Background Research

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The cloud

> Cloud computing 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. 1

The name cloud computing has been derived from the cloud-shaped symbol, commonly used as an abstraction for the complex infrastructure it contains in system diagrams. The technical definition differs a little in what we generally understand of the cloud. Today, a cloud means mostly an infrastructure deployed by a service provider, which is offering a defined service to its clients and customers.

An example

A typical cloud service provider is Dropbox[2]:

> Dropbox is a file hosting service operated by Dropbox, Inc., that offers cloud storage, file synchronization, and client software. Dropbox allows users to create a special folder on each of their computers, which Dropbox then synchronizes so that it appears to be the same folder (with the same contents) regardless of which computer is used to view it. Files placed in this folder also are accessible through a website and mobile phone applications. [3]

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1 http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf
2 http://www.dropbox.com
3 http://en.wikipedia.org/wiki/Dropbox_(service)

As in the explanation above, Dropbox acts as a typical service provider, which offers the following services: online file storage, synchronization and backups. The customer is using these services through the client applications, which uses the defined input and output channels to the Dropbox-cloud for the upload and download of data. From the user's perspective, he's uploading and downloading his files to or from the Dropbox-cloud.

Dropbox itself uses Amazon-Web-Services[4] for all kind of resources like data storage, computing power or network infrastructure. Amazon-Web-Services offers cloud computing as it is meant by the official definition. Through defined channels they can allocate storage resources and computing power on-demand. For Dropbox this model is very efficient, because they can easily grow with their customers. Using cloud services, Dropbox does not have to think about a difference between a thousand and millions of users, because from their perspective Amazon-Web-Services offers infinite resources. From a technical point of view, customers are uploading and downloading their data through Dropbox to and from the Amazon-cloud.

Uberservice

Next to Dropbox there are many other service providers. The following list should give a short overview about what services are available today:

— **Finance** (Online Backing, Accounting, Payment services)

— **Productivity** (Time Management, Invoicing, Project Management)

— **Social** (Social-Networks, Crowd-funding, Newsletter)

— **Entertainment** (Video & Music Platforms, Online-Shops, Radios, Streaming services)

— **Marketing** (Advertisements, Analytics, Networks)

— **Business** (HR, CRM, ERP, Dashboards)

— **Development** (Tools, Error Tracking, Monitoring, Testing, Design)

— etc.

Basically, you can offer everything as a cloud service. A simple recipe for creating such a service is to take an existing problem, create an efficient solution, wrap a service around it, automate everything for cost efficiency and finally let users pay per use.

All good?

Cloud computing has enabled many companies to create new outstanding services such as better social networks, video platforms, collaborative applications and simple tools like Dropbox and this is only the tip of the iceberg. Despite this progress in the field of service providers many people, such as Steve Wozniak, have the feeling that the whole thing is coming to

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4 http://aws.amazon.com/customerapps/Python/1955

fast:

> "I really worry about everything going to the cloud, i think it's going to be horrendous. I think there are going to be a lot of horrible problems in the next five years." [5]

Paul Saffo, Managing Director of Foresight at Discern Analytic, also has a twisted opinion on this topic:

> Apple users are already beginning to get a taste of it. Apple iTunes is a very mixed gift. Sure, it delivers wonderful convenience, but the age of being able to have your own music on a piece of media that you store and control is going to disappear. Today, if your music is on iTunes, if Steve Jobs changes his mind about the commercial relationship, he can make it all go away, and you can't keep it.
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> The Kindle is a cloud device. The Kindle, in fact, is the first consumer cloud device that most people are experiencing. It's a great convenience. If you lose your Kindle and you tell Amazon, they'll send you a new one and it has all your books on it, just like before, because your books really aren't on the Kindle, your books are stored in the cloud.
>
> The downside is that Jeff Bezos (Founder & CEO Amazon) knows more about your reading habits that anyone in human history has ever known. He doesn't just know what book you bought, he knows how much time you spent on a particular page or how much time you spent on a particular paragraph you highlighted.
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> So the Internet is going to dig itself deeper into the nervous system of the planet, and it's going to become much more sophisticated. But the real danger is the stuff we're doing to change the Internet to make that possible is also going to make it easier for people to try and control it. [6]

On the other hand cloud computing is great. It will lead us towards a society that is based on on-demand services and products. By automating and simplifying all kinds of processes, we are soon going to be able to produce goods only if needed and manage our resources in an intelligent and sustainable way. With cloud computing we have opened the opportunity to a new layer of services and products.

