Modelling of Emerging Internet Services: Social Networks and Crowdsourcing

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I. Emerging Paradigms in the Internet

In the last decades, the Internet changed dramatically in an economic way, but also in a technical way. The Internet evolved from a simple collection of websites providing pure information towards a service and application platform by implementing new paradigms. The rise of the *Peer-to-Peer paradigm* led to new applications and services which allowed Internet users sharing files and user generated content among each others. Later on, the application of the *Web 2.0 paradigm* empowered Internet users to become application and service developers and content providers themselves. Examples of this new generation of websites are blogs, wikis or media-sharing platforms. Thereby, the users are connected to each other by means of social networks creating new path to communicate and share information. This is referred to as *social networking paradigm*. The various online social networks and social media are quickly becoming increasingly popular and ubiquitous. Prominent examples for such social media networks are Facebook or YouTube. They lastingly change the way how people communicate and how they exchange, evaluate and retrieve content. In these systems relevant information increasingly diffuses through a network of human users rather than users being required to navigate through a network of documents.

Nowadays, a newly emerging service platform and business model in the Internet is established by the *crowdsourcing paradigm*. In contrast to outsourcing, where a job is performed by a designated worker or employee, crowdsourcing means to outsource a job to a large, anonymous crowd of workers, the so-called human cloud, in the form of an open call. This human cloud is abstracted by crowdsourcing platforms, which distribute the work submitted by employers among the human workers and act as mediator between workers and employers. The crowdsourcing paradigm is changing dramatically the future of work and work organization in the Internet. The work is organized at a finer granularity and jobs are split into cheap micro-tasks that can be accomplished quickly by the human cloud. The various forms of crowdsourcing platforms build a further increasingly important class of applications and business models in the Internet – in addition to social network networks.

II. Ongoing Research in Social Networks and Crowdsourcing

Due to the increasing interest in social networks and crowdsourcing, there is a lot of ongoing research in this area. However, there are a lot of open research issues. The impact of social networks and crowdsourcing platforms on future Internet traffic is still unknown. Due to the size of these networks and the human cloud, these platforms will significantly change Internet traffic in a manner that is similar to YouTube, Facebook or other social media networks today. Thus, it is an important telecommunications issue to model and analyze these communication platforms and the evolving complex networks, like the dynamics and the growth of social media network and crowdsourcing platforms.

An example of the current interest in these emerging Internet services reveals the special issue on “Modelling of Emerging Internet Services: Social Networks and Crowdsourcing" which is currently open for submission

until September 30th 2011, see http://www3.informatik.uni-wuerzburg.de/cfp/meis2011. Thereby, the following topics are of interest.

A. *Measurement, modelling and analysis of social networks*

- Characterisation and evolution of network topologies and interaction networks
- Detection of user communities and user interactions
- Inference of topology, friend relationships or interactions in social networks
- Population models and structural models for network dynamics
- Measurement methods and approximation techniques, e.g. sampling
- Properties of complex networks, appropriate complex networks metrics
- Information diffusion and epidemic spreading
- Opinion formation and consensus, community formation, collective decisions
- Bio-inspired and socio-physical models

B. *Measurement, modelling and analysis of crowdsourcing*

- Evolution of crowdsourcing platforms, trends, e.g. mobile crowdsourcing
- Use cases for crowdsourcing, e.g. for enterprises or in mobile domains
- Modelling the granularity of work, key components of crowdsourcing
- Modelling and analysis of the human cloud and individual user behaviour
- Models from different perspectives: platform operator, employer, worker
- Quality, cost and completion times of crowdsourcing jobs
- Modelling quality assurance mechanisms, incentive mechanisms
- Classification models for jobs and campaigns, skills and experience of workers
- Modelling recommendation systems and their impact

III. The Statistical Physics of Socio-Technical Internet Applications

A common theme in these emerging classes of Internet applications is that users play a decisive role for the attractiveness and the functioning of the corresponding platforms. In fact, one could argue that the role of social structures and collective user behaviour in these *socio-technical* systems is becoming as important as the efficiency and robustness of the technical infrastructures by which they are mediated.

An important and challenging question is thus, how the associated convergence of social and technical systems needs to be reflected in the engineering, modelling and analysis of reliable and efficient networked computing systems. How do new communication patterns resulting from the widespread use of social media services affect traffic patterns in the Internet? How do characteristics of crowdsourcing platforms and online social networks influence the collective behaviour of users? How can we model and forecast opinion-formation and spreading processes in online social networks? Can we develop forecasting and early detection mechanisms for such collective behaviour in order to instrument content distribution schemes and thus mitigate flash crowds phenomena? How can we use social structures and the processes in order to evaluate and reasonably filter increasingly vast amounts of information? And how are the fast emergence of trends and the rapid evolution of new applications and usage patterns going to affect the design of network infrastructures?

In this talk we will summarize a number of challenging problems posed by the fact that social and technical structures and processes in Future Internet applications are becoming increasingly intertwined. We particularly highlight promising aspects of the quantitative study of complex structures and collective dynamics that incorporates models, abstractions and perspectives of computer science, mathematics, statistical physics, quantitative sociology and theoretic biology. We argue that this quickly evolving interdisciplinary field is likely to play an increasingly important role in the engineering of reliable and efficient socio-technical information systems in the Future Internet.