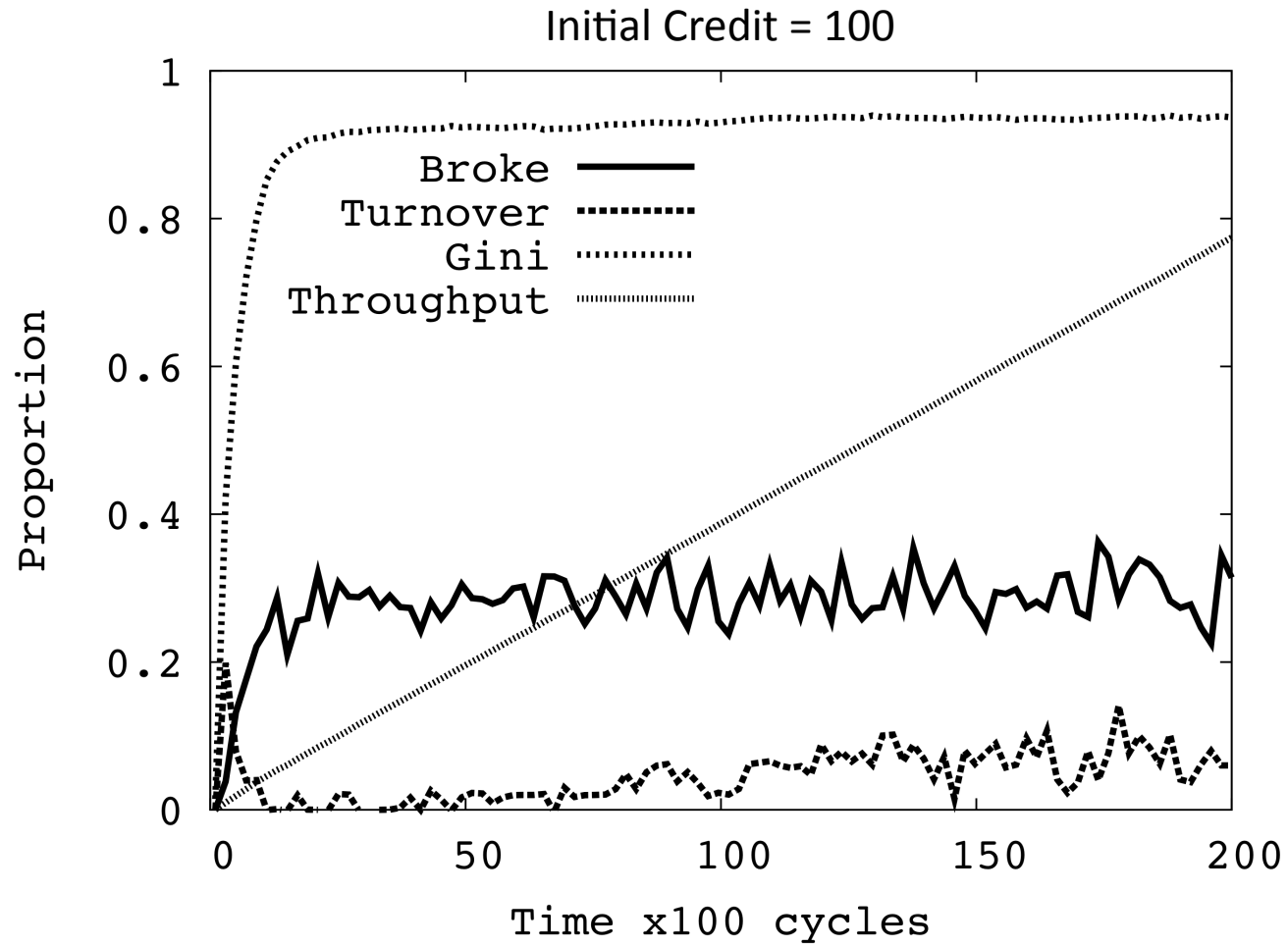
G = Gini measure (simple measure of inequality of credit)

Phi = turnover of top 10% of peers ranked by credit (credit mobility)

