

Understanding Social Networks

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ABSTRACT

This paper will give a general overview on today's social networks focusing on the most important evolvments that will influence social networks in the coming years. Our main aim is to evaluate the benefits of adopting a distributed social networking architecture rather than the centralized one. Privacy, data portability and policies represent the biggest issues today for social network users. But, can the decentralization solve these problems without creating others? To answer to this question we show some of the drawbacks such as, usability, security, maintainability and economical disadvantages that can derive from adopting a distributed architecture for social networks. Our second aim is to show how in the future the social aspect will be integrated with ubiquitous computing across all applications and devices.

Author Keywords

Online social networks, MMOG's, semantic web, interactions, policies, privacy, decentralization, ubiquitous computing.

INTRODUCTION

The term *social network* is already used in sociological studies to describe a person's network of friends, family, and coworkers and the way they interact. Since we mainly talk about online social networks, we will use the term online social network (ONS) to prevent misunderstandings.

Recently, online social networks have received a tremendous amount of attention in the media and in research. By now there is a broad spectrum of different social networks. Some of them serve special purposes, like establishing business contacts (Xing¹) or promoting yourself (MySpace²), others create complete virtual worlds (Second Life³, Massively Multiplayer Online Role Playing Games). Facebook⁴ has become a worldwide phenomenon, which has been growing rapidly over the past years and is now for many people an often used way to stay in touch with friends. Nowadays we have applications to access the most important social networks from our mobile phones.

They allow us to share information with our whole network of friends at once, instead of the typical one-to-one communication of mobile devices. This shows how the social networks are affecting the behavior of the people and are becoming an important aspect in everyday life.

Understanding their strengths and weaknesses is vital to further development and improvement. To do that, we will first identify the typical interactions in these networks and how to improve, or make better use of them. Then we will take a look at the most relevant problems OSNs face today and will present the prominent approach that could present a solution to many of these problems. Finally, we will give an overview on how social aspects will become more relevant and integrated into our mobile devices and how ambient devices could incorporate social networks in every day's life.

INTERACTIONS IN SOCIAL NETWORKS

Social networks have changed the way people interact with each other over the last few years. Therefore we will take a closer look at what kinds of interactions are most common in OSNs. Further in the paper we will show some interactions which are more characteristic for special typologies of OSN such as virtual worlds. To do this, we first need to define some of the typical areas of action services like Facebook, Orkut, and others have in common [5].

- **Profile & Friends:** All activities concerning the users own profile and visiting other user's profiles. This also includes browsing the user's homepage, that bundles news about the user's friends.
- **Scrapbook/Wall:** This describes a system for leaving other users public messages. These are usually displayed chronological on the user's profile page and thus visible to everyone, except the user defines otherwise.
- **Messages:** These are private messages, usually stored in a mailbox, which only the receiving user can access. Users can send messages to anyone, except they are blocked as unwanted senders.
- **Multimedia Content:** All features and activities that allow users to share any kind of multimedia content like photos or videos. Often there is more than one way to share certain content.

¹ <http://www.xing.com>

² <http://www.myspace.com>

³ <http://www.secondlife.com>

⁴ <http://www.facebook.com>

- Communities: Every user can start a community about any topic. Other user can join these communities either freely, if it is an open community, or by invitation or approval through a moderator, in closed groups.
- Search: Allowing users to search for other users, communities or any other content is a vital part of all OSNs. The search feature should at best be accessible all the time.

From various statistics we were able to gain a good overview about what people are actually doing in their OSNs. Facebook itself states there are over 900 million objects that people interact with [14], like pages, events or groups. This includes every profile, pages for celebrities or corporations, all the communities and many other objects. But we are more interested in how users interact with each other and not with a group or a page.

According to Benevenuto et al. [5] users spend most of their time browsing through profiles (17.9% of activities during an average visit), their own homepage (16.9%) or scrapbooks/walls (15.9%). But are these really interactions? The answer to that is yes. The browsing of other users content can be summarized as silent actions, because there is no direct action concerning the OSN, like writing something or clicking on a link. Silent actions are interactions, because users interact by reading updates or new scrapbook/wall entries, which states an exchange of information between friends. These silent actions are a vital part of interaction in OSNs, since if a user updates his profile he is clearly doing an action, but without anyone browsing his updated profile it would always be just an action and no interaction. Most statistics neglect these silent interactions although they clearly account for a majority of social interactions. Users spend most of their time (80%) in OSNs within the pages of a user's own profile or profiles of immediate friends [5].

