September 2011

**STOA-Project: Potential and Impacts of Cloud Computing and Social Network Sites**

**Duration:** October 2011 - September 2013

**Estimated costs:** Cloud computing: 180,000 EUR, project module on social networks: 50,000 EUR

**Scientific consortium**
- Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, Germany (lead partner)
- Danish Board of Technology (DBT), Copenhagen, Denmark
- Catalan Foundation for Research and Innovation (FCRI), Barcelona, Spain
- Institute for Technology Assessment and Systems Analysis (ITAS), Karlsruhe, Germany

Supervisor STOA-panel: TBD

**Brief description**

1. **Background**
   This project addresses in the first place cloud computing and furthermore social network sites. Cloud computing (CC) is also an important enabler for the rapid diffusion of social network sites (SNS). SNS have their main impact on relationships between private citizens or private citizens and businesses. In contrast, cloud computing has broad implications for all areas of society and business applications are perhaps crucial for its sustained breakthrough.

   In recent years, cloud computing has emerged as a technology which is associated with high expectations and opportunities but also with a number of concerns and risks. According to a highly-cited definition it is
   
   “[... ] a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

   It goes back to developments in Information and Communication Technologies (ICT) that have enabled the conversion of previously offline services into Internet based solutions (the so called Internet of Services, IoS).

---

1 Mell, Peter, and Timothy Grance, "The NIST Definition of Cloud Computing (Draft)", NIST Special Publication 800-145 (Draft), National Institute of Standards and Technology, Gaithersburg, MD, 2011, p. 2. (See 2. for a more detailed description of the term.)
This presents important opportunities for customers as it reduces the total cost of ownership of information systems and consequently lowers the barrier to acquisition of IT systems for (especially smaller) enterprises.\textsuperscript{2}

Therefore, the potential of cloud computing is often euphemistically celebrated. For example, the market research company International Data Corporation (IDC) estimated that the

“worldwide revenue from public IT cloud services exceeded $16 billion in 2009 and is forecast to reach $55.5 billion in 2014, representing a compound annual growth rate of 27.4%. This rapid growth rate is over five times the projected growth for traditional IT products (5%).”\textsuperscript{3}

At the same time, it has been estimated that, e.g. Amazon had less than $735 million revenues with its Amazon Web Services (AWS).\textsuperscript{4} There is therefore the question whether cloud computing services will indeed significantly shape the current European IT market structure, resulting in important value transfers and price reductions and impacting all segments.\textsuperscript{5}

Moreover, the development of this market is also pivotal for the overall competitiveness of the European economy and society, because the low adoption of ICT technologies is seen as one reason for the European “productivity gap”.\textsuperscript{6}

However, cloud computing also poses a number of challenges for enterprises as well as for private citizens. In both cases there could be increasing virtualisation of the processing of personal and other sensitive data that is transmitted and stored by commercial providers on servers situated in a location unknown to the costumer. Thus, it is to be expected that the application of cloud computing, whether mobile or stationary, will increase perceptions of risk and add further heat to the already controversial discussions on data protection and the lacking transparency of personal data transfer. Moreover, data security is a crucial issue in this context, since it has always been a limiting factor for the trust that enterprises have in cloud services (and its predecessors).

Given these challenges, it is not clear whether cloud computing will meet its potential and the high expectations connected to it. With no doubt, part of the attention paid to cloud computing can be characterized as an unjustified hype, in particular triggered by its entrepreneurial providers and their obvious interest to promote it. For example, there is a tendency to label all sorts of services as “cloud” and the concept itself is fluid to a certain degree (see 2.).


\textsuperscript{3} http://www.idc.com/prodserv/idc_cloud.jsp

\textsuperscript{4} http://www.datacenterknowledge.com/archives/2010/02/22/how-much-are-cloud-providers-making/

\textsuperscript{5} Aumasson et al. 2010, op. cit.