# Unequal capacities runs

- To determine what happens when some nodes of different upload capacities
- Parameters (same as baseline runs but):
  - All peers download capacity = 10 units
  - 10% of peers upload capacity = 10 units
  - 90% of peers upload capacity = 1 unit
  - Examined a (1.5 credit) seeding bonus approach to dynamically introduce more credit into the system

# Typical unequal capacities run



# Unequal capacities simulation results

$C$	$T$	$\beta$	$G$	$\varphi$
1	0.56	0.39	0.90	0.82
10	0.71	0.32	0.93	0.44
100	0.77	0.29	0.94	<b>0.06</b>
100++	0.97	0.01	0.71	0.00

C = initial credit

T = total throughput = total number of units uploaded as proportion of maximum possible (infinite credit)

B = proportion of nodes that are “broke” (zero credit)

G = Gini measure (simple measure of inequality of credit)

Phi = turnover of top 10% of peers ranked by credit (credit mobility)

100++ indicates initial credit of 100 with 1.5 credit seeding bonus

# Observations

*Even in a trivial model where all peers have the same capacities and user behaviour, all swarms have equal popularity and all peers start with equal credits, the performance of the system may be inhibited by credit shortages*

# Observations

*Adding extra capacity to the system, in the form of upload and download, can actually reduce the performance. This is highly counter intuitive and something that should be avoided because it implies lack of scalability.*



# Observations

*By injecting new credit into the system in the form of a “seeding bonus” a credit squeeze can be ameliorated when peer capacities are unbalanced.*

# Statistics from a Private Tracker

Day	$T$	$\Delta$	$\Delta_0$	$\delta$	S/L
1	48	24	17	0.23	26
2	40	20	15	0.25	26
3	50	25	12	0.16	25
4	67	33.5	17	0.17	25
5	52	26	19	0.24	25
6	46	23	15	0.21	25
7	87	43.5	17	0.13	25
Ave.	56	28	16	0.19	25

Approx. 50,000 peers per day, 10,000 swarms,  
access to credit balances of top 10%

$T$  = throughput in TB over all swarms

$\Delta$  = total credit increase that day in the entire system

$\Delta_0$  = total credit increase for top 10% of peers

$\delta$  = minimum fraction of credit increase that goes to top 10% of peers

S/L = seeder to leecher ratio over all swarms

# Statistics from a Private Tracker

- Indicates “rich getting richer” since top 10% are getting a lot of the new credit
- High Seeder / Leecher ratio suggestive that a credit squeeze is happening for many
- But need more information to verify this
- Would be interesting to see what happened to throughput if there was a “free day” or seeding bonus was increased

# Conclusions

- Private trackers using “ratio enforcement” policies appear to be ad-hoc and various
- But can have dramatic effects on efficiency
- Too much credit could encourage free-riding
- Too little creates squeezes = lower efficiency
- These are just initial investigations
- Much more work needs to be done!

# Take home message

- Communities formed around trackers provide an on-going global socio-economic experiment
- Self-organisation of socio-economic structures in measurable forms
- Ideas, models and theories from socio-economics may inform and learn from this
- Such communities so strong don't be surprised if they start influencing the "real world" (e.g. the PirateParty)

# References

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- Rahman, R., Meulpolder, M., Hales, D., Pouwelse, J. and Sips, H. (2010) **Improving Efficiency and Fairness in P2P Systems with Effort-Based Incentives**. Proceedings of the IEEE International Conference on Communications
- Hales, D., Rahman, R., Zhang, B., Meulpolder M., and Pouwelse, J. (2009) **BitTorrent or BitCrunch: Evidence of a credit squeeze in BitTorrent?** Proceedings of the 5th Collaborative Peer-to-Peer Systems (COPS) Workshop

# What are we trying to do?

*Where we ask “what is a socially intelligent ICT system?”*

# COSI-ICT (ASSYST)

- Complex Systems Science for Socially Intelligent ICT
- Cluster of four IPS:
- Qlectives, Epiwork, Socionical, Cybermotions
- ASSYST is an associated CA - action for the science of complex systems and socially intelligent ICT
- <http://www.assystcomplexity.eu/>



# Basic Questions from Jeff Johnson

1. What is ICT-enabled social intelligence?
2. What theories exist on social intelligence?
3. Are there engineering principles for creating social intelligence systems?