Cloud computing is an initiative by companies, whose objectives are to be efficient and reduce infrastructure costs. So the focus is currently very business related. However, at the end there is always a user consuming these services and he should be the focus too. And because the user is the substantial thing in this relationship, we have to think about the cloud from his point of view.

User, client and customer

User's love cloud services because they love simplicity and because most

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5 http://www.businessinsider.com/steve-wozniak-cloud-computing-will-cause-horrible-problems-in-the-next-five-years-2012-8

6 http://curiosity.discovery.com/question/potential-problems-with-cloud-computing

of the services charge low subscription fees, the majority of the users are willing to pay for it. On top of that, people love to interact with each other over these simplified platforms and services. High availability and the web based terminals are other big advantages from the user's sight. Nowadays, most computer users only need a browser to access all resources they need. Native applications disappear more and more.

A long time ago we used Hardware Terminals[7] to interact and communicate with a computer. Later, the computer and the terminal got combined into one product. We bought applications and installed them on our computer and interacted with attached input devices. All the generated data was stored on the internal hard disk, and if we wanted to work on something at a different location, we had to carry either the whole computer or only the hard drive with us. With the invention of the USB-Stick by Dov Moran[8] this process became more and more easy.

The usage of computers and services today develop again towards this idea of terminals. Browsers replace old command line interpreters and allow a graphical user interface with complex functionalities and enhancements. Because browsers are installed on almost every computer, we are able to access our resources from everywhere and every computer. Most people only need a browser to get their stuff done. So why don't we build a computer that is efficient in doing only this. The Chromebook project by Google follows this idea:

> With a Chromebook you won't wait minutes for your computer to boot and browser to start. You'll be reading your email in seconds. Thanks to automatic updates the software on your Chromebook will get faster over time. Your apps, games, photos, music, movies and documents will be accessible wherever you are and you won't need to worry about losing your computer or forgetting to back up files. Chromebooks will last a day of use on a single charge, so you don't need to carry a power cord everywhere. And with optional 3G, just like your phone, you'll have the web when you need it. Chromebooks have many layers of security built in so there is no anti-virus software to buy and maintain. Even more importantly, you won't spend hours fighting your computer to set it up and keep it up to date.
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> At the core of each Chromebook is the Chrome web browser. The web has millions of applications and billions of users. Trying a new application or sharing it with friends is as easy as clicking a link. A world of information can be searched instantly and developers can embed and mash-up applications to create new products and services. The web is on just about every computing device made, from phones to TVs, and has the broadest reach of any platform. With HTML5 and other open standards, web applications will soon be able to do anything traditional applications can do, and more. [9]

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7 http://terminals.classiccmp.org/wiki
8 http://www.ehow.com/about_5484089_invented-usb-flash-drive.html
9 http://googleblog.blogspot.ch/2011/05/new-kind-of-computer-chromebook.html

The Chromebook is a typical Thin-Client[10]. These kind of computers are designed for only purpose: Displaying data, which is generated somewhere else. Using Thin-Clients the 3D consuming application or the standard word-processor application does run somewhere on the cloud rather than on the computer itself. This allows us to use the application again from every computer and anywhere, without installing it on a single computer.

There are issues

To this point, we saw that cloud computing is shifting our resources to big data centers, where they can be processed faster and more efficient than on our personal computer. This outsourcing of data comes with some problems, which are often left aside, but very important:

1. Cloud services lack interoperability, which means that mostly a user using cloud service A cannot directly interact with a user using cloud service B. This behavior leads to a kind of peer pressure, where users are tempted to pay for multiple similar services.

2. There are no national or international laws regarding the ownership of data kept in the cloud by companies. In the example of Dropbox, user A is uploading his files through Dropbox to the cloud of Amazon Web Services. From the different point of views it is not clear who has the ownership and takes responsibility over these uploaded files.

3. Data stored by cloud services is mostly unencrypted and readable for everyone who can somehow access the system. It's known that companies index and query the data to get statistical informations about their users or use it for different studies. Users agreed to that somewhere in the companies AGB, but have no control about how their data is used by third parties.

4. Service providers are able to create highly efficient systems on the basis of the defined input and output channels. They mostly use a dozen of databases to store all the business relevant data including user generated data. Usually these records live alongside each other and the relationship to its owner is set by a handful of bits and bytes. Employees or hackers could easily change or corrupt data, without the user's notice.