Therefore, the current picture we have of cloud computing and its impact is somewhat blurred. However, it is also true that this technology has already made a noticeable mark on modern societies. Even if the ideas of ubiquitous computing, where everyone is surrounded by a “digital aura” communicating automatically with the environment, is not realised swiftly or perhaps never completely, the impacts on society being discussed – in particular data protection and autonomy and sovereignty of users – are central topics of IT-related technology assessments. This can be exemplified using the example of social network sites (SNS). Although typically not associated with cloud computing, they already now pose similar challenges on a large scale. Companies such as the current global market leader Facebook provide a service which allows for uploading data and connecting its users. It became extremely popular among private citizens as well as among many companies who try to capitalise on the new ways of marketing. At the same time, issues connected to user’s privacy rights and data protection have led to heated (on-going) debates.

2. State of research and feasibility of the study
Cloud computing is currently a very popular and dynamically evolving concept that can be used for many IT applications and services that we already know but also for totally new ones. As a result, there is no precise widely-accepted definition yet. The most common definition seems to be the one by the National Institute of Standards and Technology (NIST) provided above. However, it leaves much room for interpretation which is why it is accompanied by a list of “Essential Characteristics” and other specifications. Moreover, cloud computing is introduced as an essential element of intelligent infrastructures, consisting of three layers: “Infrastructure as a Service” (IaaS), “Platform as a Service” (PaaS) and “Software as a Service” (SaaS).

<table>
<thead>
<tr>
<th>Table 1: The Cloud Computing Stack</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
</tr>
<tr>
<td><strong>Software as a Service (SaaS)</strong></td>
</tr>
<tr>
<td><strong>Platform as a Service (PaaS)</strong></td>
</tr>
<tr>
<td><strong>Infrastructure as a Service (IaaS)</strong></td>
</tr>
<tr>
<td>Hardware</td>
</tr>
</tbody>
</table>

These different types of services, shown in table 1, have different levels of complexity, which increase from the bottom to the top. IaaS such as Amazon Elastic Compute Cloud simply provides a flexible infrastructure according to the user’s needs. PaaS already come with a platform that helps its users with certain services, for example, the Google App Engine, which supports developers with a web-based interface through which they can host their applications. This gets even more complex on the level of SaaS, where users

---

7 Mell & Grance 2011, op. cit.
8 ibid.
are merely confronted with the surface of a specific software, e.g. *Salesforce.com* and their solutions for customer relationship management or *Google Docs*.

Since 2009 cloud computing has become an important technological and business trend that has resulted in numerous studies focussing on different aspects of cloud computing. Since proponents of cloud computing predicted that industry had the biggest (at least initial) benefits from the new concept, business consultancies have analysed the (micro-)economic potential of cloud computing.\(^9\) On top of this there are studies predicting the potential (macro-)economic impact on a national, European or global level.\(^10\) Moreover, cloud computing has been discussed as a potential means to save resources in specific publicly relevant fields, e.g. education.\(^11\) European and national policy-makers have become aware of the importance that cloud computing might achieve for their respective industry branches. As a result, there are studies commissioned by the EC that explore the economic potential and the wider impact of cloud computing and develop strategies for Europe to realise this potential.\(^12\) Furthermore, the European Network and Information Security Agency (ENISA) has conducted an assessment of cloud computing in order to inform decision makers in policy and industry about the involved risks on multiple levels of society.\(^13\) ENISA concludes, e.g. that more protection of data is needed when remote resources are shared and a better protection against distributed denial of service attacks – both very difficult to achieve\(^14\). There is, furthermore, a gap in cloud computing research with

---


\(^14\) See, for outages: Infoworld: The 10 worst cloud outages (and what we can learn from them). Sending your IT business to the cloud comes with risk, as those affected by these 10 colossal cloud outages can attest. http://www.infoworld.com/d/cloud-computing/the-10-worst-cloud-outages-and-what-we-can-learn-them-902. June 27, 2011.