Benevenuto et al. gathered these data from various sites like Orkut, Facebook, and MySpace. The different approaches of those pages in creating a social network can clearly be seen in a comparison of user activities. MySpace, with its more self-promoting style, shows that, the most popular activities (88% of all activities [5]) are in the field of profiles & friends. This includes browsing pages of MySpace-accounts or editing their own page. Messaging represents only 5% of user activities. In Orkut, similar to Facebook, Profile & Friends also were the most common user activities, but here only 41% of all activities fall into that category. As the statistics show, it has a more interaction based activity composition, with 31% for the Photos (Multimedia) section and 20% for the scrapbook/wall.

Most of those interactions build the cornerstone of nearly every OSN, except for virtual worlds and MMOGs (Massively Multiplayer Online Game), since they depend nearly sole on direct interactions. Of course virtual worlds also make use of profiles, messages, communities or searches, but there are as well very special forms to allow

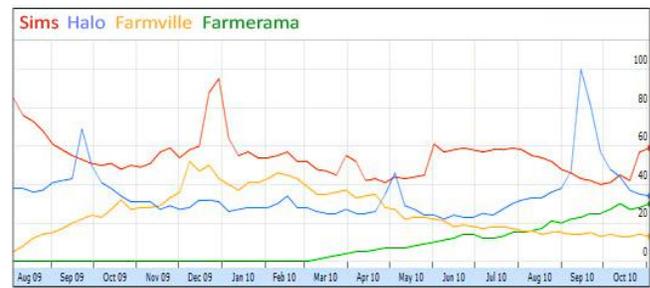


Figure 1: Volume of search-traffic for two successful computergames and two successful social games [15]

instant interactions. An avatar is an extension of the profile that represents the user in the virtual realm. Through their avatars users can communicate with each other using chat or voice chat. Only in the last few years OSNs like Facebook started to include chat-functionality. Voice chat is a key factor for MMOGs (e.g. World of Warcraft⁵) because when playing a real-time game with others, instant communication is essential to coordinate. Also it increases the immersion in the game. Furthermore, special forms of interaction, like fighting or trading goods, are found solely in such virtual worlds.

Smaller online games are a big part of the success of modern OSNs, especially Facebook. Figure 1 shows that in the beginning of December 2009 nearly as much people searched for the Facebook-game *FarmVille* as for the term *Sims*, the best-selling game series of all time⁶. In this moment *Farmerama*, another Facebook game that lets you run your own farm and compete with other Facebook users, produces nearly as much search-traffic as the popular game *Halo*. This is even more impressive considering that in September 2010 *Halo:Reach* was released (peaking blue line). Underlining the status of games in Facebook is the fact, that Facebook's topic with the largest fan⁷ base is the Facebook-game *Texas Hold'em Poker* with 28,170,491 fans, surpassing even Facebook's own page with 28,088,545 fans and *Michael Jackson* with 24,225,315 fans [18]. But although having the most fans, the poker application has only the third most monthly active users (MAU⁸: 35,533,695). Yet *Farmville*, which is not even in the top 15 of the fan-ranking, surpasses it with over 53,805,048 MAUs.

An interesting study [23] shows that the socio-enhanced content in these games not necessarily makes them more popular or leads to more players but it affects considerably the interactions. The study compares the interactions a group of users have, using two versions of the same game. The first version did not include social interactions with the

⁵ <http://eu.battle.net/wow>

⁶ <http://www.allbusiness.com/consumer-products/computing-products-consumer-software/5867466-1.html>

⁷ In the OSN Facebook the user can become a fan of a game, community or topic, to show their affiliations or interests, by clicking on a button marked "like"

⁸ every MAU has used the application at least once in the considered month

network of friends while the second allowed interactions with friends inside the game. The results show that same game with socio-enhanced content dramatically increased the amount of interactions and thus the personal connection to the game.

Because of the social aspect of the game the user gets more bound to it and the providing OSN. The data shown before displays that games are a major factor for OSNs to tie the user to their network. Their success in OSNs is because they offer the users an easy and playful, yet competitive, way to interact with their friends. This in turn leads to the conclusion that designing and improving the ways people interact in OSNs will become more and more important.

Pattern Languages for Online Social Networks

Patterns have rapidly become one of the most powerful tools in interaction design. For a better understanding we will shortly explain some key factors of such pattern languages. All pattern languages have the basic idea in common, that they should present proven solutions to reoccurring problems and link them to other patterns. Such creating a web of linked, combinable and reusable patterns. And one of the most important factors for a good pattern language is their overall purpose as stated by Alexander, namely to create a better living environment [1]. As mentioned there are several different languages with different approaches and for different uses.

One very popular pattern language was created by van Duijn et al. [30] with their “design of sites”. Most OSNs, e.g. Facebook, make good use of patterns from that language, knowingly or not and are steadily improving their design. Many patterns from the design of sites pattern language can be found on Facebook’s webpages, like the grid layout (pattern I1) or the chronological organization (pattern B6) of messages and events shown on the personal homepage. But these are applicable to all websites.