5. Transparency about the physical location of data, its usage or access capabilities is missing completely and nearly impossible to find out. After uploading data, we loose complete control over it. Nowadays, it is nearly impossible to delete something from the internet once it is uploaded.

If we want to establish cloud computing as a basis for further services, we have to get rid of these issues and create a transparent fundament for the future. New technology mostly brings also new interaction models and concepts. Perhaps we have to start thinking more fundamentally about how we should interact with data in the future.

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10 http://en.wikipedia.org/wiki/Thin_client

Social-networks

Social-networks are the most used services today on the web, Facebook being the biggest of all with one billion of monthly active users[11]. There has been discussions on wether or not a social-network can be called a cloud service, but because the term "cloud" has became much broader and separate to cloud-computing, a social-network can now be defined as a cloud service as well. [12]

The current generation is actively using all these social-networks a lot, and this allows them to grow rapidly. In fact, it is astonishing how easy it is today to connect to different people and groups after years or over long distances. However, the majority of the social-networks users have no idea, that they are giving off their digital identity by pushing data to the social-cloud everyday. And unfortunately, most users are not aware of the consequences that arise from the usage of these services and the linked disposal of their personal digital identity.

> The success of social media has created a variety of problems for relationships. Embarrassment, jealousy, false assumptions, and stalker-like behavior, are some of the social disasters that can result from the misuse of social media. An increasing number of people have actually chosen to disable their social media accounts in an attempt to save a relationship or help get over a previous one. [13]

These are problems for which everyone should and is able to find a solution that is right for himself. However, there are further things happening in the background of these services, which we have no control over and which are barely visible to any user. The secrecy of these activities make it hard to identify problems that concern the privacy of the user and find a fitting solutions.

> Questions about what social networks mean for personal privacy and security have been brought to a head by research at Carnegie Mellon University that shows that Facebook has essentially become a worldwide photo identification database. Paired with related research, we're looking at the prospect where good, bad and ugly actors will be able identify a face in a crowd and know sensitive personal information about that person.
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> These developments mean that we no longer have to worry just about what Facebook, Google+, LinkedIn and other social sites do with our data; we have to worry about what they enable others to do, too. And it now seems that others will be able to do a lot. [14]

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11 http://finance.yahoo.com/news/number-active-users-facebook-over-years-214600186--finance.html

12 http://www.bitrebels.com/social/social-networking-is-already-using-the-cloud-infographic

13 http://www.examiner.com/article/social-media-the-worst-thing-to-happen-to-relationships-since-well-anything

14 http://www.forbes.com/sites/chunkamui/2011/08/08/facebooks-privacy-issues-are-even-deeper-than-we-knew

A broader collection of criticism can be found on Wikipedia:

> Facebook has met criticism on a range of issues, including online privacy, child safety, hate speech and the inability to terminate accounts without first manually deleting the content. In 2008, many companies removed their advertising from the site because it was being displayed on the pages of controversial individuals and groups. The content of user pages, groups, blogs, and forums has been criticized for promoting or dwelling upon controversial and inflammatory topics (e.g., politics, religion, sex, etc.). There have been several issues with censorship, both on and off the site. [15]

In conclusion, one of the main problems regarding social-networks is that users who don't want to have an account because of fear against misuse, are barred out of the networks. The internet has created a two-class society: People using social-networks and people without. The question therefore is, if this division is allowed, or if we should try to find something that everyone can use without a fear of giving off hist digital identity.

Ideas, concepts and thoughts

The following section summarizes ideas, concepts and thoughts about the issues mentioned above and other things.

Decentralization

Decentralization is an ideas that became more popular, by thinking about the issues of current social-networks. Social-networks and most services are organized centralized. This means that the service provider is maintaining a infrastructure in one place or distributed in a few places. From the outside it looks like we're accessing the information always from one location. Since the authority of the data is shared between the service provider and the user it is possible that a service provider suddenly restricts access to some resources. One of the biggest problem here is that a government can easily bar users of an entire country from accessing information on the internet:

> Between January and April 2011 public demand for political reform cascaded from Tunis to Cairo, Sana'a, Amman and Manama. This inspired people in Casablanca, Damascus, Tripoli and dozens of other secondary cities to take to the streets to demand change. By May the political casualties were significant: Tunisia's Ben Ali and Egypt's Mubarak, two of the region's most recalcitrant dictators, were gone; Libya was locked in a civil war; several constitutional monarchs had sacked their cabinets and committed to constitutional reforms (and some several times over). […] Democratization movements had existed long before technologies such as mobile phones and the internet came to these countries. But with these technologies, people sharing an interest in democracy built extensive networks, created social capital, and organized political action. With these technologies, virtual networks materialized in the streets. As a desperate measure, many states tried to

15 http://en.wikipedia.org/wiki/Criticism_of_Facebook

choke off information flows between activists, and between activists and the rest of the world.