For the state of research, see http://www.tclouds-project.eu/ and, e.g.: Marnau, Ninja; Schirmer, Norbert; Schlehahn, Eva; Schunter, Matthias: TCclouds. Herausforderungen und erste Schritte zur sicheren und datenschutzkonformen Cloud. Datenschutz und
regard to a more holistic assessment of technology and policy aspects that the STOA study aims to fill. Especially, the citizen perspective has up to now largely been lacking in the debate. From this perspective, we might also question whether the energy-intensive cloud computing technology exacerbates environmental issues or if it rather helps to alleviate them as some have suggested."15

In order to grasp the potential and impact of cloud computing, ETAG considers it necessary to use a rather narrow definition of cloud computing, which is oriented towards the above given differentiation of IaaS, PaaS, SaaS with shared resources.

This is apparently necessary due to the trend of re-labeling existing services that may incorporate elements of cloud computing as “cloud services”. At the same time, the scope of the intended study might become unmanageable if the concept is further extended. Therefore, we do not wish to incorporate ideas such as “Everything as a Service” (EaaS) which adds “Humans as a service” as another layer on top of the “cloud computing stack” (see table 1), i.e. the way how human intelligence is using a web service (e.g. crowdsourcing).

Still, given its societal importance, the partly overlapping issues and due to STOA’s suggestion, ETAG plans to also tackle the terrain of SNS. These were prominently defined as:

“[...] web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system.”16

However, this definition is also not absolutely precise and one can also find a number of similar terms, which are often used synonymously (e.g. social networks, social network[ing] sites/services/platforms). Depending on the applied definition and its interpretation, various services can be categorized under this label, evidently Facebook, LinkedIn, MySpace etc., but perhaps also microblogging services (e.g. Twitter), video platforms (e.g. YouTube) or social bookmarking services (e.g. delicious). Their impact has been discussed in various studies, reaching from sociological aspects17 to commercial...
academic usage. As noted above, they pose a number of challenges, which are similar to cloud computing issues, especially when it comes to privacy concerns. For the purpose of this study, the development of “social cloud computing”, which has recently been discussed in technology and business media, is of particular interest. However, services associated to this trend are normally defined by their functionality to connect people and to form communities which is implemented through an Internet (cloud computing) platform. Some of the raised issues are very specific to this kind of application and are not easily applicable for other cloud computing services. Thus, we think this topic should be tackled in an extra module, parallel to the rest of the project.

3. Objectives of the project and research questions
Given the situation described above, the proposed research project needs to incorporate and assess the key findings and conclusions of the relevant research conducted in this field. Based on the results of this research, options will be developed that are relevant for actions of European decision makers. Major research questions are:

- Which are the technological and economic developments cloud computing is based on?
- What are the driving factors and barriers for the further evolution of cloud computing in Europe? Who are the main actors and what are their interests?
- To what extent does cloud computing impact the European ICT industry, other industries, public administration, research and science as well as consumers? What are the impacts on society and economy as a whole?
- What are the security and legal issues related to cloud computing?
- What are the foreseeable needs for parliamentary activity?
- What options for action for European decision-makers and in particular for the European Parliament exist?

---

19 Nitweken verändern, Spektrum Akademischer Verlag, Heidelberg, 2011.
4. Preliminary project plan
Basically we present a plan for (1) a project on cloud computing and for (2) an extra module on Social Network Sites. It is planned that during the initial consultation phase, as well as during the final reporting phase, that work will be done jointly in all working packages, while during the main work phases, the work will be done separately, obviously with close co-ordination (see table 2 for a project overview).

Consultation phase (October 2011 – January 2012)

In order to sharpen the focus of the project and to make it as relevant as possible for European Parliament decision makers, the first phase of the project will be a consultation phase. The aim of the consultation phase is to develop a detailed project plan on the basis of a short literature review, an executive overview of the state of research on cloud computing, and of a cursory synopsis of the relevant activities and actors on the global, the EU and the member states level in this field. This brief start-up document (max. 20 pages) will also include a detailed proposal for the next project phases. The document will be discussed with interested MEPs and selected experts in order to ensure political relevance and hopefully create longer term commitment.