We already pointed out the importance of socio-enhanced games in OSNs. The added social content in these games could represent a pattern for interactions in social networks; we find it almost in all the applications that run on social networks. For example in many Facebook games there is a list of friends at the bottom of the applications screen, showing the user a row of avatars or profile-pictures that indicate which of the user’s friends also play this game. The user can then interact and play with or against them easily. But usage of a bottom bar to interact with your friends is found nearly nowhere else. On most sites in the web, a conventional list is used to show who you can interact with. Most common MMOG use such a list or simply show them on your map. This shows that there is no proven best solution, or solutions, to this common problem and hence no pattern.

Another OSNs exclusive example is the *like* feature, which allows user to comment on nearly every object (wall entries, status updates, games, communities ...) with one click if they like this particular objects content. It became so popular that now users can find these *like* buttons

directly on numerous websites. The OSN digg.com⁹ makes use of this feature in an even greater way. Digg collects what a registered user *diggs* (“digg”-buttons function the same way as the *like* buttons) and offers the user personalized advertisements or further websites the user might be interested in. Yet this feature fits none of the existing patterns we researched.

Until now only limited work has been done in this area. Some even take the opposite way. Instead of identifying good patterns, they describe so called anti-patterns. These anti-patterns describe patterns in OSNs, which can be found in most of them, but are not really desirable. As for example the *ex-boyfriend* anti-pattern [13] describes the negative effect that by default your actions inside the OSN are viewable for all your friends. Even those who you maybe do not want to share anything with, like ex-boyfriends or co-workers. These anti-patterns are usually easy to spot, especially taking into consideration that it is in their own best interest to encourage the users to give them Feedback about such things. Yet sometimes outrage can be even more efficient than direct feedback. When Facebook’s beacon feature was launched, in a short amount of time there were many different groups and discussion complaining about the problems they encountered [21].

As of our research, patterns about OSNs or with a stronger focus on user-user interaction are still very rare and mostly in developing phases. The “design of sites” pattern language even specifies different types of websites in their first level of patterns. But none of these *Site Genre* patterns they describe is applicable to OSNs. This shows that there is a great need for a OSN specific pattern language, or at least an expanding of existing languages, that also focuses on the stronger influence of user-user interaction and not only human-computer interaction.

Social Networks and E-Learning

Another topic that has been at the center of many discussions and research in connection with OSNs is education. Today most universities expect their students to have internet access. And from personal experience we can state that most of our courses offered at least the course materials online, and many required to hand in assignments online. But the ongoing debate is whether OSNs can help students, or the general population, in their learning. We therefore want to present some of the pros and cons we identified in our research.

One major factor that points to OSNs bolstering the learning experience is that “knowledge rests in networks” [10]. This means only through synchronization with other people knowledge can be established, because “learning and knowledge require diversity of opinions” [10]. OSNs allow easy exchange and combination of information, thus creating profound networks of people sharing, combining and improving their knowledge. Because they offer a broad variety of ways to interact and share content, OSNs seem to

⁹ <http://www.digg.com>

be perfectly equipped for helping people learn. Offering the possibility to easily co-author documents is also very important to building knowledge, as the example Wikipedia¹⁰ shows. Additionally, virtual worlds could offer users complete virtual classrooms or universities [29], where groups can work on a joint project at the same time, or whole classes could be taught.

But a disadvantage of such virtual campuses is that these projects are restricted to the virtual reality, so no real-life test or constructs could be accomplished. Another major issue of virtual worlds and many OSNs in general, is the anonymity of the avatars and profiles. The user can never know for sure if an unknown source or is reliable and really who or what he/she claims to be. Another problem originates from what we just mentioned as an advantage, the decentralized network of many sources. If such a network becomes too big, reaching a consensus about topics becomes less likely and the knowledge is in danger of being too diffused. Furthermore, the asynchronous and text-based communication in many OSNs (except in virtual realities) proves to be very difficult in discussions [25]. While it gives user a certain amount of time to prepare responses, it also takes away all advantages of face-to-face conversations.

In none of the papers we researched a working solution to enhance learning experiences with the help of OSNs was presented. But all seemed to agree that this field of study is very promising for the future. We wanted to show that OSNs have a great potential for improving learning and knowledge acquisition, but there are still many obstacles to overcome until such learning-centered OSNs will be part of our everyday life.

Improvements for Interactions in OSNs

We now raise the question how interactions in OSNs can be improved. As mentioned before there is need for better guidelines for the design of interactions in OSNs.