> Mubarak tried to disconnect his citizens from the global information infrastructure in the last week of January 2011. It was a desperate maneuver with mixed impact. A small group of tech-savvy students and civil society leaders had organized satellite phones and dialup connections to Israel and Europe, so they were able to keep up strong links to the rest of the world. [16]

Restricting access to the full internet is rare, but censorship is common and happens all the time. With decentralization, restricting of a certain network is more difficult, because there is no single point of failure.

Shared control

Another advantage of a decentralized and distributed architecture is that everyone is able to create and maintain a node in the system. Such a node could provide an access point for only one person or a whole community who trusts the managing person. Since the cluster of nodes has no central point of authority all nodes are equal and able to talk each other.

> The Diaspora network is a recently launched decentralized online social network with over 216,000 users as of November 16, 2011. It is a network of independent, federated Diaspora servers that are administrated by individual users who allow Diaspora users' profiles to be hosted on their servers.
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> To address the problems and concerns associated with data ownership, privacy, and security of centralized OSN sites, several decentralized OSN designs have been recently proposed and experimented in several ongoing projects, such as PrPI, Mr. Privacy, Diaspora, and PeerSon. Among those decentralized design approaches, the Diaspora network is the only real-world Internet-scale decentralized online social network in use today, to the best of our knowledge. [17]

Diaspora is good example for such a decentralized network. The network has almost all functionalities other social-networks have. The big advantage however is, that everyone has full control over his data. You are able tho host your personal node, with exclusively your own profile on a server or hardware you own and no one else has access to. Unfortunately, there are no ways to interact with people using another social network like Facebook or Google+, which is necessary to most users to consider a move to a decentralized network.

Compatibility is a big issue for most cloud-services. Since most of the services are lacking of a well documented import and export function there

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16 Howard, Philip N., Agarwal, Sheetal D. and Hussain, Muzammil M., When Do States Disconnect Their Digital Networks? Regime Responses to the Political Uses of Social Media (August 9, 2011). Available at SSRN: http://ssrn.com/abstract=1907191 or http://dx.doi.org/10.2139/ssrn.1907191

17 Bielenberg, A.; Helm, L.; Gentilucci, A.; Stefanescu, D.; Honggang Zhang; , "The growth of Diaspora - A decentralized online social network in the wild," Computer Communications Workshops (INFOCOM WKSHPS), 2012 IEEE Conference on , vol., no., pp.13-18, 25-30 March 2012

is mostly no way to get data in or out easily. For social-networks there are initiatives like the Tent Protocol to address this issue:

> Tent is a protocol for open, decentralized social networking. Tent users share content with apps and each other. Anyone can run a Tent server, or write an app or alternative server implementation that uses the Tent protocol. Users can take their content and relationships with them when they change or move servers. Tent supports extensible data types so developers can create new kinds of interaction. [18]

There is much work to do until we have the ability to create our own personal social-network experience.

Encryption

Another concept for increasing the security and privacy level of services and data is to encrypt them. When data gets encrypted before transferring to a service provider, the provider itself can't read the data and from their perspective so the data is useless. This encryption its mostly done using a asynchronous encryption method[19] with public and private keys.