Main tasks:
- Definition of relevant technological concepts (Future Internet, Internet of services, Cloud Computing, Mobile Computing, Social Network Sites etc.)
- Compiling overview of existing and relevant studies
- Analysis of differences, similarities and interrelations of the concepts of cloud computing and deriving working definitions
- Development of project description

Internal Milestones
- Kick-off expert meeting and MEP briefing
- Elaborated project description

Deliverable: Interim Report/Detailed Project Plan
(31 January 2011)

Phase 1: Foundations of cloud computing (February 2012 – October 2012)

Based on the initial overview prepared in the consultation phase the overall aim of this phase is to analyse the technological, economical and legal foundations of cloud computing. This includes the evolution of the technology and the current state of services based on it as well as an analysis of driving factor and barriers for the take up of cloud computing in Europe.
The phase encompasses two parallel work packages, which require close co-
ordination due to the interrelations in some points. The work will be based on
desk research as well as consultations with leading experts in the different
fields. Moreover the consortium will also actively seek co-operation with
interested MEPs.

WP 1: Evolution of cloud computing technology and concept
In order to shape the understanding of cloud computing it is necessary to
research and analyse the evolution of cloud computing technologies and
concepts, since the idea behind it has a rather long tradition that can be traced
back to the 1960s. This also includes a review of technological requirements
necessary for a broad diffusion of it. In a second step a robust description and
definition of existing technologies and services as well as an analysis of their
differences and similarities will take place. The results will be compiled in a
working paper.

Main tasks:
- Analysing the evolution of the cloud computing technology
- Describing examples of existing cloud computing technologies as well
  as exemplary current services based on the technology
- Analysis of the technological requirements (network capacity, technical
  measures for storage etc.) for a diffusion (today/future)
- Outlook on possible future technological developments

Internal Milestone
- Working paper 1: Evolution of cloud computing concepts and
technology (September 2012)

WP 2: Driving factors or barriers for cloud computing in Europe
Complementary to the technological evolution and state of the art of cloud
computing this work package is aimed at analysing the current cloud
computing environment. In a first step this includes an overview of the
current market for cloud services in Europe and (for selected countries
abroad, depending on data availability) the structure of the relevant
industries. In a second step we will - based on the existing literature - identify
the most important driving factors and barriers for the uptake of cloud

21 E.g., in the early 2000s (part of) the concept was known as “application software providing”,
that was promoted for several years but did not prevail for economic reasons. Cf. Friedewald, Michael,
Peter Georgieff, and Markus Joepgen, "Application Service Providing - Software mieten statt kaufen",
Already in the 1980ies, applications such as CAD/CAM were run on US servers, by European manufacturing
companies, in order to save costs (cf. Hoß, Dietrich; Gerhard, Klaus-Uwe; Kramer, Helgard; Weber, Arnd: Integrierte
computing in Europe. In a final step we will analyse and assess the identified factors.

**Main tasks:**
- Providing an overview of the current market situation (including suppliers and their locations)
- Identifying major factor driving or hindering the current evolution of cloud computing
  - technological factors (e.g. standards)
  - economical/business factors
  - social/cultural factors (e.g. acceptance of technology)
  - legal factors (e.g. regulations related to data protection)
- Analysing and assessing the identified factors

**Internal Milestone**
- Working paper 2: Driving factors and barriers for the development of cloud computing (September 2012)

**Deliverable:** Report containing 2 working papers (31 October 2012)

**Phase 2: Impacts of cloud computing on society and economy (November 2012 – April 2013)**

Based on the previous work, the goal of this phase is to analyse the economic and social impacts of cloud computing. Further specifications may also come from MEPs or will be developed as suggestions in the course of phase 1. It consists of two parallel work packages, each dealing with a specific part of impacts. The rationale behind this split into general economic and social impacts on the one hand and especially impacts in the field of customer rights, privacy and security on the other is that the importance of the latter, which is also reflected in the public debate and research, requires an in-depth analysis. However, the close connection of both areas requires a tight co-ordination and co-operation between both and will lead to a common draft conclusion paper.