By now it is clear how many different connections and online ties we assemble during our online life. And these connections are at the core of the most interesting development concerning OSNs. Often these connections are as vital a part of information then the data itself. Friendlists in OSNs are in essence lists of connections. OSNs already make use of these connections in order to suggest friends and communities or to provide news. These suggestions are based on what connections your connections (friends) have and comparing them to connections (e.g. to communities) you already have. By analyzing these combinations of connections and data, a new form of information is revealed, semantic information.

In 2001 Tim Berners-Lee introduced the next step in the evolution of the internet, the semantic web [6]. Berners-Lee wanted to create a framework for information-sharing across all applications, platforms without any boundaries.

The semantic web makes use of connections that exist in the web, such as linkage of sites, referencing of sources or friendlists. Google already ranks their search results not only on the basis of how well certain keywords match the provided keywords of a site, but by taking into account the amount of links that point to a site. Google refined the PageRank¹¹ algorithm to include the weight/importance of the site that the links originate from. But while finding and exploring these connections is easy, making real sense of them is very difficult. Especially in reference to a given problem, like a search query.

Typing a question or a sentence (e.g. “my blackberry keeps freezing”) as a search query today seldom returns the results one wants or needs, except someone else posted the exact same phrase in a forum or blog. But if the search engine would be able to make use of semantic information from OSNs, it could provide the user not only with sites matching the keywords of the query. For example, the results could be improved by taking into account how many friends like a certain site in the users OSNs. Likewise posts from friends that match the query could be included. Even the inclusion of posts that are responses to similar questions posted in an OSN is thinkable. This approach is very interesting, because right now people rather ask their social network (online or in real life) if they seek answers to such questions. The reasoning for that has many aspects.

First is the point that asking a question in natural language is much more effortless than trying to figure out what keywords a user would have to use to get the results one seeks. The type of information needed is also an important factor. People tend to ask questions in social networks if the question concerns a recommendation (e.g.: ‘who knows a good bar in Munich?’) or an opinion (e.g.: ‘what do you think of the new MacBook?’). Many people ask their friends because they believe their answers to be more trustworthy than those given out by an anonymous search engine, where the user would have to determine for oneself if the source is trustworthy. Another factor is the response time. Most subjective or personal questions do not need a direct response and people accept that they have to wait some time if they want a good answer. Furthermore, people know that their friends can tailor their answer based on their knowledge about the person asking the question [26].

This demonstrates that if search engines were able to integrate knowledge from OSNs, their results would be more personalized and trustworthy. But do to this perfectly, the search engine site would have to know about what OSNs a user is subscribed to and who the users friends are, which at the moment states a major privacy problem. In a semantic web however, the search engine would only need to know about the users connections and then explore them for results. To be more specific, a search engine would get the personal data from the user and after it executed the search request, could forget all about it.

¹⁰ <http://www.wikipedia.org>

¹¹ <http://www.google.com/corporate/tech.html>

Main problem for the further development of the semantic web seems to be the unwillingness of the corporations behind these sites to give up their precious data, because technically the semantic web could easily be established (more on that in the next section).

THE ACTUAL ISSUES IN OSN

The users of the social networks today have to deal with several problems. Perhaps the most important ones derive from the fact that these sites are centralized. This means on one hand, that they are closed to the rest of the web and do not offer data portability to the users. On the other hand, it also means that these companies are the only authority that controls the data from the users [2]. Users have to agree to the policies of these sites when using their services. Most of these users are unaware of who will use their data, but even for those users who are aware that their data will be targeted to advertising for example, no choice is offered by these policies. Another aspect that is affected by this lack of control over the personal information is the user privacy. In the following three sections we will analyze these issues in more detail and will give an overview of how is dealt with them at the moment, giving concrete examples.

Data Portability

Many users are present in many different social networks, such as Facebook, Twitter, MySpace, YouTube, Flickr and much more. For all these networks users go through a long process of establishing a network of connections, of uploading or creating content, without having any opportunity to transfer preexisting information and connections directly between these sites. Each user, when joining a new social site, has to manually create his/her virtual identity by defining its connections to other users and by creating certain content that characterizes him/her. This has two main problems. Firstly it requires additional and unnecessary effort for the users. Secondly once this amount of user data was created, it does not belong only to the user, but also to the site that hosted this information. For example in Facebook if a user wants to leave the network, he does not have the right to delete his data from the company servers, because the data belongs to the network. The companies that own these sites almost always are applying anti-cooperation policies. The large revenues generated by the users data makes these companies not willing to facilitate the growth of competitors, thus none of them is cooperating on data portability issues. Recently this tendency seems to change and there is global participation in projects such as “The Data Portability” project with members from Facebook, Google and Microsoft, or Open Social foundation.