# 1. What is ICT enabled social intelligence?

First let's ask:

**What is Social Intelligence?**

# What is social intelligence?

Answer

It is the opposite of:

**Antisocial stupidity**

# What is social intelligence?

- What is meant by intelligence?
  - doing the right thing to achieve goals given the information at hand (reason)
  - learning from experience in order to improve performance (adaptation / learning)
- What is meant by social?
  - some population of intelligent entities (agents)
  - agents cooperate to achieve their goals
  - goals of agents may or may not conflict
  - interactions restricted by spatial, temporal and informational constraints - may be dynamic

# What is social intelligence

- Feedback mechanisms:
  - individual (micro) to collective (macro)
  - collective (macro) to individual (micro)
- Leading to, emergent, “collectively good” outcomes
  - Adam Smith called it the “hidden hand” in the context of markets
  - Many mechanisms other than markets

# 1. What is *ICT enabled* social intelligence?

- Social intelligence in which:
  - ICT plays a significant role in social mediation
  - The agents are users and possibly computational agents and services
  - enables the emergence of “collectively good” outcomes through e.g.:
    - Fostering cooperation (incentives)
    - Conflict resolution (norms, rules, policing)
    - “Fair” and “productive” allocation of resources
    - Filtering out “bad” adaptations and spreading “good” adaptations

## 2. What theories exist on social intelligence?

- **Evolutionary theory:** reciprocal altruism, kin, group and cultural group selection
  - How +ve social behaviors / strategies / norms emerge through evolutionary processes
- **Common pool resource theory:** Ostrom's CPRG
  - How people govern common resources collectively and productively
- **Social contract theory:** Rawls' "Theory of Justice"
  - Using reason to derive just social norms / laws that others subscribe to rationally
- **Economics, markets, peer production, symbolic interactionism, ethnography...**

### 3. Engineering principles for creating social intelligence systems?

- Active research area we focus on in QLectives
- Socially inspired design patterns for P2P:
  - Direct reciprocity (e.g. TFT in BitTorrent)
  - Indirect reciprocity (e.g. credit / points systems)
  - Group selection (e.g. evolving communities)
  - Altruistic punishment (e.g. self-policing)
- See ***QLectives deliverable D2.1.1*** for details on [www.qlectives.eu](http://www.qlectives.eu)



# Elinor Ostrom 1990

**Ostrom identifies eight "design principles" of stable local common pool resource management:**

1. Clearly defined boundaries (effective exclusion of external unentitled parties);
2. Rules regarding the appropriation and provision of common resources are adapted to local conditions;
3. Collective-choice arrangements allow most resource appropriators to participate in the decision-making process;
4. Effective monitoring by monitors who are part of or accountable to the appropriators;
5. There is a scale of graduated sanctions for resource appropriators who violate community rules;
6. Mechanisms of conflict resolution are cheap and of easy access;
7. The self-determination of the community is recognized by higher-level authorities;
8. In the case of larger common-pool resources: organization in the form of multiple layers of nested enterprises, with small local CPRs at the base level.

# User Models

- We need realistic models of how users behave when embedded within given ICT systems
- A priori theoretical models tend not work – users rarely behave “rationally” in the sense of maximising some simple utility
- Empirical measurements suggest its complex – heterogeneous, adaptive, but progress can be made
- Need large-scale deployments / measurements – an empirical / experimental approach

# Rawls' "veil of ignorance" approach

- assume we wish to specify the kind of society that is just and good
- but we stand outside the society and don't know what role we ourselves would play
  - we are ignorant of what endowments, knowledge, capacities and position we would hold
- what rules / norms would we accept as just and fair? i.e. what would we accept as “collective good”

# Designing a socially int. system

- We wish to specify the requirements of a system that will structure interaction between peers
- the protocol could run on diverse devices with diverse goals, capacities and user behaviour
- but we need 1 billion users of the system to make it a success (and get rich)
- What collective goals will we define such that many different devices and users would accept and run it?
  - “do no evil”? or “make the world a better place”? or “from each according to his abilities to each according to his need”?

Replacing the banks....