Here a fragment of the official about-text from the recently launched successor of megaupload.com, mega.co.nz:

> We are a dedicated group of technologists who were given the time, opportunity and Internet access to build an awesome cloud storage service that will help protect your privacy. We have programmed this Internet service from scratch in Auckland, New Zealand. Unlike most of our competitors, we use a state of the art browser based encryption technology where you, not us, control the keys. […] We hope you like it. [20]

With Mega, Kim Dotcom plans to create a fully privacy aware cloud storage service, where users have the total control over their data, as he says:

> I think it's important for the Internet that there is more encryption. Because what I have learned since I got dragged into this case is a lot about privacy abuses, about the government spying on people. You know, the US government invests a lot of money in spy clouds: massive data centers with hundreds of thousands of hard drives storing data. And what they are storing is basically any communication that traverses through US networks. And what that means they are not spying on individuals based on a warrant anymore. They just spy on everybody, permanently, all the time. And what that means for you and for anybody is that if you are ever a target of any kind of investigation, or someone has a political agenda against you, or a prosecutor doesn't like you, or the police wants to interpret something in a way to get you in trouble — they can use all that data, go through it with a comb and find things even though we think we have nothing to hide and have done nothing wrong. They will find something that they can nail you with and that's why it's wrong to have these kinds of privacy abuses, and I decided to create a solution that overtime will encrypt more and more of the internet. So we start

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18 https://tent.io/about
19 http://en.wikipedia.org/wiki/Public-key_cryptography
20 http://www.mega.co.nz

with files, we will then move to emails, and then move to Voice-Over-IP communication. And our API [Application Programming Interface] is available to any third-party developer to also create their own tools. And my goal is, within the next five years, I want to encrypt half of the Internet. Just reestablish a balance between a person — an individual — and the state. Because right now, we are living very close to this vision of George Orwell and I think it's not the right way. It's the wrong path that the government is on, thinking that they can spy on everybody. [21]

Open platforms

The open-source community is substantial for the forthcoming of the digital age. The development of free software ensures a basis for further development. Open-source software is easy to use, reliable and also trusted. Free software is the basis for the internet infrastructure and all its services on top.

The version control system git and the social network Github[22] started a little revolution of collaborative work in the open-source community. Many companies began to open parts of their software products, others created new alliances to develop technologies as free software like Android[23] or openstack[24]. Many projects would not be developed if there wasn't a platform like Github, which enabled many developers to work easily together.

Beside of software platforms, there are hardware platforms like Arduino[25] and raspberry pi[26]. Both enabled many developers and artists to prototype and hack embedded systems. People who never touched electronics before, are suddenly able to create little devices with programmable micro controllers. As these projects are based on the open source idea, the community began to build an ecosystem around these projects, who never thought off before.

> The Arduino is not just one simple thing making it a little hard to define. It is a micro controller platform, an open-source design that encourages modification and reuse, a community that has embraced and grown up around the Arduino, and a new crop of projects and devices that can trace their lineage to the Arduino and have in return contributed back to the development of various aspects of the entire Arduino ecosystem. […] The Arduino ecosystem begins with the Arduino platform, itself several layers of hardware and software working together to create a cohesive whole. [27]

With the growth of projects like Arduino new things began to evolve and with the rise of electronics the community soon built one of the first home 3d printers.

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21 http://rt.com/usa/news/kim-dotcom-interview-mega-673
22 http://www.github.com
23 http://www.android.com
24 http://www.openstack.org
25 http://www.arduino.cc
26 http://www.raspberrypi.org
27 Beginning Arduino Programming, Brian Evans, 2011, Apress

> "This technology has been around for 20 years, but it's about to hit the public in a big way," she later explains. "It's going to affect every facet of life — letting you manufacture bespoke products on demand that can be customized for an individual, and giving designers the freedom to make complex parts with less waste of material and a lower carbon footprint because it's made locally.
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> The technology may have been around for decades, but until recently the costs of manufacture have made the process prohibitive for mass applications. Now you can build your own entry-level 3D MakerBot printer from a kit for just £800 ($1,300) […]. [28]

With 3d printers an industrial revolution has started and the making community is growing from day to day.

Mix

Bringing these technologies together, enables projects like FreedomBox:

> We're building software for smart devices whose engineered purpose is to work together to facilitate free communication among people, safely and securely, beyond the ambition of the strongest power to penetrate. They can make freedom of thought and information a permanent, ineradicable feature of the net that holds our souls. [29]

FreedomBox is a platform for distributed applications. The idea is that everyone, can build is own box with hardware they like and install applications they want. These applications are designed to work decentralized and without an central authority. When everyone has such a box, we could connect to many people in a save and free way.

But the problems is, that not everybody is able to hack this box from raw parts together. We have to build something that is so simple and easy, that everyone is able to use it. We have to think more from the users perspective!

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28 http://www.wired.com/business/2011/05/3d-printing-an-industrial-revolution-in-the-digital-age

29 http://freedomboxfoundation.org