As a result we have tools such as desktop applications or web sites that attempt to reduce the user’s effort in managing multiple social networks. Figure 2 shows such an approach, called social network aggregator. These aggregators are usually separate applications that provide the main common fields of a typical social network and where the user can manage all his accounts to different

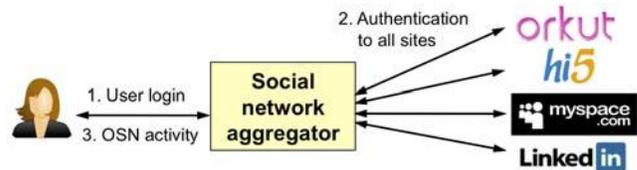


Figure 2: Illustration of a user connecting to multiple OSNs through the social network aggregator [7]

social sites. Once a user logs in to such an aggregator application he gets authenticated to all the specified social networks. This way the user is able to access all his accounts from one convenient interface. These interfaces offer only very basic interactions and cannot cover all the possible functionality of the separate social networks. For example they do not support advanced features like games. It is clear that this approach is not a good solution for the data portability problem.

Social Network Policies

The social network policies are composed by use statements and privacy policies. There are laws that regulate some aspects of these policies and independent organizations such as virtualpolicy.net that guard over them [22]. However it is difficult for users to read these policies which usually include economical and legal models. The more complex is the site the bigger is the use statement. For example in Second Life we have a 7492 word statement which is far more complex than a simple e-commerce site with 1576 words [22]. Second Life is the most complex example to analyze in terms of policy, due to his high analogy with the real world. We can see that in this huge virtual social network there is almost no distinction of virtual and real value. “A user claims to have earned 1 million USD with virtual property dealings” [22]. In this case each action of the operators, such as changing policies, which may damage the property, may be actionable by law. [22]. Currently, the operators are the only part that has the right to change and apply new policies. If we take a look at other types of sites where no real economic value is exchanged there are other kinds of consequences that policy changes bring to the unaware users.

A well-known example is the Facebook beacon feature. This feature allowed third-party websites to automatically post on the users activity wall, what they were doing or buying in these sites. The default privacy control was allowing beacon to publish everything on the users’ activity stream. Facebook didn’t make his users aware of this policy change. Consequently this unexpected change created in many cases personal embarrassment. Many users found events published in their profile such as booking a trip, buying something on e-bay, or renting a movie in blockbuster. Furthermore, each site had its own opt-out control and this was creating additional effort to maintain privacy by the users. After a massive negative feedback Facebook decided to create a global control on what was published by these third parties [11]. Later on this service

was shut down and Facebook had to pay 9.5 Million USD to fund an online safety foundation [21].

Privacy

What is observed until today is that users joining a social network do not pay attention to the privacy issues. They are encouraged by the sites they join to share as much as possible information about themselves. The design and the interactions of these sites are such that sensible information is requested from users. In most of the cases these users are not aware that this information will be available to many other unintended audiences. For example third party sites or unknown users that have access to your data because of the default OSN settings. Privacy only becomes important for the user after some inconvenient episode has been experienced.

In table 1 are represented the results of a large study on random Facebook profiles, in different locations around the world. As you can see the percentage of users that allow their profile to be viewed is varying from 50% to 93%. The number of users that allow their friends list to be viewed is even bigger. These are the default settings of Facebook and this study shows that at least half of the users change them. The same situation is observed in other social networks. For example a study on 5000 random MySpace profiles shows that 79% of the users have the default privacy settings. Another study over 67000 Twitter accounts shows that 99% of them have again the default settings [39]. These permissive default settings can create many problems. Identity theft and phishing are some examples. A very easy form of identity attack is when the attacker reconstructs the profile of an easy accessible user and afterwards sends friendship requests to the social network of the victim. Many of the victim friends will trust the request and accept it. This will lead to more sensible data in possession of the attacker. For more complex techniques we address you to this paper [7].

Regional network	Users	% view Profile	% view Friends
London	2486000	51	76
Australia	2015000	63	83
Turkey	1866000	50	76
India	633000	68	86
Hong Kong	520000	59	82
Mexico	448000	73	90
Singapore	382000	70	88
Greece	241000	70	91
Brazil	118000	87	96
Jamaica	41000	72	91
Iran	21000	91	97
Algeria	10000	92	98
Angola	2000	91	98
Nauru	200	93	96

Table 1: User privacy settings in different networks [24].

There are many other consequences of privacy lacking in social networks. The sensible part of the users which may particularly suffer this is the population under the age of 18. Under the pressure of the European commission and children organizations many social sites are adhering to regulations to protect this portion of users against exposure to unknown audience. Actually MySpace and Facebook do not allow the profiles of under 18 year old users to be viewed by those over 18 and vice versa, unless users are friends. But still this does not offer any guarantee that molesters cannot approach these users under fake under 18 accounts.