The desk research in phase 2 will be complemented by a workshop that will bring together leading stakeholders from industry, civil society, and academia as well as interested MEPs to discuss and validate the preliminary findings and recommendations of this phase.

The expected outcome of this phase is an analysis of the economic and social impacts of cloud computing in the form of two working papers, and a set of preliminary recommendations for European decision-makers on the issues at stake.

**Wp3: Economic and social impacts of cloud computing**
This work package is aimed at an identification and analysis of general economic and social impacts of cloud computing in Europe. In a first step it will analyse the direct impact caused by cloud computing on the IT services, Software and Internet markets and industry in Europe. One important point in the course of this part of the analysis are the impacts on existing structures of the industry, especially with regards to the business models of FLOSS (Free/Libre Open Source Software) or proprietary producers. In a second step the direct impact on others, i.e. private business, public authorities, science and innovation system and private households, will be identified and analysed in close co-operation with WP4. This includes also exemplary analysis of impacts on the structure and organization in these areas. Finally it will also give an overview of indirect impacts on society and economy based on the existing literature.

**Main tasks:**
- Identifying and analysing direct impacts on the software and IT services industry/market
- Identifying and analysing direct impacts on private business, public authorities, science and innovation system, and private households
- Analysing indirect impacts on economy and society (growth, job creation etc.)

**Internal milestones**
- Working paper 3: General economic and social impacts of cloud computing (March 2013)

**WP 4: Security and legal issues of cloud computing**
Given the high importance of questions related to privacy and security in the case of cloud computing it seems important to perform an in-depth analysis of these questions, including their legal aspects. In three strands we will address the problems of customer rights related to the use of cloud services, the challenges to governance arising from it as well as technical aspects of security and privacy in cloud computing. All this will be analysed in detail and in concertation with the parallel work package (WP3).

**Main tasks:**
- Researching technical issues and options
  - security issues and measures in the cloud (confidentiality, availability, integrity)
  - Technical options
  - Research issues
- Researching customer rights in the cases of:
  - unavailability of services
  - loss or corruption of data
  - data breach, loss of sensitive information
- Analysing governance issues


- Process, storage and delivering in countries with different legislations
- International harmonisation of legislation on cloud computing
- International enforcement of legislation
- Responsibility for security problems
  - Auditing requirements
- Contractual issues
- Options for EP action

**Internal Milestones**
- Working paper 4: Security and legal issues of cloud computing (March 2013)
- Workshop (WP 3 and WP 4) at the European Parliament (Spring 2013)

**Deliverables:** *Report containing 2 working papers and a draft conclusion paper (31 April 2013)*

**Phase 3: Final reporting (May 2013 – September 2013)**

**Reporting**
The final project phase will consist of reporting and quality control. It will include a critical internal review of the key findings and recommendations generated by the project. The aim is to produce a high quality final report that will be considered useful by European decision-makers.

**Main tasks:**
- Compiling the results of the previous phases (and the extra module on social networks as appropriate)
- Integration of workshop results and MEP comments
- Internal review
- Writing final report

**Internal milestones:**
- Integration of workshop conclusions and MEP comments (August 2013)
- Review of Final report (August/September 2013)

**Deliverable:** *Final Report (30 September 2013)*

**Extra module on Social Networks Sites**

Given the specific context and issues of Social Network Sites, this topic will be treated in an extra module which is independent from the others, but at the same time co-operates with them whenever possible. For example, when legal aspects such as costumer rights are tackled in the main project, these results
might be relevant for SNS, too. In this way, it will be possible to account for the specific issues of this field, but also to benefit from work in the other workgroups. The module will be designed along the research questions of the main project, but adapted where necessary. To guarantee a close linkage, both will be intertwined during the consultation and the final reporting phase.