# Tragedy of the financial commons

- Some examples:
  - Individual bank creates excessive credit through lax loans that can be securitised and sold on (to another bank)
  - Asset bubbles transfer wealth from the majority to the minority
  - State debases the coin via printing money
- Two broad responses:
  - More central control – Hobbsian Leviathan
  - Less central control – Efficient markets

# Some financial functions

- Value transfer
- Credit creation
- Value storage
- Exchange of services and products
- Quality money?

# Alternative

- Possible emerging alternative:
  - Radically decentralise systems that support financial functions
  - Use emerging trends in distributed information systems
  - Alternative economic / cooperation theories



# Emerging trends in info. systems

- Over recent years a number trends have emerged within information systems:
  - social networks (facebook, LinkedIn)
  - peer production (wikipedia, open source)
  - peer-to-peer systems (BitTorrent)
  - virtual currencies (second life, farmville, BitCoin)
  - cheap mobile devices connected to global networks

# Alternative cooperation theories

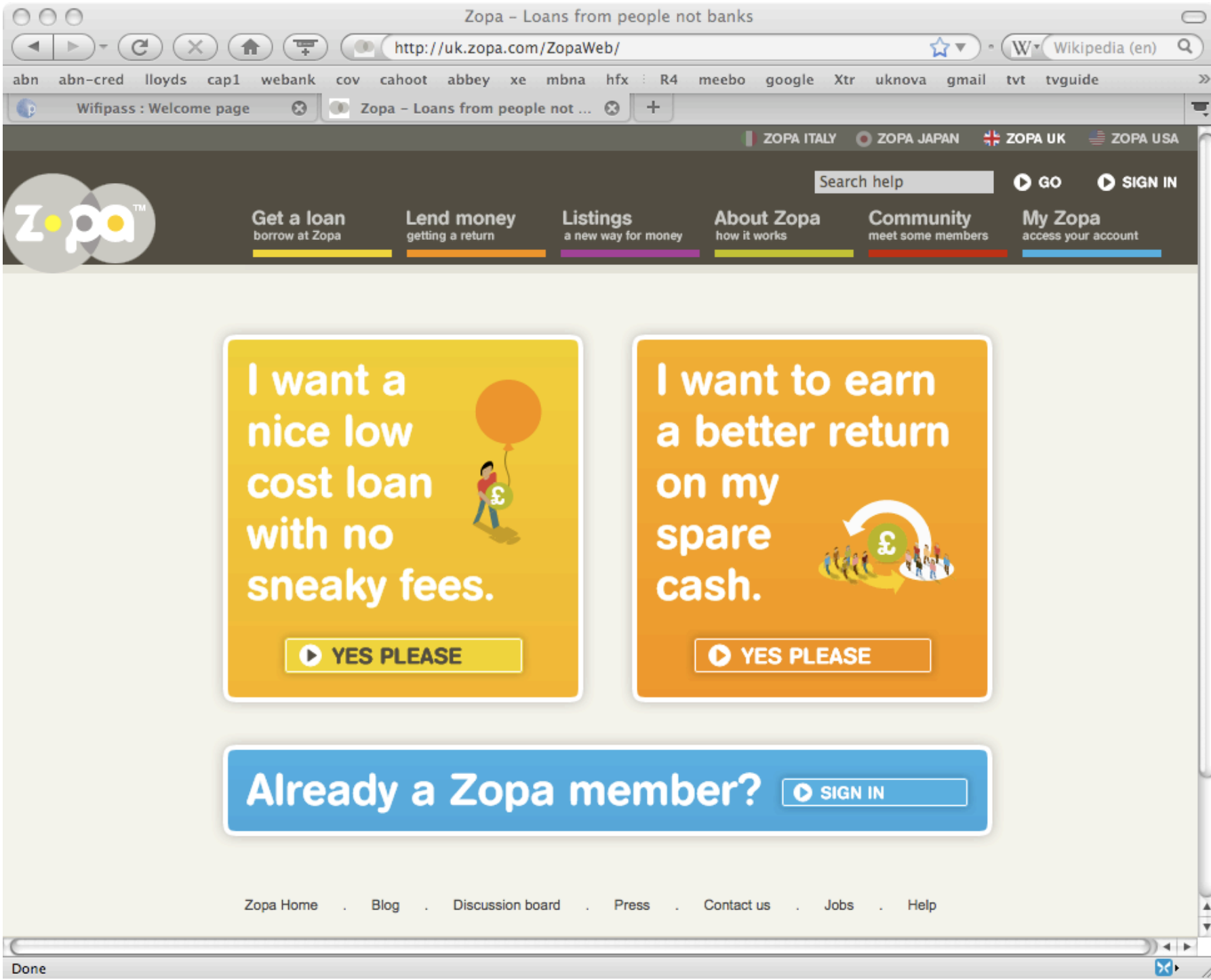
- Bottom-up forms of altruism and trust
  - group selection, migration
- Reciprocity:
  - direct, indirect, network
- Others:
  - affinity, reputation, altruistic punishment