Except the privacy issues deriving from exposure towards unknown single users, another major issue is the sharing of information with third party sites. Again we will refer to Facebook as the richest site with third parties applications. The privacy leakage derives from the fact that Facebook guarantees access to all of the user's data to these applications, even though less information is needed by them. In these cases the user has no option than to share all of his data in order to use these applications. For web trust purpose the W3C (World Wide Web Consortium) developed a protocol called P3P (Platform for Privacy Preferences) which allows the sites to specify in a machine readable language what information is collected from the users and with which other third parties this information is shared. Applications of this protocols are not yet consolidated, we can mention the same P3P toolbox or research products like PeCAN (Personal Context Agent Networking) that give users an overview on how particular sites will share their data. These platforms are using the underlying P3P protocol to provide tools that allow users more control over their data by means of web toolboxes [21]. These toolboxes are usually browser plugins like "Privacy Bird" or they are already included in other experimental browsers. A 2008 study [12] shows that the number of sites that deploy the P3P format varies between 10% in the typical most popular sites to 21% in e-commerce sites. This and other concerns, such as the expiration date of the data collected or the lack of control over the real data usage, suggest that this is not a good solution so far.

DECENTRALIZATION AS A POSSIBLE SOLUTION

We offered an overview of the issues in today's social networks in the previous paragraphs. There is a crucial tie between those issues. The data of the users is owned by social networks sites which conserve the right to use them according to their interests. To give a common solution to those issues, most of the efforts are directed in implementing a decentralized online social networking. The main idea is that users should have more freedom to store and manage their data in open servers and join or leave specific applications, while all the information and interactions generated are stored in these servers and not in the application server. There are today different implementations of distributed social networks on a research level and a few commercial sites in testing phase.

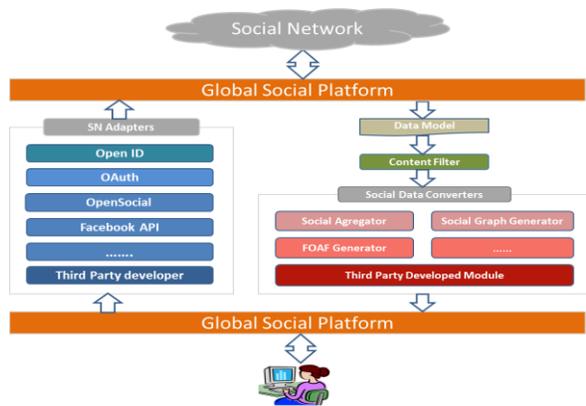


Figure 3: Decentralized social network architecture and technologies [27].

All these implementations utilize several technologies for decentralized data sharing. In figure 3 is represented a schema of the data flow in a distributed social network. We will briefly explain the protocols and frameworks that enable the decentralized data flow from the user to a generic social network and further will explain the idea behind the interactions of a generic social application and the user private data collection.

The left block represents the data flow from the user to a generic social platform, it describes the protocols for authentication, authorization and application interfaces. In detail:

- OpenID¹² is a standard that describes the authentication procedure of a decentralized network.
- OAuth¹³ is a standard for authorization. It allows users to share resources with different sites, without having to specify their credentials everytime.
- OpenSocial¹⁴ is a common API for a group of social networks developed by Google, MySpace and other social networks

The right block indicates some technologies used by the distributed networks to identify and interact with the user and his network of connections.

- The RDF¹⁵ (Resource Description Framework) describes the data model. The resources are represented as URI (Uniform Resource Identifiers) and the query language is SPARQL (Protocol and RDF Query Language).
- FOAF¹⁶ (Friend of a Friend) is a powerful format that describes a person and his network of friends in a machine readable way.

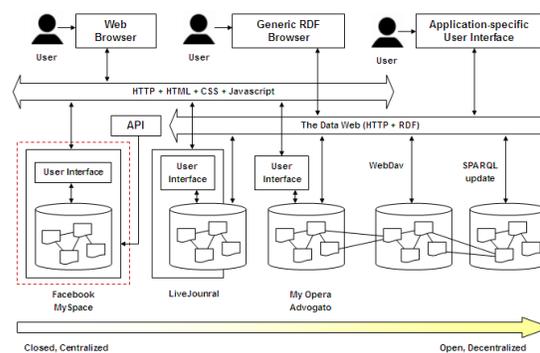


Figure 4: The spectrum of online social networking [2].

Today only a few sites allow their users to export their network of friends to other applications. Figure 4 gives a range of applications classifying them according to data portability. Beginning from left we have the centralized sites such as Facebook and MySpace that do not expose their data to the web in RDF format. The only way to export/import data and connection network is relying on the respective API's. In the middle we have sites such as LiveJournal¹⁷, Advogato¹⁸ and Hi5¹⁹ which are offering FOAF export by outputting their data in RDF format. These sites are the first step towards decentralization but they are not totally decentralized because the user is limited to the services provided by the site. To the right we have the pure decentralized sites. In these sites where the users can directly create and edit their profile pages by means of open protocols.