However, there will be also a set of specific research questions related to SNS, that will be addressed in both parts of the modules. In a first step the module will review the different types of SNS like more business oriented sites like LinkedIn or XING on the one hand and Facebook and the VZ group on the other side. One focus of this part is related to the great success in terms of heavy usage of the latter type of SNS among younger people. Based on existing literatures the module will seek to identify motivations for the intensive use of SNS by them. In a further step also risks related to this extensive usage by young people will be explored. Building upon this review of cultural and social factors the module will also analyse legal implications arising from that situation. In further steps technological and economical factors like the different types of business models (membership, data exploitation, in-shop-concepts, etc.) or alternative technological approaches like Diaspora will be researched. This will also include an assessment of the identified factors as well as an outlook to direct and indirect impacts of SNS for the economy and society as a whole.

The second part of the module will address questions related to security and privacy in SNS. Also here are some specific issues that differ between SNS and cloud computing. For example customer rights in the case of unavailability will not have the same importance, while especially questions related to the deployment of data protection and privacy will have much more importance due to the public character of SNS. Therefore the module will review this points and set specific foci related to SNS. The analysis of it will be an major input for the workshop at the European parliament. the goal of this workshop is to discuss policy options for the EP with all relevant stakeholders. Therefore MEP’s, representatives of the Commission, experts and researchers as well as representatives of the industry (Facebook, XING, etc.) will be invited.

Main tasks:
- Providing an overview on the current market situation (including suppliers and their locations)
- Identifying major factor driving or hindering the current evolution of SNS:
  - technological factors (e.g. standards)
  - economical/business factors
  - social/cultural factors (e.g. attitudes towards privacy issues)
  - legal factors (e.g. regulations related to data protection)
- Analysing and assessing the identified factors
- Analysing direct and indirect impacts on economy and society
- Researching technical options and issues, customer rights and governance challenges related to SNS

**Internal milestones:**
- Working paper 5: Driving factors and barriers for the development of Social Network Sites (October 2012)
- Workshop at the European Parliament (Spring 2013)

**Deliverable:** Separate report on Social networks sites (31 May 2013)

5. **List of stakeholders (industry leader, organisations and other stakeholders)**

- Lutz Heuser, CEO AGT Germany/CTO AGT Intl., ISTAG
- Robert Jenkins, CTO CloudSigma
- Pierre-José Billotte, Chairman EuroCloud
- Michael Sharpe, VP Standardisation Projects ETSI
- Daniele Catteddu, Expert in Security and Resilience of Communication Networks, ENISA
- Lutz Schubert, HLRS Stuttgart Head of Intelligent Service Infrastructures
- Burkhard Neidecker-Lutz, SAP Technical Director
- Keith Jeffery, President ERCIM & STFC Director
- Frederic Etro, University of Milan
- Erkki Ormala, Vice-President, Technology and Trade Policy, Nokia Corporation
- Tom Togsverd, Director General, Danish Federation for ICT and Electronics, Digital Europe
- Caspar Bowden, Microsoft’s data protection officer for Europe
- Peter Dickman/Emanuel Müller, Google Europe
- Lars Hinrichs, XING, Founder
- Matthias Schunter, IBM, Technical Leader of EU-project TClouds
- Thilo Weichert, Independent Centre for Privacy Protection
- Paolo Balboni, lawyer, specialising in cloud computing
- Lorenz Bogaert, NETLOG, CEO
- Zaryn Dentzel, TUENTI, CEO
- Marc-Sven Kopka, EU Social Network Group, Spokesperson
- Megan Richards, European Commission, DG INFSO
- Rainer Zimmermann, European Commission, DG INFSO
- Susan Pointer, Amazon.com, Brussels
- Chaos Computer Club
- Seth Schoen/Erik Josefsson, Electronic Frontier Foundation, Brussels