# Some on-going projects

- P2P lending (lend/borrow directly)
- Members banks (become a bank)
- Money free economies (eliminate money)
- P2P money (create your own money)

# Eliminating banks / interest

- Zopa – P2P lending system without a bank.  
Nonlocal, becoming successful
- JAK Bank – Members bank controlled by and for only the members. Eliminates interest.  
Highly local



Search help

GO SIGN IN

Get a loan  
borrow at Zopa

Lend money  
getting a return


Listings  
a new way for money

About Zopa  
how it works

Community  
meet some members


My Zopa  
access your account

I want a nice low cost loan with no sneaky fees.



▶ YES PLEASE

I want to earn a better return on my spare cash.



▶ YES PLEASE

Already a Zopa member? ▶ SIGN IN



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**Networking**

Do you want to share your contact details and to find other projects/people interested in interest-free economy in your country? Click [here](#)

**More information:**

[International Newsletter](#)

[Questions and Answers about JAK](#)

[JAK Ambassadors](#)

[Other interest-free projects](#)

[Coming events](#)

[Past events](#)

## JAK International

This is the international webpage of JAK Medlemsbank (JAK Members Bank). Our main goals are:

- 1.Explain how the system of JAK Medlemsbank (JAK Members Bank) is working.
- 2.Link to other interest-free projects all around the world
- 3.Receiving information from you – the readers – about projects, events and dreams related with interest-free economy

Here you can find our [International Newsletter](#)

Here you can also find information about JAK Medlemsbank (JAK Members Bank) in different languages: [English](#), [Italian](#), [German](#), [Spanish](#), [French](#), [Arabic](#), and contact to people who can help you to understand JAK in different languages: our [JAK Ambassadors](#).

We are not alone in our work to create interest-free economic alternatives! [Here](#) you can read about other projects who share this ambition!

**Subscribe to JAK's International Newsletter here:**

**e-mail address**

Name and Country (optional)

**Networking**

### NYHETER >>

**2010-01-27** Medlemsavgiften 2010  
*- Du har väl bestämt dig?  
Kvällsöppet ikväll- ring på 0500 - 46 45 00*

**2010-01-13** Stort intresse för räntefri workshop i Köpenhamn

**2010-01-12** Schemat för JAK skolan i februari är spikat

**2009-12-21** Ny sparfaktor och låneavgift

**2009-12-15** JAK ska vara renlärt

### KURSER & SEMINARIER >>


**2010-02-19** JAK Skolan på Axvall  
**2010-03-05** JAKskola för unga 5-7 mars 2010

### BLOGG >>

**2010-01-20** JAK Växer! Men vad...

# Eliminating money

- CouchSurfing – people freely share spare accommodation all over the world. Global and active
- Freecomony – people freely share anything (generally localised)




**Sign Up** **Login** **Language: Language** ↕

**Login** **Surf / Host** **Community** **Messages** **Share** **About**

Participate in Creating a Better World, One Couch At A Time [Sign Up](#)



**CouchSurfing is a worldwide network for making connections between travelers and the local communities they visit.**



**SEARCH FOR A COUCH NOW!**











Find an available couch from the list below

[Find Out More](#)

[Is This Safe?](#)


[Sign Up Now!](#)

**Users Online**

-  Sweden
-  Israel
-  United States
-  China
-  China
-  China
-  Canada
-  India
-  Germany
-  South Korea