The main idea of a decentralized OSN is that users will be enabled by frameworks to choose a server that hosts their data as a FOAF file, their activity log and their multimedia files [2]. The FOAF specifies a format to describe people and their connection network. To each user is assigned a specific URI that identifies them. Each person has many attributes included in a FOAF file and can have their network defined with a specific property "foaf:knows" [8]. This property can be seen as links that point directly to the URIs of people that the user knows. In this way users can be linked to each other, even when their data are stored in different servers.

Benefits of the Decentralization Approach

There will be many benefits in adopting decentralization in OSNs. Decentralized online social networks promise to be the solution to most of the problems of today's social networking that we exposed in this paper. First of all it will solve the issue of data ownership. The user will be the only authority over his data. He will easily create and delete any information regarding him in the server. Secondly, in a decentralized OSN, the user is the only one who decides with what audiences his data will be shared. Users will have complete control over their information without having to

¹² <http://openid.net/>

¹³ <http://oauth.net/>

¹⁴ <http://www.opensocial.org/>

¹⁵ <http://www.w3.org/RDF/>

¹⁶ <http://www.foaf-project.org>

¹⁷ <http://www.livejournal.com>

¹⁸ <http://www.advogato.org>

¹⁹ <http://www.hi5.com>

agree to unclear and instable policies. The open protocols that will allow users to create and edit the profile, will also allow them total control over each aspect regarding privacy and data publication. Lastly users will have more freedom of interaction with each other without being restricted by different services and sites [2].

Obstacles for Adopting It

The major obstacle in realizing the decentralized social networks is the adoption by the users. An additional effort would be requested from them to migrate their data to decentralized servers. From what we said before the users would have to configure their own servers where they will store their data and as we know this is not the easy and requires additional effort. What innovation history teaches us is also that users do not easily abandon traditional technology to adopt a newer one, even though it promises to solve their issues. First because it represents something that needs to be learned and second, because the new technologies always need some time to consolidate their interfaces and mechanisms. Users usually do not opt for a site with less functionalities or activity interactions as they already have. It will be a big challenge to offer them a good framework that interacts with the web in an innovative but yet easy way.

Another challenge would be the verification mechanisms. It is asserted that decentralization will assure privacy, but it is not yet clear how the authentication of the users will happen [2]. Security mechanisms are not yet well consolidated in Distributed social networks and there are many options, for example usage of OpenId security infrastructure, or use the most consolidated SSL. Last but not least the economic reasons might be as well an important factor to consider. As we know the largest incomes today in social network are generated by selling the users data for targeted advertisements. In a distributed network, the user has total control over his data and might not want to share it for personalized advertisement. This would result in less interest and advertising investment available for distributed social sites.

USABILITY IN FUTURE SOCIAL NETWORKING

The actual scenarios of computing created by social networks where not addressed in the early ubiquitous visions. What is essential in ubiquitous technologies is that every situation can turn into a computing situation. Nowadays the mobile platforms are trying to satisfy this computing request. Thanks to mobile platforms we have internet access everywhere; we can easily compute and receive news, images, videos, documents and calls from any location. Now even more functionalities are added to these devices in order to satisfy information needs with fewer devices to handle. For example the navigation systems are also integrated in mobile phones, allowing more information to be shared in an automated and ubiquitous way. Instead of the ambient computing vision, what is observed is that mobile computing is the prominent future on ubiquitous interfaces for social networks. We will

present in the following paragraph some innovative ideas, regarding the potential ubiquitous computing that social networks may have, by use of mobile platforms. Furthermore we will dedicate the last paragraph to present some experimental application domains of ubiquitous computing, in terms of ambient computing with a strong social interaction.

Social Networks in Mobile Platforms

Social networking in mobile platforms offers many advantages and possibilities, but it still has many usability problems. Web browsing on small screen devices will continue to be a constraint for mobile users. Therefore more convenient interfaces are needed. Also the reduced processing capacity of these devices needs more adequate protocols and technologies, other than the ones used for computers. A characteristic of the mobile devices is that they already include position tracking technologies. There are many ways to utilize this information.

Today micro-blogging sites with location aware information are the most spread usage of this kind of services. These micro-blogging sites are usually used by tourists to get local information about the area they are visiting. By logging in into these mobile applications they get instant information about all the activities and the users that have published their profiles in these social network sites. There are many options possible in utilizing location aware information, but the usage of these services remains still limited because of many reasons. One of the major reasons is the privacy concern in sharing such sensible information. In many studies conducted mainly in working environments, the results showed, that testers were highly concerned about their privacy. The concern was reduced only in the cases where the feedback about what was being shared was offered as an option of the system. [20].