- Quick Links**
- [FAQ's](#)
  - [Sign Up Now!](#)
  - [About CouchSurfing](#)
  - [What Members Say](#)
  - [Interesting Statistics](#)
  - [New CouchSurfers](#)
  - [CouchSurfing Tips](#)
  - [Latest News](#)
  - [Surf Shop](#)
  - [CS Collectives](#)


**CouchSurfing Statistics**



CouchSurfers	1,648,916
Successful Surf or Host Experiences	1,757,588
Friendships Created	1,916,917
Positive Experiences	3,059,073
Countries Represented	234
Cities Represented	69,690

[more statistics »](#)

**Testimonial**



Sandra Benvie  
Prince George  
**British Columbia**

I've just had my first couchsurfer..and it has been a wonderful experience to be able to provide a fellow traveller with a bed for a couple of nites. I think this is the best thing the internet has to...

[read more](#)


[more testimonials »](#)

**Latest News**

**General News**

January 27th, 2010 — [Meet CouchSurfers for Exploration,](#)

**Some Random CouchSurfers**





# thefreeconomycommunity

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Join the world's fastest growing alternative economy ...

- ✓ Save money. Learn new skills. Reduce your carbon footprint. Meet new friends locally. Get help with projects for free.
- ✓ Share skills, tools, and spaces through **freeshare**.
- ✓ Share advice, information or ask freeeconomic questions in our **forum**.

The Freeconomy Community's aim is to help reconnect people in their local communities through the simple act of sharing.

Find out more - [watch the video](#), read about our [philosofree](#) and [how it works](#).

**Latest Blog Entry**



Sat  
23 Jan

**Money as Debt**

join for free!

username:

password:

Sign In

[forgotten your details?](#)

Join your local freeconomy



how it works  
freeconomy philosofree  
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inspirational stuff  
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forum

# P2P money

- Using a social network of trusted friends
- Each person can apply a credit level to each link in any monetary unit
- Payments between nodes (value transfer) involves the system finding a route of credit between nodes
- Depends on trust and enough back-to-back transfers to balance over time
- Compare to *Hawala* system and other “informal value transfer” IVT, systems



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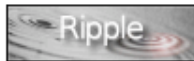
[Log in](#) [Sign up](#)

### Ripplepay.com Home

Ripplepay.com is a payment system where you can be your own banker. Connect to your friends, family, and associates and your credit with them becomes a fully-functional currency. [Read more.](#)

*1825 users*  
*662 accounts*  
*2054 payments*

Contact Ryan with question, concerns, or feedback.



### Login

Username or Email Address

Password

[Forget your password?](#)

### Register

[Click here to sign up as a new user.](#)

# P2P Money

- Currently know of no widely used deployed system (but *BitCoin* gaining ground)
- Bootstrapping problem - possible way forward:
  - Create a p2p virtual currency in a virtual game world with existing social networks
  - Take detailed measurements and collect data
  - See if it works and produce models
  - If successful grow the currency outside the virtual game

# BitCoin

- P2P fully distributed crypto-currency
- Distributed database of all transaction (transparency)
- Various anti-attack mechanisms
- No central control = should be hard to shutdown
- New coins issued in a controlled and distributed way
- Seems to be in a speculative bubble right now

# Quality money

- Subjective rating = objective quality?
- In a given community:
  - if enough people believe a unit of exchange is high quality they will accept it for payment
  - then it is high quality
  - But, you can only fool *all* of the people *some* of time...

# Let 1000 experiments bloom

- Given a sufficient ecology of financial commons systems (avoiding a financial monoculture)
- Individuals can “vote with their feet” migrating to those that are of high quality
- Hence even “rational” behaviour could drive quality rather than driving it out
- Tiebout (1956), Hayek (1978)

# Bits and bats

- Some leftover slides that might be interesting



# Trends

- Recent trends
  - Peer Production (wikipedia, open source)
  - Social Networks (facebook)
  - Peer-to-Peer (P2P) systems (bittorrent, skype)
- Related themes
  - Communities not individuals (social)
  - Sharing, giving, social production without traditional economic incentives
  - New kinds of “commons” new kinds of tools for managing those commons