As we saw there are many possibilities to utilize the location aware information. Users can automatically broadcast their current location in their activity stream for example. Users can give meaning to different locations which will be translated into different ringtone profiles or integrated in an instant messaging status. For example being at the office would automatically activate a silent mode for the phone and a do not disturb mode for the instant messaging. It is worth to mention an interesting study done with an experimental location sharing mobile application [4]. It was tested with two different groups of people. One group was composed by work colleagues and the other by a group of friends, inside these groups there were also two couples. Users were asked to use the Connecto application for two weeks. This application provided three main types of information about the user, the location, the time spent there and the time when the location was left. The feedback was very positive, different comments showed that this application helped in the coordination and time management of these people. "For example, one participant explained that just by seeing that his friend was at the shooting club, he knew that he was

taking care of picking up supplies for the upcoming weekend trip. Therefore he did not have to call and make sure the supplies had been picked up” [4]. “Similar incidents happened with the two couples. They both reported episodes where one asked his/her partner to pick up something on the way home after seeing that the partner had just left the university or work” [4].

Ambient Devices for Social Networking

In this section we will present some prototypes that have the aim to provide new types of social interactions based on ubiquitous computing. In these examples the vision of ambient computing is implemented.

Figure 5 shows the Breakout for Two [28] project. It allows people to play a physical ball game against an opponent via a real-time, life-sized video and audio conference. In many cases players did not know each other and this application established new kind of friendships based on them being able to interact like playing directly against each other. Although this project is from 2003, it shows that the augmented reality contributed in creating a more immersing, enjoyable and natural experience, and thus establishing a more personal interaction. Microsoft Kinect²⁰ and Nintendo Wii²¹ enable today’s users to play physical games with friends via internet, but none lets the user build a network of friends to share scores. Plus, in most of these games you interact by use of avatars and not see your “real” friend how he/she is playing. If these game consoles could make use of the shown aspects, they would be able to create very special networks, because as seen the bonding that playing such games create is deeper compared to just playing against avatars.

But game consoles are only one device that could be used to create social ubiquitous networks. In a study by Harboe et al. [16] the idea of social TV was researched. This study tested a system that enabled users to interact via TV. The



Figure 5: Man playing Breakout For Two [28]

users were able to use a buddy list, similar to those known from instant messengers, to see what their friends were watching. People watching the same program, were able to send emoticons and simple predefined messages (e.g. “call me”) to each other. Of course if a user not wanted to be disturbed, he could turn the system off. The participants stated that they were very intrigued by the opportunity to connect with others while watching TV, but they also criticized the limitations of the system.

In a laboratory study Baillie [3] tested different systems for comparison. One group watched TV using a system similar to the one mentioned above, the second group tested a system that allowed them to use a voice chat to communicate and at last a control group watched TV together in one room. After the test the participants were asked how much they enjoyed watching TV in the proposed ways, ranking on a scale from one to seven. The surprising result was that the voice-chat-system users rated their experience nearly as good as the face-to-face group. But again nearly all participants liked the general idea of being able to interact with others while watching TV, independent from the system.

What was concluded by these studies, is, that only certain features, like the shown buddy-list, were really appreciated in the Social TV. But it should allow users to create groups and select certain people for communication, so not every message is sent to all others watching the same program. This would be especially important for the voice chat function, because if you want to listen to the TV program, it can be disturbing to have someone else talking over it. Of course for a text based system, a TV-device would need a special remote with maybe a small flip-out keyboard, similar to those of smartphones.

Many experiments have been set up, with the aim to bring together OSNs and ubiquitous computing. From these experiments different approaches were adopted to improve the social context of ubiquitous computing. We can say that the reality of social ubiquitous computing is still far from being implemented. The pioneering experiments we showed are some of the sporadic cases of testing combinations of social networks and ubiquitous computing in real-world scenarios.

CONCLUSION

The social networks today are evolving very quickly. The influence of them is growing continually and penetrating in the everyday interactions of people. There are many kinds of interactions generated in the social networks. The integration of these interactions with the rest of the web will be an important step to improve the web usability and achieve the semantic web paradigm. But what concerns the users of these social sites nowadays is lack of control over what is shared with the others. To solve the issues related to this phenomenon most of the efforts are directed in realizing a decentralized architecture for social networks. The decentralized architecture offers a solution to the data ownership problem, but it is not yet an optimal solution for

²⁰ www.xbox.com/en-US/kinect

²¹ http://www.nintendo.de/NOE/de_DE/wii_54.html

the future of social networks because it still has many drawbacks. The future of social networking is evolving very fast towards ubiquitous networks such as in mobile devices or with social TV. We will see more social aspects integrated in each application or device every day.

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